Lappeenranta
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OVERCOMING THE COMPLEXITY OF SOFTWARE PRODUCT MANAGEMENT

Thesis for the degree of Doctor of Science (Technology) to be presented with due permission for public examination and criticism in the Auditorium 1382 at Lappeenranta University of Technology, Lappeenranta, Finland, on 18th of June, 2013, at noon.

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Abstract

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This thesis describes an approach to overcoming the complexity of software product management (SPM) and consists of several studies that investigate the activities and roles in product management, as well as issues related to the adoption of software product management. The thesis focuses on organizations that have started the adoption of SPM but faced difficulties due to its complexity and fuzziness and suggests the frameworks for overcoming these challenges using the principles of decomposition and iterative improvements.

The research process consisted of three phases, each of which provided complementary results and empirical observations to the problem of overcoming the complexity of SPM. Overall, product management processes and practices in 13 companies were studied and analysed. Moreover, additional data was collected with a survey conducted worldwide. The collected data were analysed using the grounded theory (GT) to identify the possible ways to overcome the complexity of SPM. Complementary research methods, like elements of the Theory of Constraints were used for deeper data analysis.

The results of the thesis indicate that the decomposition of SPM activities depending on the specific characteristics of companies and roles is a useful approach for simplifying the existing SPM frameworks. Companies would benefit from the results by adopting SPM activities more efficiently and effectively and spending fewer resources on its adoption by concentrating on the most important SPM activities.

Keywords: software product management, product management activities, grounded theory, qualitative research

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List of publications

I. Maglyas, A., Nikula, U., Smolander, K. (2011). "What Do We Know About Software Product Management? – A Systematic Mapping Study", Proceedings of the 5th International Workshop on Software Product Management (IWSPM). Trento, Italy, pp. 26–35.

II. Maglyas, A., Nikula, U., Smolander, K. (2011). "Software Product Management in the Russian Companies", Proceedings of the 7th Central and Eastern European Software Engineering Conference (CEE-SECR). Moscow, Russia, pp. 1–9.

III. Maglyas, A., Nikula, U., Smolander, K. (2012). "Comparison of Software Product Management Practices in SMEs and Large Enterprises", Proceedings of the 3rd International Conference on Software Business (ICSOB). Cambridge, MA, MIT Sloan, USA, pp. 15–26.

IV. Maglyas, A., Nikula, U., Smolander, K. (2012). "Lean Solutions to Software Product Management Problems", IEEE Software, Volume 29, Issue 5, pp. 40–46.

V. Maglyas, A., Nikula, U., Smolander, K. (2012). "What Do Practitioners Mean when They Talk about Product Management?", Proceedings of the 20th IEEE International Conference on Requirements Engineering (RE). Chicago, IL, USA.

VI. Maglyas, A., Nikula, U., Smolander, K. "What Are the Roles of Software Product Managers? An Empirical Investigation" *Submitted to the Journal of Systems and Software.*

In this thesis, these publications are referred to as *Publication I, Publication II, Publication III, Publication IV, Publication V* and *Publication VI.*

Symbols and abbreviations

APM	Associate Product Manager
CEO	Chief Executive Officer
CED	Cause-Effect Diagram
CIO	Chief Information Officer
CM	Configuration Management
CRT	Current Reality Tree
CST	Critical Social Theory
CTO	Chief Technology Officer
EBM	Evidence-Based Medicine
EBSE	Evidence-Based Software Engineering
GT	Grounded Theory
ISPMA	International Software Product Management Association
IT	Information Technology
LE	Large Enterprise
MDRE	Market-Driven Requirements Engineering
PM	Product Management
RSQ	Research Sub-Question
SCM	Software Configuration Management
SLR	Systematic Literature Review
SME	Small-Medium Enterprise

SPM	Software Product Management
TOC	Theory Of Constraints
TPM	Total Product Management
VC	Version Control

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1. Introduction

The main purpose of a product and service is to provide additional value to a customer. The identification of product value for a specific customer is tightly coupled with the vision and strategy of product development, which are parts of the discipline of product management. In today's competitive markets, it has become challenging to create winning products. For example, today we can observe how the Internet giant Yahoo! loses its position in the market and needs to rethink its strategy (Wired 2012). As a step forward, Yahoo! has hired a new CEO, Marissa Mayer, who invented a leadership program at Google called Associate Product Manager (APM) and has grown many product managers for Google itself as well as for other companies. According to analysts, hiring a product team for Yahoo! would be an important step for Marissa to recover the company (Wired 2012). This real life example demonstrates that expertise in software product management cannot be overestimated.

The success of any product depends on the knowledge and skills of many people, including developers, testers, project managers, and many others. The product manager represents the business and technology parts of the product and creating the right mix of business strategy, development, and customers' needs (Dver 2003). The product manager is responsible for many artifacts, including product requirements, the strategic plan, business and technology roadmaps, business cases, and the product release plan (Kittlaus & Clough 2009). Nevertheless, the boundaries of the responsibilities of the product manager are quite fuzzy. In practice, "even within the software industry, the definition and role of the Product Manager varies widely" (Dver 2003).

In the competitive software market, it has become increasingly important to deliver products in time and to decrease the cycle time from the customer request to the product delivery (Cusumano 2004). The current challenges of the product company include but are not limited to addressing requirements for frequent updates, providing advanced customer support, and organizing effective collaboration with the customers (Lehtola & Kauppinen 2006). Software Product Management (SPM) suggests practices, methods and tools for achieving these goals, but its adoption includes challenges resulting from the complexity of SPM. The current trend in the research of SPM is devoted to the development of frameworks and models, e.g. (Gorschek et al. 2012; Weerd, Bekkers & Brinkkemper 2010), making the SPM adoption even more complicated. In this thesis, the main research goal is to investigate *"How to overcome the complexity of software product management?"* The focus is on the product management processes and practices in companies that have started to adopt software product management but faced difficulties in its adoption due to the fuzziness of SPM activities and/or roles.

The SPM activities describe the product or service creation from the product point of view, and cover all the stages of the product lifecycle from idea and strategy to launch and support (Vähäniitty, Lassenius & Rautiainen 2002; Kappel 2001; Gorschek et al. 2010; Suomalainen et al. 2011). Accompanying development processes are considered in the terms and goals of SPM as a single process of creating a successful product. The goal of the present thesis is to understand the role of SPM in general and product managers in particular, as well as improving SPM activities that should assist the development of high-quality products on time, on budget, and for the right market. The purpose is to make SPM adoption easier for companies adopting SPM but having problems with implementing SPM activities and sharing the responsibilities among product managers.

The thesis is divided into two parts, an introduction and an appendix including six scientific publications. In the introduction, the research problem and its shaping are presented together with the methods used during the research process. The results are summarized to present the contribution of the whole research project. The appendix is composed of six publications that have gone through a scientific referee process in the field of software engineering. These publications present in detail the results of the studies described in the introduction.

The introduction consists of six chapters. Chapter 2 starts by introducing the research area, providing the necessary background for understanding the following chapters. This chapter also defines the context of the thesis. Chapter 3 describes the research method in detail, including the philosophical foundations of the research, the research characteristics and methods, and the whole research process of the thesis. In Chapter 4, the publications presented in the appendix are summarized with descriptions of

their relations to the whole research project. Chapter 5 combines implications of the results for research and practice and discusses the research limitations. Finally, Chapter 6 concludes the thesis by summarizing and discussing the results, including the future research topics.

2. Software product management

This chapter explains the central themes, concepts, and definitions forming the background for the research project described in the following chapters. The aim of this chapter is to describe the context of the thesis by introducing the definitions and frameworks used in the thesis. The chapter starts with several definitions of software product management representing different viewpoints to the problem of what SPM really is. Then, a brief history of product management from its birth in Procter&Gamble in 1931 to the present is given, followed by a description of the characteristics specific to software products only. In the next two subchapters, product management frameworks and product managers' roles are described to set the scope of the thesis. The SPM activities and roles represent the basics of the product management discipline, and this thesis contributes to these SPM foundations.

2.1. Definitions of software product management

Software product management is a discipline uniting technical and business perspectives in the development of software products. Since the goal of any product is to provide additional value to the customer, SPM may be seen from the perspective of value-based software engineering (Boehm 2003; Barney, Aurum & Wohlin 2008; Ojala 2008; Strasunskas & Hakkarainen 2012). However, the concept of value provided by software products remains ambiguous. In many products, e.g. in the automotive industry, software is only a small part of the whole product, and therefore it is often considered as a cost center rather than a value adding component (Biffl et al. 2005). Even for pure software products, the value that product brings to a customer or a user can differ significantly. Some users value performance while others may prefer reliability and usability to performance (Dver 2003; Ojala 2008). In addition, the

perceived value of the product may be affected by positioning and other marketing activities conducted by a company in the market (Cusumano 2004). Overall, the perceived and real values of software products are not easily defined. They consist of many value aspects that should be taken into account in the development of both pure software and software-intensive products (Khurum, Gorschek & Wilson 2012). In this thesis, the term value is used in its general meaning as something bringing additional economic or qualitative benefit to a specific customer for solving the customer's business problem (Haines 2008).

Ebert defines software product management as "the discipline and role, which governs a product (or solution, or service) from its inception to the market or customer delivery in order to generate biggest possible value to the business" (Ebert 2007). Based on empirical investigation of projects in the telecommunication industry, Ebert found that the focus on SPM can reduce the cycle time in the business unit by 36%. In addition, SPM was found to have a positive impact on quality (Ebert 2007). The goal of SPM, which is summarized as generating value to the business, is embedded in Ebert's definition. In this regard, SPM plays an important role in managing products to achieve the company's business goals and creating a winning strategy in the market.

Gabriel Steinhardt, an expert in product management for high-tech industries, has a slightly different view of product management. According to his definition, product management "is an occupational domain that is based on general management techniques that are focused on product planning and product marketing activities" (Steinhardt 2010). Moreover, he considers product management as a core strategic function in organizations.

According to Haines, "product management is business management at the product, product line, or product portfolio level" (Haines 2008). He defines product management as a model for a business organization, which includes strategizing, conceiving, developing, introducing, managing, and marketing products.

The foci of the three definitions above are quite different. The first one concentrates on the main goal of product management as a source of value for the business, while the second emphasizes two main components of product management (product planning and product marketing). Haines' definition of product management describes product management as equal to business management, but at different levels of the product, product line, and product portfolio. Overall, all these definitions describe product management from various perspectives. A lack of a unique and widely accepted definition of product management is one of the signals suggesting that we are dealing with a complicated phenomenon.

2.2. History of product management

Initially, the concept of product management was introduced in Procter&Gamble in 1931 (Gorchels 2000), when the company faced difficulties with one of their products. To get out of this situation and to avoid similar problems in the future, the top management of the company decided to hire a special person, a brand manager, who was responsible for managing the product. This experience was so positive that the practice of assigning product managers to a product or a product line was copied within the company. Later on, this practice spread outside the company and was adopted by its competitors. Finally, the practice of hiring managers for products, or product managers, has become a widely accepted way for management of products in industries (Murphy & Gorchels 1996).

As product management was widely adopted in companies working in different business domains, the concept of product management attracted the attention of the research community. In the early 1960s, Borden created a model, known as the four P's of marketing, consisting of *product*, *place*, *price*, and *promotion* (Borden 1965). In this model, *product* is related to the issues of product development or creation. *Place* describes the process of identifying or developing the markets where the product can be marketed and sold. *Price* takes into account issues related to financial considerations. *Promotion* includes activities related to product advertisement and market communications (Broom, Lauzen & Tucker 1991). Today, Borden's model is considered as a marketing framework (Jager 2007), but in general the model describes how products should be managed, and therefore it can be seen as one of the first theories of product management.

In comparison with other industries that started adoption of product management practices decades ago (see e.g. (Carroll & Grimes 1995; Toffel 2003)), product management in the software industry has not existed for a long period. One of the first studies on software product management was presented by Kilpi (1997). In this work he considers SPM as "a process consisting of version control (VC), configuration management (CM), product management (PM), and total product management (TPM)" (Kilpi 1997a). In comparison with previously developed models of product management that mainly concentrated on the marketing and sales activities of product management, Kilpi also took technical activities of product management in the software industry into account, such as the processes of organizing version and configuration management for delivering software products. SPM is also tightly connected to Market-Driven Requirements Engineering (MDRE) because the selection of product requirements for the next releases is one of the main responsibilities of a product manager (Regnell et al. 2001; Gorschek et al. 2012). MDRE as a discipline focuses on issues of requirements elicitation, analysis and documentation under the pressure of time-to-market (Karlsson et al. 2002). As in product management, in MDRE the requirements are gathered externally from customers and partners and

internally from developers, marketing managers, and sales managers (Gorschek & Wohlin 2005). In this regard, MDRE can be considered as a part of product management and as the main area where the product manager works to make the product successful in the marketplace.

Although the existing product management practices may be applied to any product regardless of its domain, this thesis focuses on software-intensive products in which the primary component is software (Gorschek et al. 2010). Overall, there are several characteristics of software that distinguish it from other products and make this type of products specific for management:

a) limited importance of production and logistics but great importance of requirements management (Kittlaus & Clough 2009);
b) uncomplicated procedures for changes in software (Kittlaus & Clough 2009) resulting in high frequency of releases (van de Weerd et al. 2006b);
c) reduced costs of producing additional copies (Kettunen 2009);
d) complicated nature of the software product (Messerschmitt & Szyperski 2003; Kettunen 2009).

In addition, software is a specific product representing the result of human thinking, or in other words, knowledge rather than physical artifacts. It has also been claimed that software is the most sophisticated product of human invention that we currently know (Messerschmitt & Szyperski 2003). The sources of this complexity are hidden in the nature of software, consisting of many blocks from different vendors, along with the possibility to run the software at a hardware manufactured by different vendors (Kittlaus & Clough 2009). In addition, software product managers work in the problem space planning, developing, and executing plans, roadmaps, and strategies but they also have a clear tie to the solution space orchestrating the product development team (Fricker, Gorschek & Myllyperkiö 2007; Kittlaus & Clough 2009). This is not common for other industries where product managers are often isolated from manufacturing or developing activities (see, e.g. (Pragmatic Marketing 2010a)). This can be partially explained by comparing other disciplines, e.g. car manufacturing with software development. In car manufacturing testing is usually handled separately and usually by machines (Carroll & Grimes 1995; Kettunen 2009), while the software products can be designed, developed, and tested by the same team. These specific characteristics of software have resulted in the development of software product management as a distinct discipline (Condon 2002; Dver 2003).

2.3. Product management frameworks

There are several product management frameworks. Some of them describe product management processes regardless of the business domain, e.g. Pragmatic Marketing

(2010), while others have been developed on the basis of studies and observations of software products (van de Weerd et al. 2006b; Ebert 2009; Kittlaus & Clough 2009; ISPMA 2012). These frameworks have overlapping parts, but they have different structures and use different terminologies to describe similar activities. For example, depending on the framework, the components of software product management may be described as functions (Kittlaus & Clough 2009), activities (Ebert 2009), or process areas (van de Weerd et al. 2006a).

The Pragmatic Marketing Framework ((Pragmatic Marketing 2010a) presented in the left-hand column of Table 1 provides a blueprint of 37 key product management activities grouped into four clusters: strategic, market, technical, and sales activities. The framework represents a general overview of product management practices regardless the business domain in which it is going to be used. The framework has become well-known due to the active marketing and training activities of the Pragmatic Marketing organization. Overall, the framework and supporting materials provided by Pragmatic Marketing describe the process of managing the product from its inception to termination regardless of the product type.

Table 1. Summary of product management activities in different product management frameworks. Bold font in the cells represents the groups of activities. The group unites the activities itemized in the cells below

Pragmatic Marketing Framework (2010)	Reference SPM framework (van de Weerd et al. 2006b)	Software product management processes (Ebert 2009)	ISPMA SPM Framework 1.1. (ISPMA 2012)
Strategic activities: market problems, win/loss analysis, distinctive competence, market definition, distribution, product portfolio, business plan, pricing, buy, build, partner, product profitability.	**Portfolio management:** partnering and contracting, market trend, identification, product lifecycle management, product line identification.	SWOT/portfolio analysis, positioning and value proposition, strategic planning and management, business case, product and technology roadmapping, voice of customer understanding, phase/gate process, project management, product definition and requirements, supplier management, engineering management, risk management, marketing planning, product launch, service and support management, service, partner, sales management,	**Core SPM:** market analysis, product analysis, positioning and product definition, delivery model and service strategy, sourcing, business case and costing, pricing, ecosystem management, legal and IRP management, performance and risk management, product lifecycle management, roadmapping, release planning, product requirements engineering.
	Product roadmapping: theme identification, core asset identification, roadmap construction.		
Market activities positioning, buying process, buyer personas, marketing plan, customer acquisition, customer retention,	**Requirements management:** requirements gathering, requirements identification, requirements organizing.		
	Release planning: requirements prioritization,		

program effectiveness, launch plan, thought leadership, lead generation, referrals and references.	requirements selection, release definition, release validation, launch preparation, scope change management.	customer relationship management, marketing mix optimization.	**Participation:** corporate strategy, portfolio management, innovation management, resource management.
Technical activities: competitive landscape, technology assessment, product roadmap, innovation requirements, using scenarios, requirements, status dashboard.			**Orchestration:** engineering management, project management, project requirements engineering, quality management, marketing planning, customer analysis, opportunity management, marketing mix optimization, product launches, operational marketing, sales planning, channel preparation, customer relationship management, operational distribution, service planning and preparation, service positioning, technical support, marketing support, sales support.
Sales activities: sales process, collateral, sales tools, channel training, presentations and demos, "special" calls, event support, channel support.			
37 activities	**16 activities**	**18 activities**	**38 activities**

The reference framework for software product management ((van de Weerd et al. 2006b), second column from the left in Table 1) represents a synthesis of software product management practices based on studies and observations of mainly large software companies. The framework defines four main process areas, portfolio management, product roadmapping, requirements management, and release planning, with their inputs and outputs. In comparison with the previous framework developed by consultants, this framework has been developed by researchers.

The next framework is presented as a list of product management activities supporting the product lifecycle from the strategy and vision development through

concept, development, and market entry to its evolution ((Ebert 2009), third column from the left in Table 1). In total, 18 activities were identified as related to the managing of software products. According to Ebert (2009), the goal of software product management is to provide leadership to activities like portfolio management, strategy definition, product marketing, and product development. The processes listed in Table 1 show the formal content of product management or, at least, the activities in which a product manager is heavily involved.

The Software Product Management Framework proposed by Kittlaus and Clough (Kittlaus & Clough 2009) defines the major functions involved in software product management with tasks to participate in or to orchestrate. In this framework, the SPM activities are divided into corporate level and product (family) level activities, which are differentiated by the level of authority and strategic impact to the company business. In addition, this was the first framework in which the core product management activities were identified. In total this framework defines nine major functions involved in product management: *Market Analysis*, *Product Analysis*, *Product Strategy*, *Product Planning*, *Development*, *Marketing*, *Sales and Distribution*, *Support, and Services*. The first two functions, *Market Analysis* and *Product Analysis*, are the sources of qualitative and quantitative data for a product manager, who makes decisions and operates on the basis of this information. The *Product Strategy* and *Product Planning* functions unite the core product management activities, such as portfolio management, resource allocation, positioning, roadmap, and others. These major functions include business-related activities, such as business case and pricing model development, as well as legal aspects of product development. The rest of the major functions, *Development*, *Marketing*, *Sales and Distribution*, *Support and Services*, are functions orchestrated by the product manager, as they have a significant impact on the success of the product. This framework has become the basis for the development of the ISPMA SPM Framework (ISPMA 2012). The right-hand column in Table 1 presents the latest available version of this framework. This framework is not only an evolution of Kittlaus and Clough's SPM framework but also a synthesis of the reference SPM framework and SPM activities. Therefore, it may be considered as the latest view of the organization and evolution of software product management.

In addition to the described frameworks, researchers and practitioners also argue about the inclusion of additional activities related to software product management, such as finance (Konig 2009), defect management (van de Weerd & Katchow 2009), and software configuration management (Kilpi 1997b). The discussion on which activities may be related to product management is still in progress. For example, Steinhardt (2010) states that product management consists of two parts only: product planning and product marketing. Nevertheless, the definitions of these activities are quite broad and they include many sub-activities. Looking at the activities in the framework, it seems that product management includes all possible activities in an

organization. The source of this problem is embedded in the nature of the product manager's work. The product manager actively collaborates, orchestrates, and communicates with many other departments, including development, marketing, sales, and support. This means that he or she should be familiar with all these activities, but at the same time, it leads to discussions about how the product manager's responsibilities are penetrated to other activities. Therefore, it is necessary to answer the question of which activities are unique for the role of the product manager and which activities could be fully delegated to other roles.

Overall, both Pragmatic Marketing (2010) and the ISPMA SPM Framework (ISPMA 2012) include almost the same number of product management activities (37 vs. 38). In both cases, the number of activities is high, which makes the adoption of product management practices challenging. In addition, a product manager works at the intersection of business and technology to create winning products in the competitive market, which makes the product manager's work even more complicated (Haines 2008). Overall, the decision to implement all SPM activities at once in a company may cause many difficulties in the beginning, because it is seldom clear where to start. Only the ISPMA SPM Framework (ISPMA 2012) and its predecessor the Kittlaus and Clough framework (Kittlaus & Clough 2009) describe the core activities of SPM. In the case of starting SPM adoption on the basis of other frameworks, the company has to take the risk of radical changes (Christensen & Overdorf 2000; Nikula et al. 2010).

2.4. Product manager's roles

The management roles have been studied in detail by Mintzberg (1971, 1990, 1994), but he has concentrated mainly on what we call the project manager's role, which is devoted to project planning and controlling. Mintzberg (1990) claims that the role of a particular manager is a synthesis of ten roles he has identified empirically. These ten roles are divided into three groups called interpersonal, informational, and decisional roles (Table 2). Altogether these roles explain that managers are not only in charge or organizing, coordinating, planning, and controlling of people and activities, but they are also responsible for making decisions and developing strategies within an organizational unit based on their interpersonal relations with the team members. Therefore, formal authority is a necessary component for a project manager, giving a status (Mintzberg 1971).

Although Mintzberg's studies of roles has been criticized due to their research methodology limitations, such as small sample size, missing reliability checks, and a simplified coding method (Martinko & Gardner 1990), Mintzberg's model of roles has been used as a basis for studying the nature of management positions, such as the role of a Chief Information Officer (CIO) (Grover et al. 1993; Gottschalk 2002). Mintzberg's model of roles was replicated by Grover et al. (1993) when they studied the

managerial roles of C-level executives. In this study, only six of the ten roles were identified, the other four roles (figurehead, disseminator, disturbance handler, and negotiator) were not considered as separate roles due the correlation of their activities with the activities of the other six roles.

Table 2. Mintzberg's management roles (adapted from (Mintzberg 1971))

Roles	Description
Interpersonal roles	
Figurehead	The manager is a symbol, obliged to perform a number of duties
Leader	The manager acts as a leader, pervades all activities, encourages subordinates, and replies to requests
Liaison	The manager establishes a network of contacts to bring information to the organization
Informational roles	
Nerve Center	The manager has access to all information and each member within the organization. Therefore, the manager accumulates and generalizes information from all members of the organization
Disseminator	The manager acts as a transmitter of information to other members
Spokesman	This role is similar to the previous one, but the information is transmitted outside the organization
Decisional roles	
Entrepreneur	The manager acts as an initiator and designer of all changes and improvements in the organization
Disturbance Handler	The manager focuses on corrections, which he or she is forced to make
Resource Allocator	The manager is responsible for allocation and control of all resources within the subordinate unit
Negotiator	The manager is a participant in negotiation activities in the organization

The number of activities described in the product management frameworks leads to a situation when a product manager cannot be responsible for all the activities alone. The Annual Product Management and Marketing Survey (Pragmatic Marketing 2010b), which explores the responsibilities of product managers, identified that in 2010 the most frequent activities of product managers included *maintaining the roadmap* (91%), *writing product requirements* (86%), *understanding market problems* (77%), *defining positioning* (74%), and *performing competitive landscape* (73%). According to these results, product managers are typically involved in researching the market needs and customers' wishes, writing requirements, and planning the product. However, these main activities have changed over the past five years (Table 3).

The product manager is often described as a product "*mini-CEO*" (Gorchels 2000; Dver 2003) or as a person responsible for "making sure that everything gets done" (Haines 2008). The "*mini-CEO*" role of the product manager leads to discussions that this level of authority requires for the product manager to have a number of specific characteristics or competencies, which cannot be easily listed (Haines 2008). Namely, the role of the "*mini-CEO*" may mean "operating without the authority and resources available to a corporate CEO" (Steinhardt 2010). To describe the product managers'

roles in a more realistic manner, Steinhardt (2010) suggests three strategic and two tactical roles for the product management team. The two tactical roles are *sales engineer*, who is responsible for pre-sales and demo activities, and *marketing communication manager*, who is responsible for communications with the customers and preparation of copyrighting materials. The three strategic roles include *product planner*, *product marketer*, and *director of products*. The *product planner* identifies and articulates market and product requirements, and based on these requirements creates product roadmaps and release plans. The role of the *product marketer* is to generate awareness and demand for the developed product. The *product director*, or *vice president of product management*, should facilitate and orchestrate other product management roles by providing an overall product vision, product strategy, and team leadership. In this regard, this role represents a higher level of hierarchy in the product management team (Steinhardt 2010). However, this role model assumes that the roles are assigned to different persons within a separate product management department in large companies. In small companies, start-ups, or medium-sized companies there may be only one individual who incorporates all these four roles, except the director of products. In this case, the role of the product director is usually held by the Chief Executive Officer (CEO).

Table 3. Top five product management activities based on the Annual Product Management and Marketing Survey (2007-2011)

2007	2008	2009	2010	2011
monitoring development projects	maintaining the roadmap	maintaining the roadmap	maintaining the roadmap	understanding market problems
writing product requirements	writing product requirements	writing product requirements	writing product requirements	maintaining the roadmap
preparing business cases	performing competitive analysis	preparing business cases	understanding market problems	writing product requirements
creating sales presentations and demos	researching market needs	understanding market problems	positioning	positioning
creating materials for internal audiences (intranet/wiki)	understanding market problems	defining positioning	performing competitive landscape	performing competitive analysis

Haines (2008) states that a product manager should be familiar with the following practices to be successful in the long run:

- leading and influencing
- cross-functional teaming
- making decisions

- financial planning and analysis
- assessing the industry and competition
- market segmentation and targeting
- forecasting
- formulating product and market strategies
- leveraging the product lifecycle

Floyd and Wooldridge (1992) have studied the strategic role of middle managers. Their typology of the middle management involved in strategy development consists of two dimensions: behavioral and cognitive (Figure 1). The behavioral dimension describes the upward and downward influence of the middle manager in the organizational hierarchy. The cognitive dimension unites the integrative and divergent influence. *Synthesizing information* is a function of a middle manager that involves collecting and interpreting of the information from different sources in order to propose a strategic initiative to the top management. *Championing alternatives* reflects the ability of a middle manager to select certain projects and advocate them to the top management in order to get resources for their implementation. *Facilitating adaptability* shows that middle managers are often a source of the changes in organizations in order to make an organization more flexible. *Implementing deliberate strategy* is the key role of middle managers with the purpose to control the strategy execution (Floyd & Wooldridge 1992).

		Behavioral	
		Upward	Downward
	Divergent	Championing alternatives	Facilitating adaptability
	Cognitive		
	Integrative	Synthesizing information	Implementing deliberate strategy

Figure 1. A typology of middle management involvement in strategy (Floyd & Wooldridge 1992)

The typology of middle management roles has been improved by Balogun (2003), who suggests four additional roles of middle managers as change intermediaries (Figure 2). In addition, the concept of *sensemaking* presented in the framework introduces the social aspect of the middle manager work, including the importance of informal communications within a team and with particular team members (Balogun 2003) In comparison with the typology of roles by Floyd and Wooldridge describing only the strategic impact of middle managers, Balogun describes the middle managers as key players in organizational changes. Two of the four roles

(implementing changes to departments and keeping the business running) are related to the traditional understanding of management consisting of planning and controlling activities, while the two other roles describe the role of the middle manager as a person who changes the organization and implements the decisions made by the top management. Balogun emphasizes the role of middle managers and considers the lack of middle managers as one of the main reasons why changes in organizations fail (Balogun 2006).

		Nature of activity	
		Sensemaking	Coordination and management
	Peers/self	Undertaking personal change	Keeping the business going
Orientation	Team	Helping others through change	Implementing changes to departments

Figure 2. Middle managers as change intermediaries (Balogun 2003)

Overall, researchers and practitioners of product management agree that the role of a product manager is cross-functional, but the question of what product managers really do is still relevant (Condon 2002; Dver 2003; Ebert 2007). Product managers are in an intermediate position between IT executives and project managers, and therefore inherit responsibilities from both types of roles (Karlsen, Gottschalk & Andersen 2002). In this regard, product managers may be considered as middle managers who "link the activities of vertically related groups and are responsible for at least sub-functional work flow but not the work flow of the firm as a whole" (Thakur 1998). As a middle manager, the product manager acts as a link between the top and the lower level of the organization, and therefore the product manager has an ability to mediate between strategic and operational levels (Floyd & Wooldridge 1997). In general, the role of any middle manager is complex (Balogun 2006): they make a strategic contribution and implement the decisions made by the top management (Floyd & Wooldridge 1992), but at the same time the middle managers also perform tasks such as planning, controlling, and budgeting, which are common for all managers, regardless of their level in the organizational hierarchy (Wooldridge & Floyd 1990; Floyd & Wooldridge 1994).

2.5. Summary

In this chapter, the scope and background of the thesis was presented by describing the basic concepts related to software product management, including product management frameworks and product managers' roles. The variety of definitions, frameworks, and responsibilities of product management held by the product manager shows a lack of consistent understanding of the product management discipline and the role of the product manager within an organization. This situation becomes even more complicated in the software industry, which is characterized by a highly competitive landscape and frequent changes in technologies (Dver 2003). In these conditions, a strong product management basis defining, explaining, and assessing the roles of product managers and product management practices adopted in organizations would be beneficial for managing a product lifecycle consistently and predictably, increasing profit for the business.

3. Research Method

This chapter starts with a description of the basics of the philosophical foundations of the research, including positivism, critical theory, and constructivism. Although this thesis may be considered mainly as related to constructivism, it would not be fair to forget the positivist paradigm due to its importance for the development of the Grounded Theory (GT) (Glaser & Strauss 1967). The GT used in this thesis was developed as a reaction to the dominant position of the positivist approaches in research (Bryant 2002). The description of critical theory is included due to its importance for developing social theories and because it was the first to introduce the idea that the researcher cannot be separated from the phenomenon he or she observes (Kieran 2008).

This chapter also includes a short description of research characteristics and a general overview of the research methods used in the thesis. The main research goal is divided into four detailed research questions presented in Chapter 3.5. Then, in Chapter 3.6, the selection of the research methods used for the thesis is described.

The thesis has been designed as a three-step research process, as described in Chapter 3.7. In the preliminary phase a systematic mapping study on the topic of software product management was performed and a preliminary study was conducted to identify the main problems faced by practitioners in companies. Based on these preliminary results, the further studies were aimed to address the problems and to fill the research gaps identified during the preliminary phase. In the main phase, the collected data were analyzed using the Grounded Theory. Three frameworks were developed, explaining product managers' roles, the differences between SMEs and large companies in the adoption of software product management practices, and how the existing problems in software product management can be addressed by the

application of lean principles. In addition, six core product management activities were identified in order to overcome the complexity of the existing product management frameworks.

3.1. Overview of the philosophical foundations of the research

In this section, a brief overview of the philosophical foundations of the research is given. The described three paradigms (positivism/post-positivism, critical theory, and constructivism) represent various points of view to the philosophical foundations of the research. Each philosophy relies on its own assumptions about knowledge and reality. Therefore, the approaches to investigation of the physical and social worlds and how to acquire knowledge are also different, depending on the research paradigm.

3.1.1. Positivism/post-positivism

The main assumption in positivism is that the reality is objectively given and can be studied by measuring its characteristics, which are independent of the researcher and the method of measurements. Therefore, the studies are designed as theory testing through hypotheses that may be accepted or rejected. Positivism relies on the following assumptions (Orlikowski & Baroudi 1991):

- each phenomenon under observation may be measured and described in the best way;
- the researcher has no impact on the object under observation;
- generalization of the results is possible and independent of the time and context of the experiments;
- cause-effect relationships are directional and can be studied and tested with hypotheses.

The underlying assumptions presented above fit well for conducting natural science research where a phenomenon may be easily measured and described. However, social science has different requirements, e.g. the studied phenomenon cannot be easily isolated from the environment. Although positivism has been widely used in research of software projects and information systems (Orlikowski & Baroudi 1991; Smyth & Morris 2007), it has been criticized for difficulties of application of the underlying positivist assumptions in studies of social phenomena (Galliers & Land 1987). Initially, the positivists relied on a coherent set of facts to verify hypotheses and to create a theory inductively. They used verification of the theories by proceeding by induction. However, new findings could contradict the initial findings, and therefore the generalizations and developed laws were challenged. In other words, the problem

was that "a million white swans can never establish, with complete confidence, the proposition that all swans are white; one black swan can completely falsify it" (Guba & Lincoln 1994). Therefore, Popper's theory of falsification was created to support the fact that a hypothesis can be falsified where evidence does not exist (Popper 1992). When the evidence does not support a null-hypothesis, the negative statement is proven. In this regard, Popper suggests a deductive rather than inductive approach to studies where ideas can be falsified if the evidence is no longer supported by the hypotheses (Popper 1992). Moreover, the falsification theory was one of the first steps in a paradigm shift from positivism to post-positivism. The critique of logical positivism in general and the verification idea in particular was advanced in the theory of falsification developed by Thomas Kuhn (Bird, 2004; Mayoral de Lucas, 2009).

Positivists assume that a physical world and a social world exist independently of humans. Therefore, they can be studied independently without taking researcher intervention into account. Orlikowski & Baroudi (1991) give the example that "organizations are understood to have a structure and reality beyond the actions of their members." From this perspective, the researcher aims to find proper measurements for the phenomenon under observation but any interpretations are forbidden. In addition, the positivist paradigm assumes that people act rationally. If this is not confirmed, it means that the social system does not work in a proper way and it is considered as fluctuations that can be fixed to make the system stable (Persson 2010).

Post-positivism has been developed to take account of the critiques of positivism. When the positivists believe that the reality can be studied objectively and independently, post-positivists accept the fact that the "real" reality can be studied only imperfectly and that the researcher has an impact on the phenomenon under observation. Similar to positivists, who believe that only one reality exists, post-positivists also believe that a reality exists but it can be studied only imperfectly and probabilistically due to the researcher's limitations and bias (Robson 2002).

When the positivist research paradigm relied fully on quantitative data only, the post-positivist research paradigm also accepts qualitative data or "truths" gathered outside quantitative methods. This fact was critical for the acceptance of a qualitative paradigm as another way to conduct the research (Clark 1998).

3.1.2. Critical Theory

The term "critical social theory" was first introduced by Max Horkheimer in the 1930s (Kieran 2008). In contrast with the other social theories that consider the researcher as an independent observer, in the critical social theory (CST) the researcher cannot be separated from the studied phenomenon. Moreover, CST relies on the assumptions

that "(1) there is a difference between observing nature and observing people and (2) inquiry into social activity should focus on understanding their meanings from within the social context and lifeworld of actors" (Ngwenyama & Lee 1997). The role of the researcher is to provide a critical view to the studied phenomenon and explain it as objectively as possible, describing limitations and critiques at the same time. Myers & Klein (2011) define the underlying principles of critical theory philosophy as "a belief in the ability of people to change their material and social circumstances, yet the capacity to change is constrained by prevailing systems of economic, political, and cultural authority; a belief that contradictions inherent in existing social forms tend to lead to inequalities and conflicts, yet these conflicts lead to the emergence of new social forms; and a belief that knowledge is grounded in social and historical practices" (Myers & Klein 2011).

There are three elements in the critical theory: insight, critique, and transformation redefinition. In practice, it may be difficult to separate these elements from each other, as they are interconnected. The purpose of insight is to provide a detailed background and understanding of the phenomena under observation. In critical research it is important to describe the phenomena in detail before engaging in critical analysis. The second element, critique, aims to provide a critical viewpoint to the studied phenomenon in the economic, political, or social context. This is the place where the researcher's bias takes place. The last, third element, transformation redefinition provides ideas on how the construct described in the beginning of the study can be improved (Myers & Klein 2011). A summary of these elements is presented in Table 4.

Table 4. The three elements of critical theory (Myers & Klein 2011)

	Description
Insight	This element is concerned with interpretation and gaining insight. Insight can be gained in various ways, e.g., using critical hermeneutics and the archaeology of knowledge, or the concepts of social reproduction via the mechanisms associated with symbolic capital.
Critique	This element is concerned with critique, the genealogy of knowledge, and the social practices of control and reproduction. This element goes beyond interpretation to focus the researcher on the power structures that lie behind accepted interpretations.
Transformation	This element is concerned with suggesting improvements to the conditions of human existence, existing social arrangements, and social theories. Theories are not the primary driver for changes, but potentially fallible lenses through which we see the world. The ultimate arbiters of the desirability of changes are those affected by them.

The critical theory is differs from positivism in the following ways (Ngwenyama & Lee 1997):

- it aims to interpretation and critique of the organizational actors;
- it accepts several methods of study, such as participation, observation, and analysis of contextual data;

- it does not separate the subjects of the study from its context;
- it recognizes that the organizational context is important for understanding the phenomenon.

The critical theory has become a valuable research paradigm in information systems research because it is concerned with both social issues and technological issues. Altogether it provides a deep and critical understanding of the impact of information systems on the society (Hirschheim & Klein 1994; Ngwenyama & Lee 1997; Myers & Klein 2011).

3.1.3. Constructivism

Constructivism is based on the idea that the reality is socially constructed (Berger & Luckmann 1967). Constructivist researchers do not accept the claim that an objective reality exists and it can be studied. They claim that multiple realities exist, and therefore they tend to use such research methods as interviews and observations, which allow them to get several different viewpoints to the phenomena under observation. For constructivists the researcher's goal is "to understand the multiple social constructions of meaning and knowledge" (Robson 2002).

The social world in constructivism is not considered as "given" but "produced" by human interactions and actions, so it can be studied through interpretations. For example, "this tradition [constructivism] does not presume that organizational structure or social relations are objectively known and unproblematic, but attempts to understand how and why individuals, through their socialization into, interaction with, and participation in a social world give it a certain status and meaning" (Orlikowski & Baroudi 1991). Moreover, the researcher is involved in the studied phenomena and cannot be seen as an external observer. The constructivist researcher attempts to derive categories and constructs from the field by examining it, rather than the positivist researcher, who comes with predetermined instruments for measurements (Troelstra 1999; Jackson & Klobas 2008).

The positivist approach has been criticized for not providing the means to examine human beings, their actions, and the study context. In the constructivist approach all these contextual factors and human experience are taken into account to provide a deeper understanding of the phenomenon under observation (Fong 1986). In information systems research constructivist studies are accepted as another way to conduct the research with a set of principles for conducting and evaluating it (Klein & Myers 1999).

3.1.4. Summary

The research paradigms described above may be considered as a set of basic beliefs (or metaphysics) to conducting research. In general, each research paradigm answers three main questions: the ontological question ("What is the form and nature of reality and, therefore, what is there that can be known about it?"), the epistemological question ("What is the nature of the relationship between the knower or would-be knower and what can be known?"), and the methodological question ("How can the inquirer (would-be knower) go about finding out whatever he or she believes can be known?") (Guba & Lincoln 1994). In Table 5 below, positivism, post-positivism, critical theory, and constructivism are summarized in the form of answers to these three basic questions.

Table 5. Metaphysics of alternative inquiry paradigms (Guba & Lincoln 1994)

Item	Positivism	Postpositivism	Critical theory	Constructivism
Ontology	naïve realism – "real" reality but apprehendable	critical realism – "real" reality but only imperfectly and probabilistically apprehendable	historical realism – virtual reality shaped by social, political, cultural, economic, ethnic, and gender values, crystallized over time	relativism – local and specific constructed realities
Epistemology	dualist/objectivist, findings true	modified dualist/objectivist, critical tradition/community, findings probably true	transactional, subjectivist, value-mediated findings	transactional/ subjectivist, created findings
Methodology	experimental/ manipulative, verification of hypotheses, chiefly quantitative methods	modified experimental/ manipulative, critical multiplicity, falsification of hypotheses, may include qualitative methods	dialogic/dialectical	hermeneutical/ dialectical

The philosophical foundations of the research described above were considered necessary to explain the research methods used and research questions posed in this thesis. The multiparadigm approach (e.g. survey with qualitative analysis) has been used in the thesis, and so the description of the different research paradigms was necessary for understanding the underlying concepts and research paradigms of the thesis.

3.2. Research characteristics

Every study should be carried out *systematically*, *skeptically*, and *ethically* (Robson 2002). All these characteristics are necessary to prove that the results of the study are scientifically sound. *Systematical* means that the methodical approach is repeatable through a step-by-step procedure. It allows other researchers to conduct the same study and get the same results if all the prerequisites and conditions are equal. The Longman Dictionary gives the following definition for skepticism: "an attitude of doubting that particular claims or statements are true or that something will happen" (Pearson Longman 2008). In research, *skeptical* refers to thinking about one's own (and others') ideas critically because every result should be criticized initially by the researcher, then by others. The research is conducted *ethically* if it follows moral rules and principles, and the interests of each participant are safeguarded (Robson 2002).

Validity and generalizability define the trustworthiness of the study. The validity of the study refers to the accuracy of the results while generalizability shows how the gathered results can be extended to other cases (Punch 2004; Tsang & Williams 2012). Validity is usually discussed from the perspective of threats to internal, external, and construct validity, which are different for qualitative and quantitative studies (Boudreau, Gefen & Straub 2001).

In quantitative research, internal validity shows that the study has been done correctly. It includes such aspects as following predefined procedures for measurements, not changing the instrument during the experiments, and reducing the impact of personal characteristics of the participants (Creswell 2003). External validity, also known as generalizability, takes account of questions of generalizing the results from the studied set to the whole population. Typically, problems arise when the population is defined incorrectly. For example, the population has special characteristics such as age, profession, experience, which are not under study and their effect on the gathered results is unknown (Punch 2004). Construct validity reflects on how adequate the results obtained from the measured data are, e.g. whether the scale was properly developed. Threats to construct validity occur when the researcher uses inadequate measures and definitions of the variables during the experiments (Creswell 2003).

In qualitative research, internal validity is a concern for studies when the researcher tries to conclude whether event A led to event B (Yin 2002). If the researcher does not have enough evidence for this conclusion, or another factor affecting the result is missed, it leads to unreliable results. To avoid these issues and to improve the accuracy of the results, eight strategies can be used: data triangulation, in-depth member checking, rich descriptions for the process and findings, researcher bias clarification, discrepant information description, prolonged time of the study, use of peer debriefing, and use of an external auditor (Creswell 2003).

External validity in qualitative research has been a major problem in accepting qualitative methods, such as case studies, as scientific (Creswell 2003; Onwuegbuzie & Leech 2006; Beverland & Lindgreen 2010). Qualitative methods propose an analytical generalization rather than the statistical generalization in quantitative methods (Lee & Baskerville 2003). Analytical generalization is a process of establishing the domain to which the developed theory may be applied and generalizing this theory to a broader set of cases within this domain. It can be achieved by conducting new studies within the selected domain to replicate the previous findings and their evolution to a higher level of abstraction (Yin 2002; Creswell 2003; Strauss & Corbin 2008).

The main threat to construct validity in qualitative studies is the researcher's subjectivity/objectivity, which shows how the researcher affects the research results. This threat cannot be avoided but may be reduced by using multiple sources of evidence and establishing a chain of evidence. The main goal is to demonstrate that the selected procedures and observations produce the results regardless of the researcher involved (Guba & Lincoln 1994; Onwuegbuzie & Leech 2006).

Although statistical generalizability in quantitative research may seem more reliable and feasible, it has been criticized as well (Lee & Baskerville 2003). To summarize the existing types of generalizability and to show which of them are appropriate and inappropriate for different types of studies, Lee & Baskerville (2003) have developed a framework of four types of generalizability. According to the framework, there are four ways to generalize: from empirical statements to other empirical statements, from empirical statements to theoretical statements, from theoretical statements to empirical statements, and from theoretical statements to other theoretical statements, also referred to as EE, ET, TE, and TT Types of generalizability (Lee & Baskerville 2003). The developed framework systematizes the existing types of generalizability, but the authors emphasize that neither statistical nor analytical generalizability are fully reliable because both of them break the "Hume's truism" principle that "induction or generalization is never fully justified logically" (Hume 1975). Even more important is the fact that according to this principle a theory cannot be generalized to a new setting without empirical testing of the theory in that new setting (Lee & Baskerville 2003). In other words, the theory should be tested and confirmed for each situation and setting separately.

3.3. Grounded theory

Grounded theory (GT) was developed by Glaser and Strauss in 1967 as a pragmatic approach for conducting social science research (Suddaby 2006). The approach is built upon two main concepts: *constant comparison* and *theoretical sampling*. Constant comparison is based on the idea that every piece of new information is compared

with collected data to find similarities and differences. Therefore, the data are collected and analyzed simultaneously. The concept of theoretical sampling shows the iterative process of theory building in which the next data sample is chosen on the basis of the analysis of the previous samples.

The Strauss and Corbin version of the grounded theory (Strauss & Corbin 2008) relies on a systematic codification and categorization process for observations. In the grounded theory, coding is the fundamental process for analyzing data and generating a theory. There are three basic types of coding: open, axial, and selective coding. Open coding is "the interpretive process by which data are broken down analytically" (Corbin & Strauss 1990). Its purpose is to understand what the data really means, to find the similarities and differences between the pieces of data, and to give a conceptual label to each event/action/phenomenon. Then, the concepts are grouped together to form categories with subcategories which present a higher level of abstraction than the original data.

In axial coding, relationships between categories emerge and they are tested against the data. A single test is not enough to prove or discard a hypothesis; therefore each relationship should be indicated in the data over and over again. If the hypothesis is not supported by new data, it does not mean that the hypothesis is necessarily false, but the context and conditions in which it occurred should be critically evaluated to determine what really happened.

Selective coding is a process of defining the core category. The core category shows the central hypothesis of the study. All other categories with subcategories are unified around this core. (Strauss & Corbin 2008) suggest identifying the core category by asking the questions: "What is the main analytic idea presented in this research? If my findings are to be conceptualized in a few sentences, what do I say? What does all the action/interaction seem to be about? How can I explain the variation that I see between and among the categories?"

Diagrams play an important role in data analysis, because they depict possible relationships between concepts. They are also considered as analytical tools that force the researcher to understand the data deeply (Strauss & Corbin 2008). The early diagrams are usually quite simple. They help the researcher to think about possible relationships between the concepts. Later they become more complex: new relationships between concepts arise and each concept gets its own properties and dimensions. As a result, a picture of the phenomena under observation emerges.

The coding procedures show the growth of the degree of conceptualization from description to theory through interpretation. The degree of conceptualization is tightly coupled with the scope of the theory: the higher degree of conceptualization is achieved, the more formal concepts are used for the theory building. At the

description level, the researcher works with categories and properties gathered directly from the data (open coding). At the interpretation stage, the categories and properties are analyzed by using grounded theory procedures, which allows creating a theory with substantive focus that is more abstract than the theory with a bounded context. In addition, the substantive theory has significant empirical support. The latest stage is the theory creation from formal concepts. It presents the highest level of abstraction, which is the final goal of the grounded theory approach. This type of theory has the widest scope and it can be applied to many different situations (Urquhart, Lehmann & Myers 2010).

3.4. Systematic literature review

Software engineering has inherited the evidence-based paradigm from evidence-based medicine (EBM), where the evidence-based practice has shown itself to good advantage in finding, assessing, and aggregating the results from other studies. The main goal of evidence-based software engineering (EBSE) is "to provide the means by which current best evidence from research can be integrated with practical experience and human values in the decision making process regarding the development and maintenance of software" (Kitchenham, Dyba & Jorgensen 2004).

Since 2004, when EBSE was introduced, it has become an additional methodological approach to conducting research in software engineering, with an increasing number of publications each year (Figure 3). The original ideas of EBSE have been extended and explained in detail in the form of guidelines for performing systematic literature reviews in software engineering (Kitchenham & Charters 2007). A systematic literature review, or SLR, summarizes and consolidates unconnected studies related to a phenomenon in an unbiased manner. In addition, SLRs help in identifying existing gaps in a research area.

In a systematic literature review in software engineering conducted in 2007, the authors identified 20 relevant studies, but only half of them followed the guidelines or cited EBSE papers (Kitchenham et al. 2009). At this point of time, authors still preferred to undertake an informal literature survey and the EBSE approach was not widespread. Therefore, many review papers had not used the term "systematic literature review" that is shown in Figure 3. A year later, 19 new SLRs were published, but only three of them did not follow the EBSE guidelines. The overall quality of these publications was improved as more researchers followed the SLR guidelines (Kitchenham et al. 2010). The number of published SLRs in software engineering has been increasing in recent years, and SLR has become a reasonable first step for immersing to a new research area for PhD students.

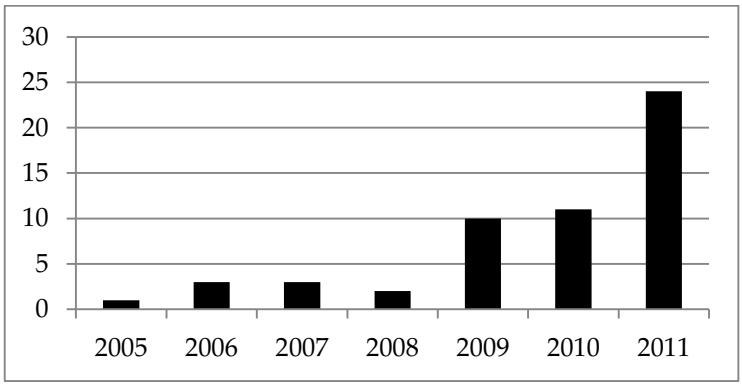

Figure 3. Number of scientific publications with the phrase "systematic literature review" in the title in the categories "software engineering" and "information systems". Source: ISI Web of Knowledge, 07.05.2012

The systematic literature review is an example of a secondary study with the aim to evaluate, synthesize, and integrate the results of primary studies which present an empirical investigation of a specific research question (Kitchenham & Charters 2007). However, conducting a full SLR is a complicated process of following predefined procedures in answering quite specific research questions (Budgen et al. 2011). In case the specific research questions cannot be identified for an SLR or broader overview of the research area is required, it may be appropriate to conduct a mapping study, also known as a scoping study. The aim of a mapping study is to "to provide a wide overview of a research area, to establish if research evidence exists on a topic and provide an indication of the quantity of the evidence" (Kitchenham & Charters 2007). In comparison with full SLRs, mapping studies have usually broader research questions, the search terms are less focused and return a large number of studies, the data extraction process is devoted to classification and categorization rather than extraction of detailed information from the study, and the analysis stage aims to provide summaries and total numbers related to the studies (Kitchenham & Charters 2007). In this regard, the mapping study is a lightweight version of the SLR. It "involves a search of the literature to determine what sorts of studies addressing the systematic review question have been carried out, where they are published, in what databases they have been indexed, and what sort of outcomes they have assessed, and in what populations" (Kitchenham et al. 2009), but deep analysis and assessment of the studies are not required. Another type of SLR is a tertiary study or "a review of secondary studies related to the same research question" (Kitchenham & Charters 2007). The procedures for conducting tertiary studies are the same as for systematic literature reviews, but instead of primary studies secondary studies are used in order to answer the research questions.

Although performing systematic literature reviews in software engineering has become an accepted methodology for conducting secondary studies, in comparison with evidence-based practice in medicine, the growth of studies in EBSE is not so significant. In the six-year period since EBM was introduced, the number of publications increased from one to about a thousand (Sackett et al. 2000). In software engineering EBSE has less impact on performing literature reviews systematically, and many of them are still performed in an informal manner. The quality assessment of the SLRs being published since 2004 shows that the average quality score appears to be increasing from year to year but it cannot be associated with the SLR guidelines only (Kitchenham et al. 2009).

3.5. The research problem and its shaping

Recently, software product management has attracted the attention of researchers in software engineering. The number of publications on this topic has increased in recent years, but SPM still stays a relevant topic in software engineering and requires more research because of its importance for the software business, see e.g. (Mohamed & Wahba 2008; Botzenhardt, Maedche & Schloegel 2010; Gorschek et al. 2012). The existing software product management frameworks (van de Weerd et al. 2006b; Ebert 2009; Kittlaus & Clough 2009) provide little guidelines for where they can be adopted. They are assumed to be suitable for any company regardless of its size, business domain, and type of product. Together with the large number of activities involved in product management, their adoption for improvements in the existing practices suggest a long and thorny way consisting of a long chain of steps with results in a distant future.

The goal of the present thesis is to show that SPM may be simplified and clarified by taking the specific features of SPM into account, like the company's size where SPM is adopted, the product manager's roles and responsibilities, and the main SPM activities for a particular company. In this regard, the main research goal is to investigate

How to overcome the complexity of software product management?

Overcoming the complexity of software product management would make its adoption easier and more valuable in terms of the resources required for changes in the organizational and management processes within the organization. In this thesis, the aim is to concentrate on the product management processes, approaches, and practices in companies that have started to adopt software product management. The objective of the thesis is to show that the adoption of software product management practices could be more valuable for the companies if they concentrated on the core

activities and specific tasks of the product managers. Therefore, the main research goal can be broken into research questions (RQs) and follow up research sub-questions (RSQs) that focus on particular aspects of the problem. To be able to answer the main question, it has been divided into research sub-questions as follows:

RQ1: What factors affect software product management practices?

RSQ1.1: What is the difference in the adoption of software product management practices in small and medium sized enterprises (SMEs) and large enterprises (LEs)?

RSQ1.2: Which SPM activities are more important for SMEs and which for LEs?

RQ2: What is the role of the product manager in practice?

RSQ 2.1: Which common roles do software product managers fulfill in organizations?

RSQ 2.2: How are these roles interconnected with each other?

RQ3: What are the problems of software product management in practice?

RSQ3.1: What are the common problems in adoption of software product management?

RSQ 3.2: Is it possible to avoid or solve these problems?

RQ4: What is product management from the practitioner's viewpoint?

RSQ 4.1: What are the core activities in software product management?

RSQ 4.2: What are the supporting activities in software product management?

The first RQ addresses the situation when the existing software product management frameworks present a synthesis of SPM activities from observations and studies of companies regardless their size. However, organizational practices in enterprises of different sizes differ. Therefore, it is important to understand which SPM activities are useful for companies of different sizes and how this affects the adoption of SPM.

The second RQ addresses the issues of roles and responsibilities held by the product managers in companies. Although the role of the product manager is often described

in the literature as a product "*mini-CEO*," it is rarely observed in practice (Steinhardt 2010). The fuzziness of the role of the product manager makes it difficult for top managers to assign tasks to product managers and control their execution.

The third RQ aims to identify the common problems faced by companies starting the adoption of software product management practices. The goal is to find out if these problems are common or specific for each company and to find a way to solve or even avoid these problems in advance.

The last, fourth, RQ aims to identify the core and supported activities in product management. The existing product management frameworks include up to 40 different activities, which make their adoption complicated. The identification of the core activities having the highest impact on increasing the product profitability and quality would help in giving guidelines to companies in the adoption of SPM activities.

Combining the information gathered during the separate studies concerning these questions will help in understanding the organizational changes necessary for the adoption of software product management. The results of the studies describe the necessary changes in the adoption of SPM in a product company. The results of the thesis aim to improve the internal and external processes in companies, which should help them to create high-quality products on time, on budget and for the right market.

3.6. Selection of the research methods

The research project described in this thesis started with a systematic mapping study (Kitchenham & Charters 2007) on the topic of software product management. This decision was made because performing a systematic literature review, or mapping study in this case, is a reasonable first step for starting a PhD project. It allows the researcher to gain a general understanding of the research area and synthesize the existing knowledge in order to identify the research gaps (Kitchenham & Charters 2007). The choice of performing a mapping study instead of a full systematic literature review was based on preliminary searches in digital databases. The number of papers on the topic of software product management was limited and there were not enough of them for a deep analysis. Therefore, the study concentrated on identification of what kind of studies existed, what research questions had been studied, where the results of the studies had been published, and what results had been achieved in the field. Overall, this represented the goal of a mapping study (Kitchenham et al. 2009) rather than a systematic literature review where assessment and evaluation of each paper is required (Kitchenham & Charters 2007).

In the following phases of the research project, the grounded theory developed by Glaser and Strauss in (1967) was used as the main research method. The grounded theory approach has evolved into two branches. The first branch is supported by Glaser (1992), the other by Strauss and Corbin (1990). The authors disagree on how the coding procedures should be done. Strauss and Corbin (1990) suggest a more formal approach to coding data, consisting of three coding procedures: open coding, axial coding, and selective coding. In addition to the three coding procedures called open, selective, and theoretical coding, Glaser (1992) suggests using a conditional matrix for tracking the various levels of abstraction during the study. Glaser criticizes the approach of Strauss and Corbin because it forces to generate a conceptual description of the phenomena under study rather than theory building. Strauss and Corbin for their part state that if the researcher does not use the model the "grounded theory analysis will lack density and precision" (Strauss & Corbin 2008). The Strauss and Corbin version was chosen for the present thesis because it relies on a systematic codification and categorization process for observations. Although the grounded theory has been criticized from both philosophical and methodological points of view (Bryant 2002; Suddaby 2006), this method is suited for research, "particularly where it proceeds from an antipositivism orientation that sees truth as socially constructed and sustained and where representation is viewed as a distributed, systems phenomenon" (Bryant 2002).

The GT was chosen as the main research method because it allows the researcher to concentrate on the chain of evidence from observations and descriptions to theory development with little interpretation on the studied phenomenon (Corbin & Strauss 1990). In this thesis, the Strauss and Corbin version of the grounded theory was chosen, because it relies on a systematic codification and categorization process for observations. The formal procedures described by Strauss and Corbin helped to decrease possible biases during the analysis. In addition, the GT forces the researcher to study the phenomenon in depth and explore the studied phenomenon in a broader way by interviewing more people and investigating more additional materials related to the topic. The GT also helps the researcher to analyze the collected unstructured material by defining the predetermined procedures of data analysis consisting of the three coding phases.

In addition to the Grounded Theory, elements from the Theory of Constraints (TOC) (Goldratt 1999) were used for identifying the root problems in software product management (more details available in *Publication IV*). Building the current reality trees (CRTs) we managed to analyze the organizational problems jointly and identify the root causes common to most of the problems. The CRTs helped to focus on many problems consistently and identify the relationships between them in order to understand how all these problems are interrelated. In comparison with other root

cause analysis tools, such as cause-and-effect diagrams (CEDs), CRTs make it easier to follow the "if-then" logic to identify the root cause problem precisely (Dogget 2005).

Overall, the Grounded Theory has been used mainly as the research methodology in this thesis, but other supporting research approaches, such as systematic mapping studies and elements of the Theory of Constraints have been also used when necessary to support and extend the ideas developed during the analysis using the Grounded Theory.

3.7. The research process

The research process was divided into three phases. In the preliminary phase, or Phase 1, a systematic mapping study on the topic of software product management was conducted. Then, Phase 1 continued with a preliminary study on the existing software product management practices and issues in companies using the Grounded Theory. The two different studies included in Phase 1 represented state-of-research and state-of-practice in the field of software product management when the research project started. During these two studies the existing problems and research gaps were identified, and this helped to build a roadmap for the following studies. Phase 2 was the main phase where the data were collected and analyzed. All the main results reported in this thesis emerged during this phase. In the second phase, the research method was qualitative data analysis using the Grounded Theory on the collected interview data, combined with analysis of supporting documentation gathered from interviewees. In the last, the third phase, a survey on the core activities of software product management was conducted. It was a special type of a survey where the respondents were not limited by providing any predetermined options for answers usual for surveys, as the problem was approached in an inductive fashion to keep the meanings as open as possible. Moreover, the answers in the survey were open for the respondents, so they could read and see the answers of previous respondents. This allowed applying the qualitative method for the data analysis. The Grounded Theory was used for this study as well. The whole research process, divided into three phases is illustrated in Figure 4.

3.7.1. Phase 1: Preliminary phase of the thesis

The preliminary phase consisted of performing a systematic mapping study to synthesize the existing knowledge in the field of software product management and conducting a pilot study to identify existing SPM problems. The Grounded Theory was chosen as the main research method for qualitative data analysis from the beginning. However, performing a mapping study did not contradict the Grounded Theory guidelines to enter the field without any predetermined knowledge because "grounded theory is not an excuse to ignore the literature" (Suddaby 2006). Suddaby (2006) considers as a common misconception that the Grounded Theory researcher

should enter the field with a blank mind. Similarly, Dey says that "there is a big difference between an open mind and an empty head" (Dey 1993). Therefore, using the GT methodology cannot be an excuse for eliminating the literature study. Conducting a systematic mapping study on the topic allowed getting a broad overview of the field, identifying the existing gaps and problems in the field, and planning further studies based on work already done.

The purpose of the empirical pilot study was to understand how organizations manage their software products and how their product management processes are implemented. Organizations of different sizes from very small to large, doing business in telecommunication, software products, and software service fields were chosen for this study (Table 6). The companies were divided into several groups depending on their size. In this division software companies are classified as SMEs if they have less than 500 employees (U.S. Small Business Administration 2010). Then, the large companies were divided into three groups: medium large, large, and extra large to avoid mixing large domestic companies with international corporations. The GT approach was used for qualitative analysis of the collected data. The identified core category *company context* explains the impact of historical and cultural events on the adoption of product management in the organizations. The background and current situation in the organization has a significant effect on the existing roles and processes, and these factors have therefore to be taken into account when studying SPM activities in an organization. The results of the preliminary studies were reported in *Publication I* and *Publication II.*

Table 6. Profiles of the organizations interviewed in the preliminary research phase

Business domain, type of product	Organization size	Size (employees)	Established	Roles of interviewees
International developer and supplier of a wide range of software, integrated solutions and hardware technologies	Large	1800	1990	Deputy managing director for R&D
Developer and provider of telecommunication solutions, software and hardware	Medium large	800	2007	Manager of Mobile Development Department
Integrator and developer of software for SMEs	Medium	350	1994	Deputy director of Software Development Department
International provider and developer of interactive media solutions	Medium	150	2002	Team lead, Project manager
Developer of software tools	Medium	120	2000	Product marketing manager
Developer of software products for servers	Small	15	2009	Technical director, Sales director

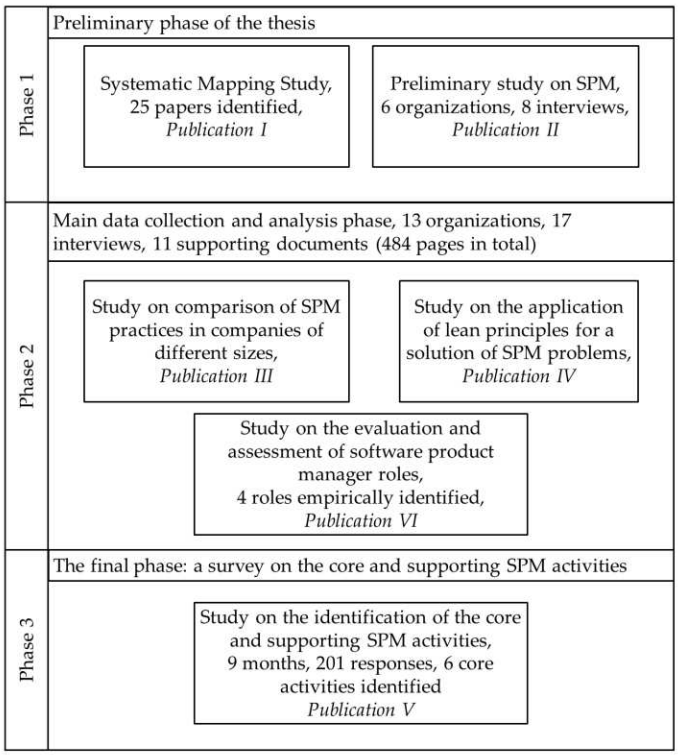

Figure 4. Research process divided into three phases

3.7.2. Phase 2: The main data collection and analysis phase

In the main data collection phase, the interviews with the organizations' representatives were continued until a saturation point in the data was achieved. In comparison with the preliminary phase, seven organizations were additionally studied and nine interviews, mainly with product managers, were conducted (Table 7). After six interviews in this round it became obvious that we were no longer able to identify new categories. The interviewees talked about the same areas and issues in product management, but their focus on each topic varied depending on the organization. New categories in the analysis rarely emerged, and this was considered as a sign of theoretical saturation, but to be certain, three more interviews were conducted.

The interviews were recorded and transcribed. During the transcription process, an attempt to decrease losing of information such as hesitancies, pauses, and changes in intonation was made by making notes in the transcripts. External events, such as interrupted phone calls and small breaks in the interviews were also documented. When possible, face-to-face meetings with the interviewees were conducted, but Skype video and audio interviews were used as well. The selection of interviewees

was guided by existing contacts and snowballing (Strauss & Corbin 2008), where the next interviewee is a referral from a previous one.

Table 7. Profiles of the organizations interviewed in the main data collection round

Business domain, type of product	Organization size	Size (employees)	Established	Roles of interviewees
Business and operational support systems	Extra large	10,000+	1982	Product manager
Internet applications	Large	3,000	1997	Two product managers
Security solutions	Large	4,000	1997	Product manager
Storage management solutions	Medium large	800	2002	Product manager
Data security and storage management	Medium	350	1994	Product manager
Banking software	Medium	300	2004	Two product managers
In-house development of IT solutions	Medium	250	2000	Senior business analyst

The units of analysis (Yin 2002) were product management and processes that support the product lifecycle. The semi-structured interviews conducted in two rounds with managerial personnel at each company helped to elicit details of product management issues and processes in the organizations. The interviews conducted with "technical" personnel, such as the team lead and project manager in the preliminary phase showed that they were mostly unaware of product management practices, and it was difficult for them to describe the processes related to product management. Those responsible for the technical details of implementation were usually familiar with the development processes, but the main focus of this thesis was out of their scope. However, these viewpoints were also included in the analysis, because they extended the vision of product management. The main goal was to interview mainly the middle and top management, and therefore we preferred the interviewees who have the role of a product manager, but the interviews with those who actively communicate with product managers in their work, e.g. the deputy director of software development were also conducted (Table 6).

The key informants included product managers, sales directors and marketing managers. The questions about product strategy, roadmapping, product marketing and decision making processes were asked from all the interviewees, but the questions were tailored a little bit for each interview, depending on the role of the interviewee. The general sets of questions for the first and the second round of interviews are presented in Appendix II. Additional questions on organizational, hierarchical, and product structure were asked to understand the companies and the interviewed individuals better, but these questions were specific for each interview, depending on its flow. The semi-structured interviews were flexible, depending on

the flow of the discussion. New questions arose during the interviews and some questions were removed because of their irrelevance for the context and the interviewee.

The interview data were complemented with supporting documents. The interviewees were asked to provide documents written by product managers. As a result, we received eleven documents, 484 pages in total (Table 8). These documents were a subject for coding procedures but they were coded separately from the interviews and were mainly used for checking hypotheses. First, hypotheses were developed on the basis of the interview data. Then, the hypotheses were checked using the supporting documentation representing the results of the product managers' day-to-day activities. We compared how the information collected during the interview was reflected in the supporting documentation, e.g. whether the product manager worked in strategy development, and who assisted this activity. In addition, publicly available information about the company was used before the interviews to get a general understanding of their business. After the interview, a brief review of the sources, such as annual reports, product announcements, and press releases was made to get additional information related to product management. Using multiple sources of evidence helped to gain a deeper understanding of the company context and the influence of product managers on the products. This also increased the validity of the results and helped to mitigate the potential bias of the interviewee's subjective viewpoint to the internal situation in the organization (Yin 2002). For example, strategies were discussed with almost all interviewees, so it was possible to compare the discussions with the supporting documentations (e.g. Strategy, Table 8) and available product releases in the Internet to check the consistency of this information.

Table 8. Supporting documentation obtained from the organizations for analysis

Document title	Type	Size
Strategy	Document	196 pages
Product plan	Document	132 pages
Product specification	Document	61 pages
Product vision	Document	35 pages
Product plan	Presentation	17 slides
Positioning statement	Document	12 pages
Features and advantages for the client	Document	7 pages
Release plan	Presentation	6 slides
Project status	Excel document	3 sheets (~13 pages)
Application description with technical details	Document	2 pages
Release plan	Excel document	1 sheet (~3 pages)
Total:		**~484 pages**

The main analysis tool used in this study was ATLAS.ti (2011), which is software for qualitative researchers, supporting Grounded Theory data analysis. In addition, CmapTools (Institute for Human and Machine Cognition (IHMC) 2011) was used for creating concept maps, which are "graphical tools for organizing and representing knowledge" (Novak & Canas 2008).

The collected data were analyzed using the grounded theory consisting of three coding procedures: open, axial, and selective coding. The rich set of data was collected by interviewing people in different positions and from different companies working in various domains of software products. This helped gain additional information about the product management processes in the organizations. Moreover, it allowed generating various assumptions during the analysis phase, which resulted in the publication of three papers: *Publication III, Publication IV,* and *Publication VI,* representing viewpoints to making software product management processes more simple and transparent. Although the semi-structured interviews were flexible in general, three main topics in product management were covered in all interviews: *activities*, *roles*, and *problems*.

During the open coding procedure of the interviews in the preliminary phase, consisting of eight interviews, it was clear that the concepts could be easily grouped together using the areas in which a product manager works, but it was unclear how many areas existed. This suggested a scheme about questions that should be asked from other product managers in the next round (Phase 2). Firstly, the differences in product management activities between SMEs and large enterprises emerged. During the open coding the interviews were coded with different aspects of software product management. Later some of the developed categories were merged and new categories were developed based on the collected data. In total, 257 codes in 42 categories emerged from the data, which clearly showed that there are the differences as well as similarities in the adoption of SPM activities in SMEs and large enterprises.

In axial coding, the focus was on the relations between the identified categories. The categories were compared with each other to establish relationships between them. These included such relationships as associations, cause-effects, contradictions, and part–of relationships. At this stage, the observations and codes became more focused on the phenomena under observation and it became possible to continue with the identification of the core category.

The purpose of selective coding is to find the core category and explain it (Corbin & Strauss 1990; Charmaz 2010). It may be one of the existing categories or a new category which has not been identified earlier. In the analysis it was observed that most of the categories were grouped into four super categories. These super categories unite SPM activities in the context of company size as follows: *SME-specific activities*, *size-independent activities*, *size-dependent activities*, and *LE-specific activities*.

Therefore, the core category was named *Effect of company size on the adoption of SPM activities*. Each of the super categories explains a part of the theory. The results of this study were reported in *Publication III*.

The second view to the collected data aimed to understand and systematize the existing problems in software product management. The analysis focused on the main problems in adopting SPM activities. The analysis indicated that the problems were not company-specific, so we continued with a root cause analysis using the Current Reality Tree (CRT) technique from the Theory of Constraints (TOC) (Goldratt 1999). In comparison with other root cause analysis tools, such as Cause-and-Effect Diagrams (CEDs) (Dogget 2005), CRTs make it easier to follow the "if-then" logic to identify the root cause problem precisely. The analysis showed that the main problems were typical for the problems addressed with the lean principles. In total, five common SPM problems were identified. All of them can be solved or even avoided by application of lean principles to software product management at the enterprise level, as described in *Publication IV*.

Finally, the analysis of how activities and problems in product management fit together with the roles and responsibilities held by a product manager in an organization was made. Four super categories representing the characteristics of a product manager and explaining his or her role in the organization were identified. A part of the concept map representing the super categories, together with their properties is shown in Figure 4. These super categories were *influence on the product*, *authority*, *access to resources*, and *influence on collaboration*. Each of the super categories explained a part of the theory about the product manager's responsibilities; therefore the core category was titled as *the role of a product manager in an organization*.

Properties are "the characteristics that give specificity to and define an object, event, and/or action" (Corbin & Strauss 1990). For each of the super categories, a set of properties explaining what the category includes was identified. These properties describe the super category from various viewpoints, providing an additional explanation to what is included in the category. The dimensions, which are "variations of a property along a range" (Strauss & Corbin 2008) were used to illustrate the differences between the four product manager roles further. The result of the analysis was a framework explaining that the role of the product manager is not limited to a "*mini-CEO*" only, but he or she may act as an *Expert*, *Strategist*, *Leader*, or *Problem Solver*. The details of this study were reported in *Publication VI*.

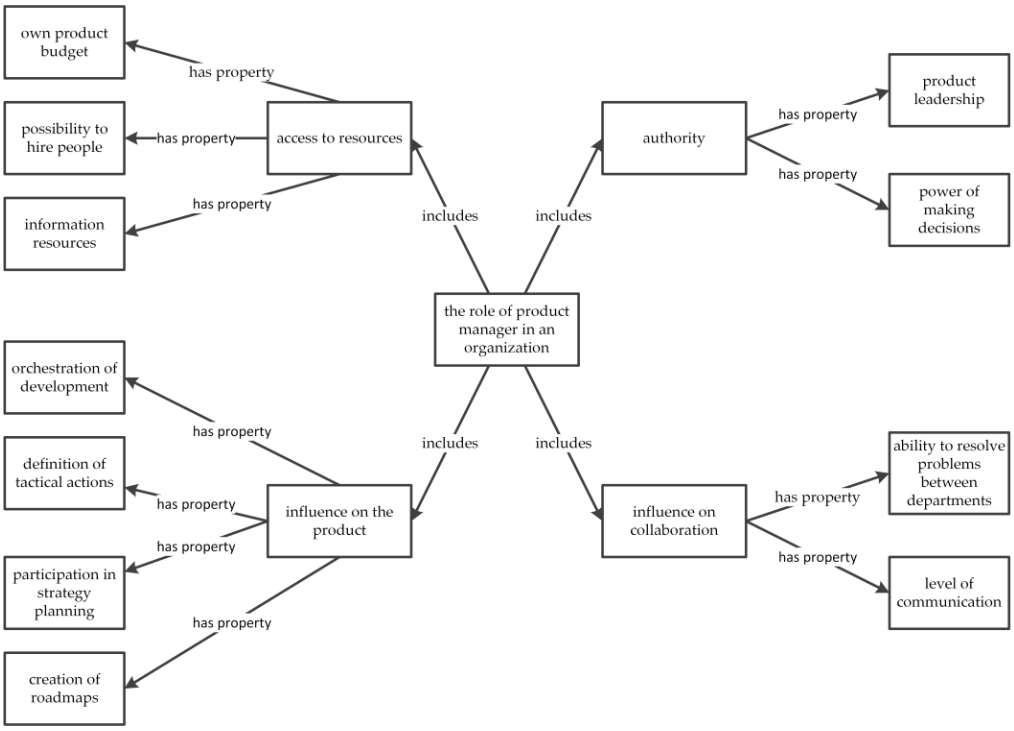

Figure 5. Super categories explaining the main responsibilities of a product manager in an organization

3.7.3. Phase 3: The final research phase

It was shown during the main analysis phase that companies have five common software product management problems, which can be addressed by lean principles. Moreover, the content of product management activities and their number depend on the company size. Taking into account the company size in the adoption of SPM activities may help to implement SPM more efficiently. Finally, it was shown that a product manager may be not only a "*mini-CEO*" but also an *expert*, *strategist*, *leader*, or *problem solver*. The different roles of product managers are related to the company's organizational structure. These roles allow the product managers and top management to understand the tasks of the product managers. As a result, the roles help to avoid a situation when the top management and the product manager have different understanding and expectations about the responsibilities of the product manager. Overall, these three studies showed that software product management is highly dependent on the company context and may be organized very differently depending on the company's organizational, historical, and hierarchical structure. However, none of these studies addressed the issue of identifying the most important activities in product management. This is a real issue due to the number of activities described in product management frameworks (van de Weerd et al. 2006b; Ebert 2007; Kittlaus & Clough 2009; Pragmatic Marketing 2010a; ISPMA 2012), which include up

to 40 activities related to product management. Therefore, the final step in this thesis was an attempt to understand what practitioners really mean when they talk about product management or, in other words, to identify the core and supporting activities in product management from the practitioner's viewpoint. The term *core activities* is understood similarly to the definition given by Kittlaus&Clough as "*the major functions with which a software product manager is involved*" (Kittlaus & Clough 2009) while supporting activities unite orchestration and participation activities and these activities do not report directly to the product manager but have to be orchestrated by him due to their importance to the product success.

In order to address this issue of product management understanding as understood by practitioners, a survey with one open-ended question was published in a public LinkedIn group for product management professionals, allowing them to answer this question freely but briefly. The question was the following: "*A very basic question for my fellow group members. What is Product Management? Please try to limit your response to 3 bullet points or as short as possible.*" The LinkedIn group has twenty thousand members. 47% of the group was members who indicated product management as their primary function. Other members were from *consulting* (5%), *marketing* (5%), and *program and project management* (5%). Other functions, such as *human resources* and *sales*, did not break the five percent level. From the seniority viewpoint, the group was almost equally divided between senior positions (*Senior Product Manager, Director, Vice President*, and *Owner*) and less experienced professionals (*Manager, Entry level position*). Professionals from the following high tech industries dominated the group: *Computer Software* (18%), *Information Technology* (14%), *Telecommunications* (7%), *Internet* (6%), *Marketing and Advertising* (4%), and *Financial Services* (4%). Other industries were represented by less than four percent. The survey consisted of only one open-ended question, and there were no constraints to the way of answering the question. In a period of nine months, the survey was responded 201 times. The respondents were not limited by providing any predetermined options, because the problem was approached in an inductive fashion to keep the meanings as open as possible. Moreover, the answers in the survey were open for the respondents, so they could read and see the answers of previous respondents. Sometimes this provoked discussions between two or three respondents, which illustrated the differences in the understanding of the product management discipline. We had no geographical or domain limits, so the survey was available for anyone interested in the product management discipline. However, the goal was to focus on the main discussion topic and keep the responses as short as possible.

Due to the open-ended question to the respondents, the responses were analyzed qualitatively using the Grounded Theory. In this study, 106 codes were identified during open coding. An example of open coding is presented in Figure 6. A transcript

of the responses is presented on the left-hand side of the figure. On the right side, codes and categories with codes, separated by colon, are shown.

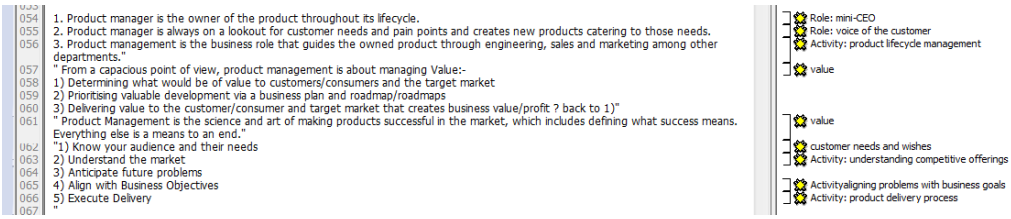

Figure 6. Example of open coding in Atlas.ti (ATLAS.ti 2011). Codes and category:codes are presented on the right side

In axial coding, the codes were distilled into 39 categories with established relationships. The next step was selective coding, which is devoted to finding of the core category and explaining it (Charmaz 2010). We identified the core category as *Product management* primarily based on the question posted in the LinkedIn group because all the categories explained this category in detail.

The study elaborated on the identification of six core product management activities: *product analysis, roadmapping, strategic management, vision, product lifecycle management*, and *external and internal collaboration*. These activities were repeatedly mentioned by the respondents as related to product management. Other activities such as *release management* and *resources management* were mentioned more occasionally, and were therefore considered as supporting activities in product management. The details of this study were reported in *Publication V*.

3.7.4. Finishing and reporting on the thesis

The thesis may be considered as a Grounded Theory research with several supplementing research methodologies. First of all, the thesis was started with a systematic mapping study (*Publication I*), which helped to get a general understanding of the research area and identified research gaps. Overall, this mapping study raised more questions than answers, e.g. why do we have so few studies on software product management? The last study (*Publication VI*) in this thesis was designed as a survey but it was a special kind of survey for using qualitative methods of data analysis. Quantitative methods are widely used for statistical confirmation of hypotheses developed during qualitative studies (Clark 1998; Creswell 2003; Onwuegbuzie & Leech 2006). In contrast, our survey was developed as "qualitative survey." The idea to use the Grounded Theory to analyze the data collected as responses to an open question, allowed identifying core product management activities inductively. However, it was not possible to confirm these

results statistically, and thus quantitative results are still needed. Overall, the results and experience of the "qualitative survey" were positive. The respondents were very active in answering the survey, and the ability to see the previous responses was an additional motivation for them.

In the middle of the thesis, elements from the Theory of Constraints (Goldratt 1999) were used to identify the root-cause problems in software product management. In the rest of the thesis, the Grounded Theory was the dominating research method. According to Strauss and Corbin (Strauss & Corbin 2008), a Grounded Theory study can be finished only when theoretical saturation is achieved. However, it may be difficult to prove this in practice. (Glaser & Strauss 1967) describe theoretical saturation as the situation when new categories stop to emerge from the data and the properties cannot be further developed. This means that the theory cannot be developed further by adding new data. At the same time, it is important to understand that the created theory is dynamic rather than static, and can be extended. This is an attribute of the Grounded Theory that cannot be eliminated (Glaser 1992). In the present case, theoretical saturation was achieved already after fourteen interviews, which is a relatively low number for Grounded Theory studies (Matavire & Brown 2008) but three more interviews were still conducted. Overall, more details could have been revealed by adding more data. However, "in practice, theoretical saturation often combines with pragmatic considerations to dictate when case collection ends" (Lee, Liebenau & DeGross 1997). These limitations include such pragmatic reasons as time and money. In this regard, we may claim that theoretical saturation might have been achieved because we had no evidence to think that adding new pieces of data would significantly improve the results. At the same time, we cannot claim that there are no cases contradicting with our results, because most theories have their own limitations in applicability, as well as contradictory examples of when the theory does not work properly.

The results of the studies were consequently reported as *Publication I-Publication VI*. Each of these publications represents a step in the theory development. The next publication used deeper data analysis than the previous one. In addition, each publication represents different viewpoints to the problems in software product management, and the studies on software product management will be continued longitudinally after this thesis work is finished.

3.8. Summary

This chapter explained the research problem of this thesis and described the research process followed to address it. In addition, the philosophical foundations of the research and research methodology were described. The research process consisting of three phases is summarized in Table 9.

Table 9. The research phases summarized

	Phase 1, preliminary phase	Phase 2, main phase	Phase 3, final phase
Research questions	RQ1: What factors affect software product management practices? RQ2: What is the role of the product manager in practice? RQ3: What are the problems of software product management in practice?	RSQ1.1: What is the difference in the adoption of software product management practices in small and medium size enterprises (SMEs) and large enterprises (LEs)? RSQ1.2: What SPM activities are more important for SMEs? For LEs? RSQ2.1: Which common roles do software product managers fulfill in organizations? RSQ2.2: How are these roles interconnected with each other? RSQ3.1: What are the common problems in the adoption of software product management? RSQ3.2: Is it possible to avoid or solve these problems?	RQ4: What is product management from the practitioner's viewpoint? RSQ4.1: What are the core activities in software product management? RSQ4.2: What are the supporting activities in software product management?
Data sources	5 digital libraries, 4 conferences, 8 interviews	13 companies, 17 interviews, 11 supporting documents (484 pages in total)	201 responses to a survey
Data analysis	Guidelines for performing systematic literature reviews and the Grounded Theory using ATLAS.ti	Grounded Theory as the main research method + the elements from the Theory of Constraints (Goldratt 1999)	Grounded Theory as a qualitative method for analyzing free-form survey answers
Reporting	Publication I, Publication II	Publication III, Publication IV, Publication VI	Publication V

4. Overview of the publications

This section presents an overview of the studies conducted as parts of the thesis and included in it, in the chronological order of their publication. The results of this thesis are based on the six publications attached as an appendix. Five publications, except *Publication VI,* have been published separately in peer-reviewed scientific conferences and journals. *Publication VI* is under review in the *Journal of Systems and Software.* In this chapter, each of these publications is discussed briefly, including its research objectives, main results, and relation to the whole thesis.

4.1. Publication I: What do we know about software product management? – A systematic mapping study

4.1.1. Research objectives

Conducting a systematic literature review is a feasible first step to start research in a new area, especially for doctoral students who are not experienced enough in the research topic (Kitchenham & Charters 2007). It allows them to explore the existing work done on the topic, to identify the most cited articles and research gaps, and get a general understanding of the research topic.

The study started with an idea to summarize the information about software product management in the cloud, but it soon became evident that even traditional SPM studies are fragmented and their number is limited. The SaaS market reached $13.1 billion in revenue in 2009 and, according to the IDC research, it will grow to $40.5 billion in revenue by 2014 (Figure 7) with an annual growth rate of 25.3% (Mahowald 2010). Gartner Research predicts that the whole cloud computing market will reach

$150 billion of revenue by 2014 (Gartner Research 2010). From the business perspective, cloud computing has still several technological and business problems that will slow down its adoption (Dimoka, Hong & Pavlou 2012). The introduction of cloud services in large enterprises will lead to changes in the corporate IT structure. From the vendor viewpoint, it is necessary to adopt all the development, supporting, and delivery processes to a new business model (Marston et al. 2011; Tyrväinen & Selin 2011).

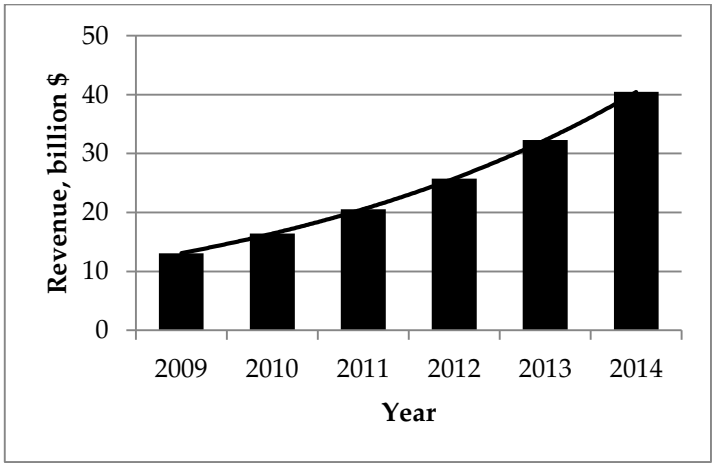

Figure 7. The SaaS market growth forecast (Mahowald 2010)

We conducted a systematic mapping study on software product management following the formal process described by (Kitchenham & Charters 2007). Our focus was on the identification of existing studies rather than evaluation of each paper and that is why the mapping study was chosen prior to a full systematic literature review. The study was guided by three research questions:

1. What research questions in software product management are being addressed?
2. What original research exists in the intersection of software product management and the cloud (service) environment?
3. What areas in software product management require more research?

The main research objective was to find existing studies on software product management and to develop a classification model based on the research topics covered.

4.1.2. Results

In total, we identified only 25 papers related to software product management, and divided them into 16 units of analysis. Two of the units (*company context* and *project*

management) served as contextual units of analysis for other units of analysis. Then, the identified units of analysis were mapped to the Software Product Management Framework (Kittlaus & Clough 2009) to find out which areas of software product management require more research (Figure 8). Only two units of analysis (*finance* and *release planning*) were related to the core activities of software product management as they are described in the Software Product Management Framework (Kittlaus & Clough 2009). Three other units of analysis (*project management*, *defect management*, and *software configuration management*) were related to the Development function, which is a part of activities orchestrated but not managed by the product manager. The top four units of analysis (company context, reference framework, improvements of SPM, and software product line engineering) were related to research in SPM as a discipline, and these studies included general aspects of product management in software industry, which are not specific for the presented functions.

During the mapping study we found that the studies were fragmented. Moreover, it was not clear which functions should be done or orchestrated by the product manager. Overall, only 6 of the 25 studies had clearly presented research questions, and 4 of the 25 studies were opinion and discussion papers without any hypotheses at all. Based on the investigation of the papers, a conclusion was made that the research area is immature and more research is required, especially in areas like product strategy, product planning, and product analysis.

Our initial focus on cloud software product management was not supported by many studies on this topic. Even though differences in environments may lead to dramatic changes in management processes (Konig 2009; van de Weerd & Katchow 2009), only few studies had been carried out in this area so far (cf. (Cusumano 2008)). In the mapping study we found a lack of a consistent approach to research in software product management for traditional products. SPM in the cloud environment is a broader area where a lack of research is evident. The development of an SPM theory applicable to both traditional and cloud environments seemed challenging, because SPM is tightly coupled with the business process and models of each company. The number of SaaS solutions will grow (Mahowald 2010) and we have to know how to manage this kind of development with a new set of problems and conditions. Thus studying the differences and similarities of traditional and cloud SPM is an unexplored area for future research.

Due to the limited number of identified studies, a decision to repeat the search procedures after six months was made. During this time we found that thirteen new papers had been published. Four of these papers were removed from the further considerations for the following reasons: one paper was written in German language, one paper included software product management in its keywords but then it was missing from the full-text, one paper presented a service for managing products (an

experience report from Microsoft), and one paper was an introduction to the Fourth International Workshop on Software Product Management. The nine articles on software product management were published at the proceeding of one conference, IWSPM. Five of the articles were full research papers, one was an industry paper, and three were short papers. For our purpose we chose only full research articles that added five more articles to the systematic mapping study half a year earlier. From 1998 to 2006 only a few new papers were published on SPM, but since 2006 a new wave of interest in SPM has emerged, and after that the concept of SPM has been studied from many viewpoints, such as agility, success factors, and company context. In the late nineteen nineties, product management was studied mainly in relation with software configuration management (Kilpi 1998). Later on, SPM has been established as a discipline consisting of many activities with a goal to manage the product from its inception to sales and support.

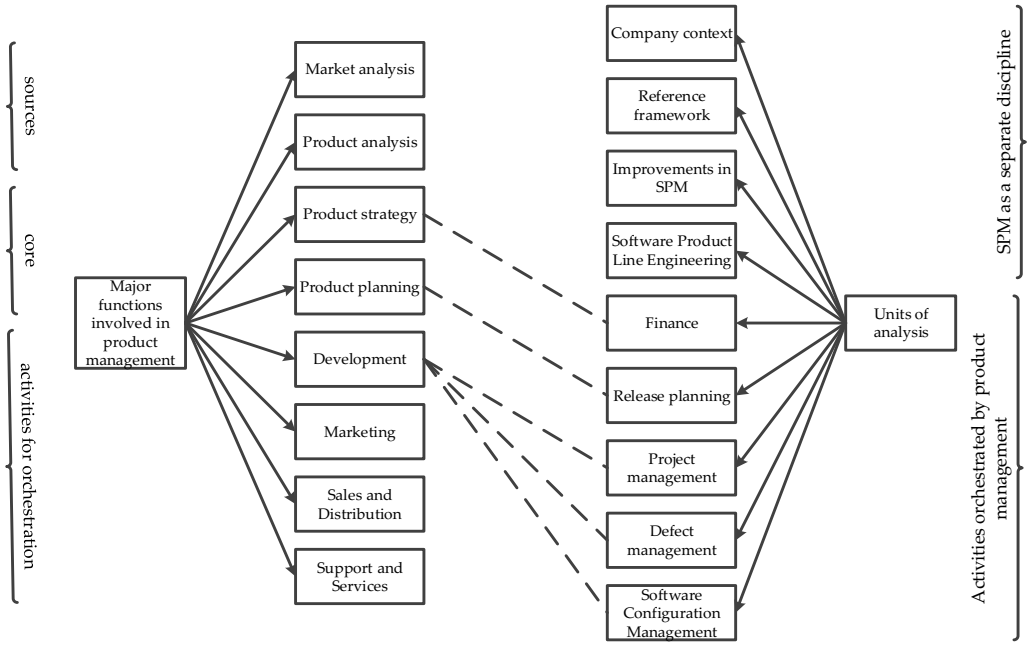

Figure 8. Relationships between the Software Product Management Framework (Kittlaus & Clough 2009) and the identified units of analysis in the research on SPM (Publication I)

The main outcome of the mapping study was the identification of the SPM frameworks (van de Weerd et al. 2006b; Ebert 2007; Kittlaus & Clough 2009), which formed a solid basis for the following studies. Other identified studies, (Bekkers et al. 2008; Wnuk, Svensson & Regnell 2009; Weerd, Bekkers & Brinkkemper 2010), provided hypotheses, which should be confirmed or rejected, as well as a general overview of the situation in SPM. After the mapping study it became evident that

SPM has not been studied fully and this area offers many opportunities for research. Moreover, the practical contribution of the research in SPM cannot be overestimated either, because SPM offers tools and practices for achieving business goals, as well as increasing the predictability and profitability of developing software products and services.

4.1.3. Relation to the whole

This publication provided an overview of the existing software product management studies along with the research gaps in the field. The initial focus on software product management in the cloud environment moved to investigation of the issues in "traditional" product management. Overall, the mapping study showed that the existing studies on SPM covered only a few SPM activities described in SPM frameworks, e.g. the Kittlaus and Clough framework (Kittlaus & Clough 2009). In addition, the study investigated issues like the lack of a consistent and widely accepted definition of SPM and its components. As a result, the practitioners' and researchers' understanding of SPM may vary in a broad range from purely technical understanding of SPM as related to software configuration management (Bersoff 1984), and release planning (Carlshamre 2002) to purely strategic initiatives like strategy and vision development. Therefore, the attempt to understand and clarify the term software product management and its components was made, and this decision was followed during the rest of the study.

4.2. Publication II: Software product management in the Russian companies

4.2.1. Research objectives

In this preliminary study the goal was to understand how the activities related to product management are implemented in practice. The purpose was to concentrate on software development organizations and to investigate the relationships between product management and other disciplines such as product development, marketing, project management, and strategic planning. The research questions of the study were as follows:

1. What is the role of the product manager in practice?
2. What are the problems of software product management in practice?
3. What factors affect software product management practices?

In the beginning of this study, it was unclear how software development organizations manage their products. Therefore, the aim was to clarify how product management is organized in different organizations and what problems exist in

practice. The study was designed as an interpretative qualitative study based on two critical assumptions (Isabella 1990). The first critical assumption was that every software company has some kind of software product management. Usually the role of a product manager exists in large companies only. Small- and medium-sized companies do not have a special person who is responsible for "delivering the right products at the right time for the right markets" (Ebert 2009), but this does not mean that they do not have product management. In these companies the responsibilities of a product manager are distributed among other roles. The second critical assumption was that organizational structure of the company from its foundation to the present day may affect software product management practices more than the developed products.

Six organizations of different sizes from small to large, doing business in the fields of telecommunication, software products, and software services were included in the study. In these organizations the units of analysis (Yin 2002) were product management and supporting product management processes. Building on the presented assumptions, a study to explore product management organizations was designed, and the Grounded Theory approach was chosen as the research method.

4.2.2. Results

During the analysis, four main categories were identified: *role*, *focus areas*, *related activities*, and *company context*. The last category was considered as a core category that explains the other categories as well as the phenomenon under observation. In this study the categories were tightly coupled with each other, and the full picture was formed by these four categories together (Figure 9).

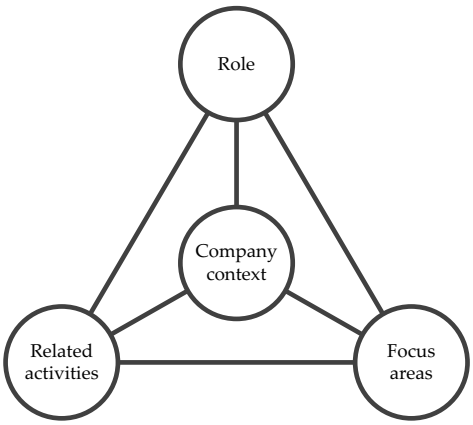

Figure 9. Preliminary model of software product management in organizations (Publication II)

The core category is *company context*, which refers to the organizational structure in the organization. The background and current situation in the organization affect the

existing roles and processes. These factors should be taken into account in studying software product management in any organization. The second category is *role*, which describes the characteristics of the product manager as a separate role in the organization. This category is a result of synthesis of experience explained by interviewees in accordance with their viewpoints to the role of the product manager. The third category is *focus areas*, which refers to the tasks and responsibilities that are specific for the product manager and cannot be delegated to other roles. The last category is *related activities*, which shows the relations between the product manager and other roles. This category is intended to explain the boundaries of product management and identify areas orchestrated or used by the product manager for getting information, for example from analysts, and providing leadership to other activities for achieving the business goals of the company.

Applying the developed model to the studied cases, we made four observations as follows:

1. The interviewees understood the necessity to have a product manager as a separate role.
2. The organizations wanted to establish product management to increase the predictability of processes and the profitability of their products.
3. Product management activities were fuzzy in the organizations because of a lack of understanding of the core processes in product management.
4. The company context was the main factor affecting product management.

Continuing the analysis, three problems in product management were identified:

1. Lack of delegation from top management to product management. In all the studied organizations, the decisions about strategy and release planning were done in close collaboration with the top management. In fact, nobody in the company had the authority to make decisions about products except the top management. As a result, the product manager did not act as the product "*mini-CEO*," because he or she had no authority and tools for creating the right product mix, implementing right projects, and defining the winning strategy.
2. Lack of knowledge about product management. Product management was a topic of interest for all the studied companies, but they had little experience in the application of SPM. All the interviewees showed interest in the adoption of the existing best practices in product management, and especially to training.
3. Mixing of product and project management. Lack of knowledge about product management leads to a mix of product and project management. Only one of eight interviewees mentioned that these two types of management should not be mixed. Moreover, mixing could be dangerous,

> because managing software products after managing a software project requires "changes in your mind and priorities" (Sales Manager). In the situation of the lack of the role of a product manager, the tasks are distributed between top managers and project managers.

Overall, the preliminary study showed that the companies understood the necessity to have product management specialists, who are separated from project and top management and have authority and tools to make decisions related to the developed product. At the same time, introduction of the new role would face difficulties due to the organizational structure of the organization. In addition, the benefits of product management to product development seemed fuzzy for some organizations, due to a lack of systematic knowledge and education.

4.2.3. Relation to the whole

When the previous study was based on existing studies in the field of SPM, in this preliminary study we studied the adoption of SPM activities in companies. As a result, a preliminary model of SPM in the organizations was developed (Figure 9), which allowed us to plan further studies. Overall, this preliminary model may be seen as a research framework for designing the following studies. The central category, *company context*, drew our attention to the problem of how the company background and characteristics like size, business domain, and type of software product affect software product management in companies. Based on these ideas, a study on the differences and similarities in the adoption of SPM activities in SMEs and large enterprises was developed (*Publication III*). The various activities held by the product managers in the studied organizations resulted in designing a study on software product managers' roles (*Publication VI*). Based on the preliminary and mapping studies it became obvious that the role of the product manager had not been clearly defined. Moreover, the activities of product managers in companies may vary a lot depending on the organizational structure, but they may have the same job title named product manager. Finally, *focus activities* and *related activities* showed us that in practice product managers were responsible for a limited set of activities described in the frameworks. Therefore, the idea that some activities are more important in SPM than others resulted in designing a survey for identification of the core and supporting activities of SPM (*Publication V*).

4.3. Publication III: Comparison of software product management practices in SMEs and large enterprises

4.3.1. Research objectives

Christensen & Overdorf (2000) discuss that changes in business models, values, and especially culture are difficult or even impossible for large established companies. In contrast, smaller organizations are more flexible and their organizational structure can be tailored to achieve an advantage over larger organizations. In general, organizational practices in enterprises of different sizes differ. For example, various studies (Blili & Raymond 1993; Karlsson & Olsson 1998; Edward 2002; Moore & Manring 2009) report on differences in business activities between small- and medium-sized enterprises (SMEs) and large enterprises (LEs). However, the existing software product management frameworks (van de Weerd et al. 2006b; Ebert 2007; Kittlaus & Clough 2009; Pragmatic Marketing 2010a) do not make a difference in the adoption of product management practices in SMEs and LEs. Moreover, these frameworks have been developed on the basis of investigations of practices mainly in large enterprises. In this study, the specific objective was to identify the differences in the adoption of software product management practices in SMEs and LEs. The difficulties that product managers and organizations face in their day-to-day activities were analyzed to identify SPM activities specific for SMEs and LEs.

4.3.2. Results

In the study of comparison of software product management practices in SMEs and LEs, four super categories (*size-independent activities*, *size-dependent activities*, *LE-specific activities*, *SME-specific activities*) with SPM activities as subcategories were identified (Figure 10).

Size-independent activities were done similarly in all companies regardless their size. SMEs and LEs were familiar with these activities and implemented them similarly, taking into account their own specific characteristics.

Size-dependent activities, such as *marketing*, *release planning*, *roadmapping*, *strategic* and *tactical planning* were found both in SMEs and LEs, but the content of these activities was different depending on the company size. For example, *marketing* in LEs consisted of global, local, and product marketing. In SMEs this kind of division was rarely observed, and their understanding of marketing resembled public relations (PR). In SMEs we also observed poor *strategic planning* in comparison with LEs. It was explained by these companies as a high level of uncertainty in the market environment. SMEs were market-driven and tried to adjust to the existing conditions. In contrast, LEs developed their strategic and tactical plans according to an internally defined vision and goal. External conditions did not play as important a role as for

SMEs because LEs had usually enough resources for ignoring transient fluctuations in the market. As a result, SMEs were more flexible than LEs, but LEs had an advantage of concentrating on *strategic planning*.

The six *activities specific for LEs* were identified as follows: *benefit analysis*, *customer orientation*, *formal decision making*, *product portfolio analysis*, *resource planning*, and *product support*. In comparison with SMEs that concentrated on development issues, LEs were different. The product managers in LEs were focused on *benefit analysis* and *customer orientation* with much less emphasis on *development*. They considered development as a black box with a specification as the input and the new version of the product as the output. In contrast with SMEs, which seemed to be more technically oriented, LEs practiced a customer-oriented approach with the focus on *benefit analysis*.

SME-specific activities such as *configuration management*, *market analysis*, and *product analysis* were typical for SMEs only. When talking about SPM activities, the product managers in SMEs concentrated on technical aspects of product development rather than on business aspects. Business-oriented activities, such as *market analysis* and *product analysis* were not considered as technical details of the product development. Although all the interviewees in SMEs mentioned *market analysis* as a part of SPM, this activity was sporadic and informal.

The described observations of the differences in software product management activities between SMEs and LEs can be summarized as three main findings:

1. LEs are customer-oriented while SMEs are technically oriented.
2. LEs have strong and powerful product managers while in SMEs the product managers have limited authority.
3. LEs rely on strategic planning while SMEs are tactically oriented.

Overall, LEs are more customer-oriented and pay more attention to strategic planning. SMEs are more technically oriented and they rely on tactical planning. Their plans depend on the external conditions and the situation in the market. In LEs the product managers are stronger and more powerful and may act as product "*mini-CEOs*." In comparison, their colleagues in SMEs do not have authority to make decisions. In SMEs most decisions are made by the top management while the product managers act as advisors and facilitators in solving problems arising between departments.

In the study, it was shown that SPM activities and goals are different for companies of different sizes. Therefore, they require different approaches in the adoption and tailoring of SPM activities. Product management cannot be implemented in the same

way in every company. There are specific characteristics, such as size in this case, which should be taken into account in the adoption of SPM.

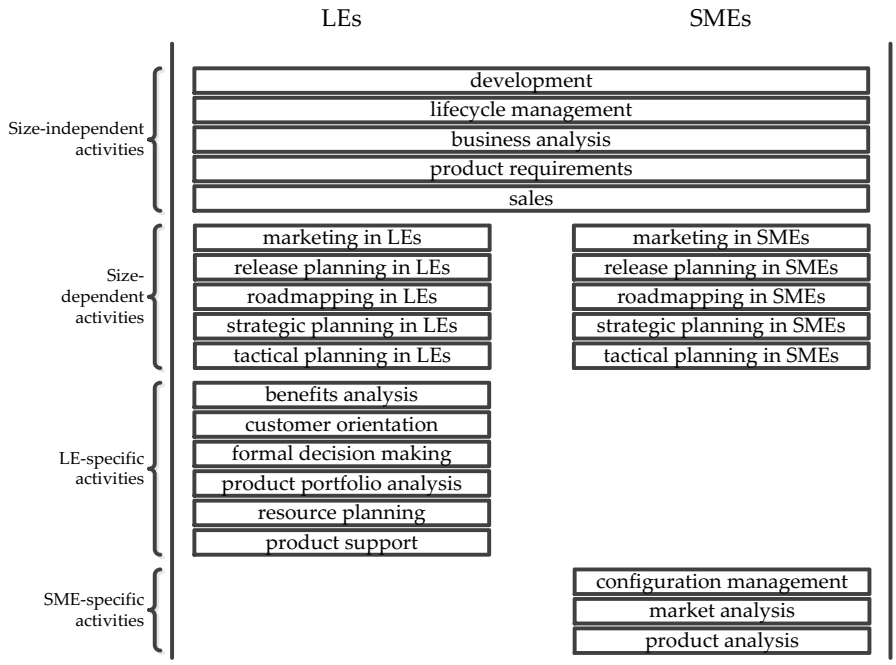

Figure 10. Central categories explaining the differences and similarities in the activities of SMEs and LEs (Publicatin III)

4.3.3. Relation to the whole

The focus of this study was on decomposition of the existing SPM activities to the two group of activities playing a more important role for SMEs and LEs, in comparison with existing studies focused on the synthesis of SPM activities in companies, (e.g. (van de Weerd et al. 2006b). The complexity of the SPM frameworks may be decreased by selecting a limited set of product management activities playing the most important role for an organization of particular size. The activities depend on the company size and they are different for SMEs and LEs. At the same time, there are activities which should be done in the same way regardless of the company size. This study also provides ideas on the evolution of SPM activities from SMEs to LEs, highlighting the differences in the roles and activities of product managers in the companies of different sizes.

4.4. Publication IV: Lean solutions to software product management problems

4.4.1. Research objectives

Software product management is a complex discipline, which helps in managing software products from inception to maintenance. Although it plays an important role in the development of winning products, each company adopts SPM activities in its own way, taking into account organizational constraints. Improvements in SPM suggest a long and thorny way consisting of adoption of many processes, tools, and components with results in a distant future. When observing thirteen software organizations that had already started the adoption of SPM activities, five common problems were identified. As the problems were analyzed, it was concluded that they can be solved or even avoided by implementation and adoption of lean principles to SPM.

Lean is a management philosophy focusing on creating more value by eliminating waste. The lean philosophy is based on five principles: *value*, *value stream*, *flow*, *pull*, and *perfection* (Womack & Jones 2003), which describe the central concepts of lean thinking for implementing a way to deliver products that satisfy customers with less and less resources. These principles have been developed on basis of the 14 original principles of the Toyota way (Liker 2003), and provide a straightforward mapping to continuous process improvement. The original principles have been adapted to software development (Poppendieck & Poppendieck 2009). However, software product management is not limited to development only, but covers disciplines such as product management, business development, marketing, sales, and support (Ebert 2007). Therefore, a broader view on lean is needed to adopt it for product management. Scrum-based agile product management (Pichler 2010) has also gained increasing interest in industry lately, and this study provides a complementary view on software product management from the point of view of lean principles to fill the gap in the present literature.

Initially, the focus of the study was on the identification of existing problems in software product management, but the analysis indicated that the problems were not company-specific. The analysis was continued with a root cause analysis using the Current Reality Tree (CRT) technique from the Theory of Constraints (TOC) (Goldratt & Cox 2004). In comparison with other root cause analysis tools, such as cause-and-effect diagrams (CEDs), CRTs makes it easier to follow "if-then" logic to identify the root cause problem precisely.

4.4.2. Results

The root cause analysis was supported by the CRT techniques that helped to identify the root problem and search the solution only for them instead of attempts to address all the existing problems. Moreover, the root problems were common for all organizations, while other problems varied from one organization to another. An example of the CRT for Problem 1 is presented in Figure 11 in which issues like loosely coupled departments, frequent requirement changes, and additional time for synchronicity are the underlying problems referring to a long release cycle.

The studied organizations were organized as separate departments that cannot be easily changed (Christensen & Overdorf 2000). Therefore, the first step was to organize collaboration between them in a more effective manner. The main source of waste in the current situation was the sequential nature of work in the units that led to constant switching between activities for each department. Moving from sequential implementation of activities to parallel would improve the situation in organizations. Sequential implementation may occasionally happen in a small organization where all the processes are chaotic and immature but it leads to short-cycle parallel activities of product analysis, development, marketing, and sales.

The adoption of lean practice at the enterprise level allows a smooth flow for each product, where all units work together. The main problem in this adoption is the necessity for synchronization between all the units, which can be solved by the product manager acting as a release planning specialist.

Overall, the problem analysis resulted in identification of five common problems that can be addressed with the lean principles as follows:

Problem 1: Long release cycle

Solution 1: Following the lean principle of *flow* at the enterprise level decreases the time-to-market

Problem 2: Product managers have no metrics for evaluating their work

Solution 2: Following the lean principle of *value* requires identifying the key performance indicators (KPIs) for the product managers and their products.

Problem 3: Organizations think that they know what customers want and need. This makes collaboration with the customers difficult.

Solution 3: Following the lean principle of *pull* allows the company to develop a product satisfying their customers faster and with fewer resources.

Problem 4: Thinking in the short term instead of the long term

Solution 4: Following the lean principle of *perfection* is the first step in the adoption of long-term thinking.

Problem 5: In the adoption of software product management practices, companies try to change instantly.

Solution 5: Following the lean principle of *perfection* gives preference to *kaizen* instead of *kaikaku*.

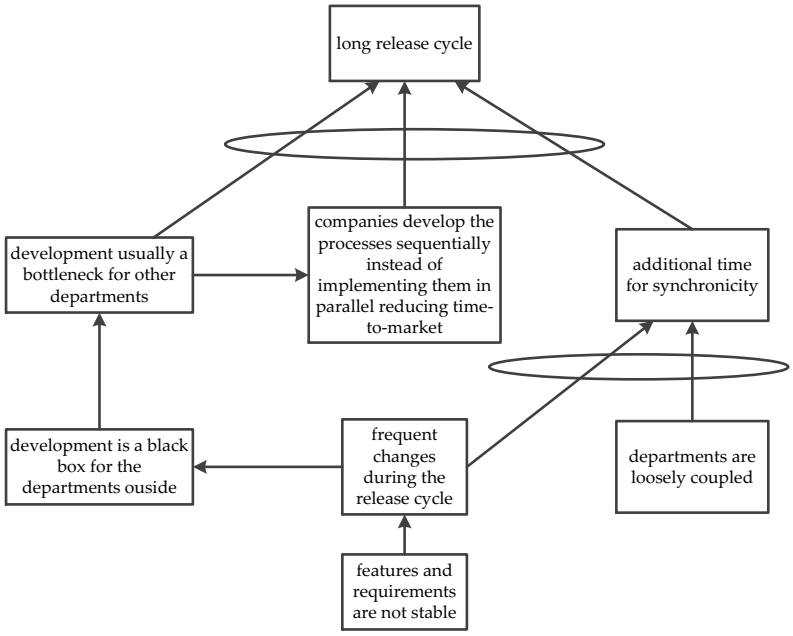

Figure 11. Current Reality Tree (CRT) for Problem 1 (the arrows indicate causality and the ellipses represent the logical AND operation between them) (Publication IV)

Using lightweight lean practices in SPM enables organizations to concentrate on the most important and easy-to-implement practices of product management with constant incremental improvements. Product management and lean have similar features, such as the central role of value and attention to customer needs, and thus the unification of these two approaches could benefit the software industry. If the organization already practices lean software development (Poppendieck & Poppendieck 2006), this approach may be extended in the broader context of SPM, including strategy, marketing, sales and support activities to achieve excellence in the marketplace.

4.4.3. Relation to the whole

An attempt to combine the lean and software product management practices showed that lean thinking may be easily adopted for solving problems existing in product management. Moreover, these problems are quite common regardless the company size, business domain, and type of product. Taking into account that the lean philosophy promotes the elimination of waste (Womack & Jones 2003), in other words makes the processes more efficient, and this philosophy fits well with SPM, the problems of the adoption of SPM may be solved, or even avoided, by combining both methods. This will have a positive impact on making SPM adoption more predictable and simpler by eliminating the waste and making the processes organized as a flow.

4.5. Publication V: What do practitioners mean when they talk about software product management?

4.5.1. Research objectives

Practitioners and researchers may mean very different things when they talk about product management. The lack of common definitions leads to misunderstandings between professionals. In practice, product managers may have various job titles while doing the same things and the same job title when doing very different things.

The inconsistency and fuzziness of product management has been discussed widely before (Gorchels 2000; Dver 2003; Maglyas, Nikula & Smolander 2011). For practitioners, the lack of common understanding of product management leads to difficulties in communication and collaboration, because their scope of work varies from one organization to another. It also has a negative impact on product management education because there may be a gap in the understanding of product management activities between the product manager and the provider of training. To fill this gap and to find inconsistencies in the understanding of product management between practitioners, a survey was designed. The research question was: "*What is product management from the practitioner's viewpoint?*" To answer this question, the survey was published in a public LinkedIn group for product management professionals, allowing them to answer this question freely but briefly. In a period of nine months, 201 responses were received from 179 unique respondents worldwide.

The respondents were not limited by providing any predetermined options, because the problem was approached in an inductive fashion to keep the meanings as open as possible. Moreover, the answers in the survey were open for the respondents, so they could read and see the answers of previous respondents. Sometimes this provoked discussions between two or three respondents, which illustrated the differences in understanding the product management discipline.

4.5.2. Results

The answers were analyzed qualitatively using the Grounded Theory (Strauss & Corbin 2008). In this study, 106 codes were identified during open coding. At axial coding the codes were distilled into 39 categories with established relationships.

We considered *Product management* as the core category from the beginning, but during the analysis we observed that the respondents switched easily from talking about the product management discipline to the product manager's role. Therefore, the categories of *Product manager* and *Product management* are to some extent interchangeable.

In total, we identified 14 activities related to product management from the practitioners' point of view (Figure 12). Six of these activities were discussed more often and in more detail than the others. A majority of the answers were related to the discussion of *product analysis*, which consisted of the *identification of unstated customer needs*, *understanding competitive offerings*, and *identification of customer needs and wishes*. The participants also discussed actively issues related to *roadmapping*, and especially to *aligning problems with business goals*. *Product analysis* and *roadmapping* were tightly coupled with *strategic management* and *vision*, which have also been considered as core activities in product management. Day-to-day routines in product management consisted of mainly *product lifecycle management* and *internal and external collaboration*. Depending on the industry and the managed product, product management may include *release planning*, *risk management*, *customer support*, and *resource management*. There were also other activities, but in comparison with the six activities mentioned above, these activities varied a lot from one answer to another.

Ten respondents were not comfortable with the term *product management*, and replaced it with the terms *business management, solution management,* and *general management.* However, the respondents could not explain the meaning of these terms properly either. *Product management* was also associated with the *marketing mix* (Borden 1965) or *product marketing*, when the understanding of product management was limited to *promotion, place, product,* and *price.* Activities like *resource management, risk management,* and *portfolio management* were more rarely mentioned as related to product management.

There were also attempts to explain the meaning of product management by using the product manager's role. The absolutely dominating viewpoint was that the product manager is the product *"mini-CEO"* (the category was identified 24 times), also referred to as the product champion. The main problem with these responses was that after attaching the label *"mini-CEO"* to the product manager, there were no explanations to what the *"mini-CEO"* should do. All the comments were quite similar and limited to the viewpoint that *"he does everything the product needs to be successful."*

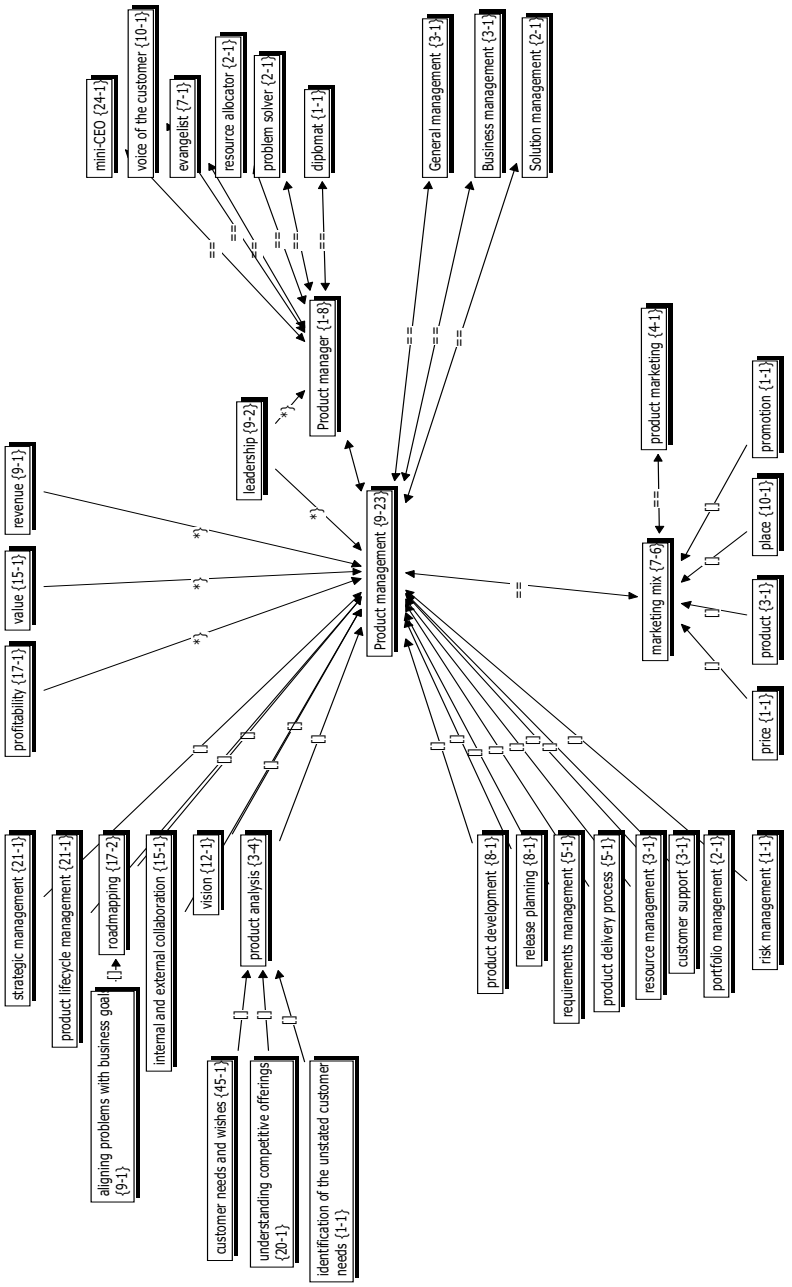

Figure 12. Relationships between the categories: [] – is part of, *} – is property of, == - is associated with; the number in brackets {} near the categories presents the frequency of the category and the number of connections (Publication V)

It was also noted that the product manager is the *voice of the customer,* who represents the customer in internal discussions. Other roles like *evangelist, resource allocator, problem solver,* and *diplomat* were mentioned a few times.

The identified six core product management activities (*product analysis, roadmapping, strategic management, vision, product lifecycle management*, and *internal and external collaboration*) were of interest to almost all product managers and provide important ingredients for evolving product management frameworks. Of the current SPM frameworks, all these core product management activities have been identified only in the Software Product Management Framework (Kittlaus & Clough 2009).

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4.5.3. Relation to the whole

The study resulted in the identification of six core product management activities and a list of supporting activities. This is an important result for overcoming the complexity of software product management, because six core activities instead of

nearly forty is a big step forward in the evolution of SPM. A limited set of activities is especially important for companies that have just started the adoption of SPM activities. It should make its adoption less complicated by decreasing the number of changes in the beginning. In addition, the identified core activities form the necessary skill sets to become a product manager. The results have an impact on the common understanding of the product manager's role for included responsibilities and recruitment requirements. It is reasonable to expect that every product manager is familiar with the core product management activities, while the other skills may vary depending on the organization and the product. Therefore, the study also has an impact on clarifying the role of the product manager.

4.6. Publication VI: What are the roles of software product managers? An empirical investigation

4.6.1. Research objectives

The existing software product management frameworks describe many activities in which a product manager is involved, including strategy and vision definition, roadmap planning, release planning, pricing, product development and others (van de Weerd et al. 2006b; Ebert 2007; Kittlaus & Clough 2009). The number of activities orchestrated by the product manager makes his or her role unclear. Moreover, due to the high number of activities, one person is not able to do them all. This leads to a situation where responsibilities are shared in the organization, and the role of a particular product manager becomes difficult to track and understand. In this regard, the product manager's role is comparable with the role of the Chief Information Officer (CIO), which has been studied earlier (Grover et al. 1993; Gottschalk 2002; Chun & Mooney 2009). A CIO is an executive-level director who focuses on the organization's strategy and processes and acts as a technical manager minimizing the costs of the existing infrastructure (Chun & Mooney 2009). The product manager unites the technical and business perspectives on the managed product as well. Therefore, these two roles are similar in their responsibilities but differ from the management point of view: the CIO works at the corporate level while the product manager works at the product level. The CIO also plays an important role in cultivating a mutual understanding with the Chief Executive Officer (CEO) of information systems and IT infrastructure in the organization. In this regard, the role of the product manager is similar to that of the CIO, but the product manager is responsible for developing a product strategy in agreement with the top management (Johnson & Lederer 2010).

The goal of the study was to identify and classify the most typical roles of product managers in organizations. The research question was formulated as follows: *""Which common roles do software product managers fulfil in organizations?"*

4.6.2. Research results

The result of this study is a framework that allows researchers and practitioners to evaluate the responsibilities of product managers (Figure 13). The framework evaluates a product manager against four empirically identified dimensions: *influence on the product (IP), authority (A), access to resources (AR)*, and *influence on communication (IC)*. The dimensions and their properties are based on a conducted Grounded Theory analysis where these four super categories were considered as the dimensions for the framework. On the basis of the properties, a three-level scale for each category was defined, as presented in Table 10.

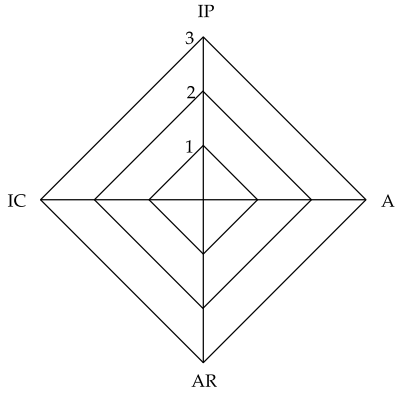

Figure 13. Assessment framework (IP = Influence on the Product, A = Authority, AR = Access to Resources, IC = Impact on Communication) (Publication VI)

Table 10. Description of the framework dimensions (Publication VI)

Super category (SC) with properties (P)	Scale		
	Low (1)	**Medium (2)**	**High (3)**
SC1: Influence on the product (IP): - **P1.1: orchestration of development** - **P1.2: definition of tactical actions** - **P1.3: participation in strategy**	Product manager develops strategy and roadmaps but it is considered as advice only.	Product manager develops and implements product strategy and roadmaps, which should be discussed with the top management. Product manager has an impact on the changes in strategy,	Product manager develops and implements product strategy and roadmaps. Product manager is fully responsible for strategic and tactical actions.

planning - **P1.4: creation of roadmaps**		roadmaps, and tactical actions.	
SC2: Authority (A): - **P2.1: power of making decisions** - **P2.2: product leadership**	Product manager is an adviser for other departments, he can make only minor tactical decisions.	Product manager agrees decisions with the top management and needs its support in orchestration of other departments.	Product manager is responsible for both strategic and tactical decisions in the frame of the developed product and only strategic actions require approval from the top management.
SC3: Access to resources (AR): - **P3.1: own product budget** - **P3.2: possibility to hire people** - **P3.3: information resources**	Product manager has no access to resources; all resources are provided by the top management.	Product manager has access to one or two resources only, e.g. he is fully responsible for the product budget.	Product manager has all the resources needed for product development, including product budget and possibility to hire new people.
SC4: Influence on collaboration (IC): - **P4.1: level of communication** - **P4.2: ability to resolve problems between departments**	Product manager works in isolation from other departments responsible for the product release and does not resolve problems arising between departments.	Product manager communicates with a few other departments and needs a support from the top management to solve the problems arising between departments.	Product manager orchestrates all the people responsible for the product and solves all the problems arising between departments.

Product managers of 13 organizations were evaluated against the developed framework, which resulted in the identification of four stereotypical profiles (Figure 14).

The first profile, named *Expert*, has low levels of properties in all dimensions. The *Expert* is a person who has deep expertise in any area of business or development, but has little responsibility over product management activities. Good examples of this profile are junior product managers who come from specific fields such as engineering, marketing, or sales. Sometimes *Experts* represent the engineering side of product development, and other activities are built around these experts. The *Experts* hold a position in which the success of the product depends on their expertise and on understanding which features should be implemented. They act as product leaders even if they participate only in the implementation, avoiding other areas of

responsibilities such as product analysis, requirements elicitation, roadmapping, and strategy definition specific for the role of the product manager.

The second profile, named *Strategist* describes a product manager who actively participates in strategic and tactical planning of the product development and has enough power and authority to bring real impact to the strategy. This means that the roadmap and vision suggested by him or her are usually accepted by the higher management with minor changes. A *Strategist* can be responsible for the product strategy as well as the marketing strategy. As the company grows, marketing is separated into another department. Then, a hierarchy in the product management department may appear along with the role of a vice president of product management. The organizational changes may be associated with an increased role of the product management department to product strategy and its implementation. The influence of the top management on the product may decrease because it is delegated to the product management.

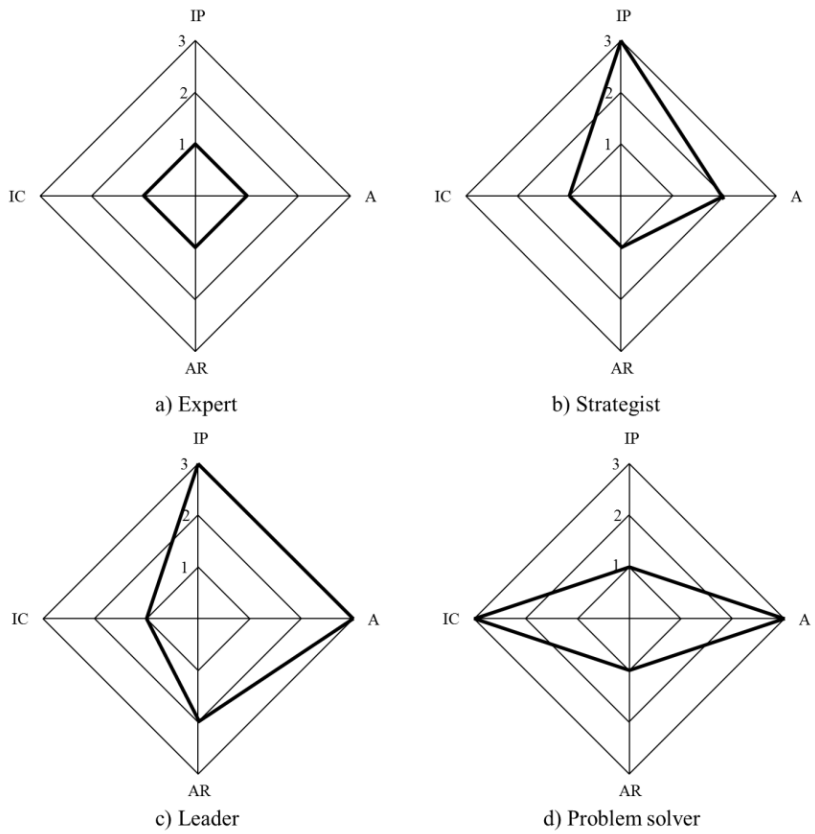

Figure 14. Empirically identified profiles (IP = Influence on the Product, A = Authority, AR = Access to Resources, IC = Impact on Communication) (Publication VI)

The third profile, named *Leader* can be characterized with a medium level of access to resources and with a high level of authority and influence on the product. The *Leader* profile is the next step in the evolution of the *Strategist.* When a strategist shows his or her influence on the success of the product by providing a strategic vision to the existing situation, his or her authority grows and he or she gains access to resources from the higher management. As a result, he or she becomes the leader of the product but is still controlled by the top management. This is a step towards becoming the product "mini-CEO."

The fourth observed profile we named the *Problem solver*. In general, the influence of this role to actual product management and development can be quite limited. A product manager of the *Problem solver* type is a negotiator between many people who represent marketing, development, sales, support, and higher management. The problem solver acts as a manager who solves arising product-related issues while the top management does the product strategy and roadmapping. The main thing here is that the *Problem solver* has good communication skills and authority in problem areas, which leads to an ability to build effective collaboration between the product stakeholders.

Overall, the developed framework provides an instrument for the assessment and profiling of product managers. It allows product managers and top management to understand the responsibilities held by product managers. It helps to avoid a situation where the top management and the product manager have different understanding and expectations about the responsibilities of the product manager. In addition to the identified four profiles, five other profiles were predicted, but they were not observed in practice. Altogether, these profiles fill gap by providing descriptions of variations in the product manager's responsibilities. The framework is useful for companies with a separate product management department because it shows how the roles can be separated within the department between product managers, so that each of them has clear responsibilities for their own part of product management. This study provides practitioners and researchers with an understanding that product manager is not limited to a product "mini-CEO" but he or she may as well act as *Expert*, *Strategist*, *Leader*, or *Problem Solver*. It resolves a problem when "being labeled or treated as a product CEO can be a daunting situation, since it nearly always means operating without the authority and resources available to a corporate CEO" (Steinhardt, 2010).

4.6.3. Relation to the whole

The study focused on providing an empirical insight into the role of product managers in software business. Overall, the study was intended to clarify the role of the software product manager and explain why their responsibilities vary from one organization to another. The four developed profiles meet this target by providing

descriptions of variations in the responsibilities. The framework shows how the roles can be separated within the product management department, so that every product manager is responsible for their own part in product management. Earlier research described the product manager as a "*mini-CEO*" (Dver 2003) but in this study four additional roles were revealed, representing a more complicated picture. These roles are the ones of an *Expert*, *Strategist*, *Leader*, and *Problem Solver*. Altogether they explain the variations in the roles of product managers and why a product manager cannot always be a product "*mini-CEO*."

4.7. About the joint publications

All the publications included in this thesis were written and performed by the same team of researchers consisting of the present author and the supervisors of the thesis, Professor Kari Smolander and Associate Professor Uolevi Nikula. The studies were designed by the present author under supervision and in close collaboration with the supervisors. The author was also responsible for conducting the interviews, analyzing the data, and preparing the first draft of the publications. However, at each phase of the research process, the actions were carefully evaluated and directed to the right course whenever necessary. In addition, the research was supported by lengthy discussions with the experienced supervisors related to the research topic, procedures and methods of analysis, research methodologies, and the results.

For *Publication I,* the author designed a systematic mapping study, collected and analyzed the publications and wrote the major parts of the publication.

For *Publication II, III, IV, VI,* the present author was responsible for the studies design, implementation of the data collection procedures, the main data analyzes, and writing the publications.

For *Publication V,* the data collection was initiated by Muhammad Waqas Akram, who started the discussion in a public LinkedIn group but the present author suggested an idea to use the data for analyzing what practitioners mean when they talk about product management, analyzed the collected data, and wrote the publication.

5. Implications and limitations of the thesis

This chapter summarizes the implications of the thesis results both for research and practice and discusses the limitations of the thesis. In general, the implications are extracted from the publications and presented as a short summary. The goal of this thesis was to overcome the complexity of software product management, which would help companies to adopt SPM activities easier. In this regard, this thesis has practical orientation. However, it has implication to SPM research as well, e.g. the developed frameworks for software product manager's roles and the differences in the adoption of SPM activities in SMEs and large enterprises. In addition, this thesis should also have an impact on product management education and the way it should be organized to meet the expectations of product management professionals. Overall, this thesis contributes to the product management body of knowledge by investigating such fundamental basis of product management as its definitions, core activities, roles, and issues in the adoption of SPM.

5.1. Implications for further research

The results of this thesis suggest that further research on software product management in general and software product management components and roles in particular is necessary for the evolution of the discipline. However, the current research trend in SPM research is based on a synthesis of the existing software product management practices and roles in all companies, regardless of their specific features. The approach *one fits all* may be dangerous for companies, because it makes the adoption of SPM difficult and unnecessarily complicated. In this thesis, the results were obtained using the Grounded Theory as the research method, which was complemented by other research techniques. The Grounded Theory allowed

conducting the study iteratively, and developing and testing the hypotheses during the whole study. Overall, the thesis implicates that further studies should concentrate on the identification of the essential characteristics important for the adoption of SPM activities, rather on unification and uniting all the existing approaches into one unified framework.

First, the framework describing the differences in the adoption of SPM activities in SMEs and large enterprises shows that in addition to synthesis of data gathered from different sources, there is a need for decomposition of the practices into several groups depending of various characteristics, e.g. the company size. In addition, this study provides an overview of the evolution of product management and gives insights into how it may evolve from simple processes consisting of only a few activities in small companies to complicated product management processes in large enterprises. The framework, comprising four groups of software product management activities which are important for SMEs and large enterprises, divides the product management activities according to company size. This framework represents an empirical attempt to show that a synthesis of software product management practices of all companies is not always beneficial for developing software product management as a discipline. Companies are different and their specific characteristics should be taken into account before starting the adoption of SPM.

Second, the study on software product managers' roles suggests a new framework for assessing and evaluating the tasks of software product managers. The framework decomposes the only product manager role described in the product management literature as a "*mini-CEO*" into four typical product manager profiles. It extends our understanding of the product manager as a "*mini-CEO*" only to containing the roles of an *expert*, *strategist*, *leader*, or *problem solver.* The developed framework shows that unification of the responsibilities of the product manager under one "*mini-CEO*" role only makes this role unclear. Therefore, instead of assigning all the responsibilities to one role, decomposition of this role into several partially overlapping roles may be a solution for organizing the product management department more efficiently. The framework also limits the number of activities in which the product manager is involved, which should have a positive impact on understanding the role. It reduces the product manager's responsibilities from everything related to the product and its management to a limited set of activities which the product manager is responsible for. In this regard, this study reveals that the picture of the role of the product manager is more complicated than earlier research describes (Dver 2003; Ebert 2007), and extends the "*mini-CEO*" role to four additional roles, which may evolve within the company. The framework also represents the career path of the product manager in the organization. It supports the idea first presented in the study of comparison of SPM activities in SMEs and large enterprises that SPM evolves with the company.

Third, the existing product management frameworks, (e.g. (van de Weerd et al. 2006b; Pragmatic Marketing 2010a) have become too complicated for adoption in organizations because they do not make any difference between the activities and consider them as equally important. The approach of decomposition described above may be applied here as well. In this case, the decomposition consists of the identification of the core and supporting product management activities, as was done in our qualitative survey (*Publication V).* This survey has an implication for evolving software product management frameworks because the identified six product management core activities are of interest to almost all product managers. Currently, only the framework developed by ISPMA (2012) and its predecessor the Software Product Management Framework (Kittlaus & Clough 2009) separate the core product management activities from other activities.

Overall, the major implications of this thesis for further research on software product management can be summarized as follows:

- The SPM research should concentrate on the essential characteristics of companies, e.g. size, which are important in the adoption of SPM and make its adoption more valuable. The framework defining the differences in the adoption of SPM activities in SMEs and large enterprises is a proof-of-concept that these differences exist and they have an impact on how SPM should be adopted. However, further identification of other characteristics is required.
- The further research on product managers' roles should not be limited to the "*mini-CEO*" role that is rarely observed in practice. The role of the product manager is broad but the responsibilities can be narrowed to four profiles: those of an *expert, strategists, leader,* and *problem solver.*
- The evolution of SPM frameworks should take into account that product management activities are not equally important. However, there are several SPM activities that are necessary for any company deciding to adopt SPM. These activities are called core activities and they are independent of the product, company, and business domain. Other activities, called supporting activities, vary from one product, company, and business domain to another.

5.2. Implications for practice

The first phase of the thesis investigated the existing problems in the field of software product management, such as the necessity to have a product manager as a separate role in the company. The software product management activities adopted by companies varied from one company to another. In addition, the existing software product management practices, tools, and frameworks are often too complicated for adoption in companies (Haines 2008; Steinhardt 2010). These frameworks represent a synthesis of SPM experience in the studied companies (van de Weerd et al. 2006b;

Bekkers et al. 2008). This synthesis leads to the situation where the abstraction level of the frameworks increases and their applicability for a particular company is difficult due to the generalizations made for incorporating the experience of many companies into one framework or SPM model.

Firstly, we divided the companies into SMEs and large enterprises (LEs) and studied their SPM activities separately (*Publication III*). This division resulted in the finding that only a few SPM activities should be done similarly in both SMEs and LEs, while most of the activities should be approached differently, depending on the company size. For practitioners, this means that the adoption of SPM activities in a particular case should start from choosing the activities playing the most important role for the company of its size. In contrast, the adoption of activities specific mainly for large enterprises may result in a waste of limited resources without significant results in the management of software products. For example, there is no need to support every decision with careful research analysis in SMEs because their organizational structure allows the managers to proceed intuitively (Christensen & Overdorf 2000). In this regard, the efforts for building a strong hierarchy between product management, marketing, and development departments may be considered as a waste of resources for SMEs (Publication III). SMEs should start looking at software product management as a tool for increasing their technical excellence, starting SPM adoption from more technically-oriented disciplines, such as configuration management and product analysis. In contrast, large enterprises have usually more resources than SMEs and less dependence on the external conditions and turbulent situations in the market. Therefore, LEs may concentrate on strategic activities which should support their business for a long period of time. In this regard, LEs are more interested in the adoption of all practices described in the SPM frameworks with focus on a formal hierarchical relationship between departments.

Secondly, so complicated process as the adoption of SPM rarely goes smoothly and without any problems. Most of these problems are not company-specific, and five of them are repeatedly observed in practice. The decomposition of these problems and the identification of their root causes showed that they may be solved or even avoided by the adoption of lean principles at the enterprise level. Today, the lean principles, also known as *Kanban*, are widely used for the management of the software development process (Poppendieck & Poppendieck 2009). Therefore, the adoption of the same principles at a wider scope and at the enterprise level should not be a disruptive change for the company. Unification of SPM activities with lightweight lean principles enables the company to concentrate on the most important and easy-to-implement practices of product management with constant incremental improvements. The extension of lean principles to strategy, marketing, sales, and support activities will support the company on eliminating waste and concentrating on achieving excellence in the market.

Thirdly, considering a product manager as a product "*mini-CEO*" does not represent what he or she really does. For example, the size of the product management department may be up to several tens of people. Thinking that they all may act as product "*mini-CEOs*" looks like an unfeasible situation. The identified four stereotypical product manager roles represent the roles which may be held by a typical product manager in the company, depending on his or her experience and responsibilities. This shift in thinking about product managers, not as *mini-CEOs* but as *Experts, Strategists, Leaders,* and *Problem Solvers* should help to organize the product management department more efficiently by sharing the responsibilities. In addition, it allows product managers to understand their scope of work and avoid a situation where the top management and the product manager have different understanding and expectations about the responsibilities of the product manager. It was also shown that the role of the product manager is dynamic rather than static, and it depends on the company. It also has a positive impact on the procedure of hiring a product manager and assigning the responsibilities, limiting a wide scope of software product management to a limited set of activities for a particular product manager.

Fourthly, at the final stage of the research process, we tried to overcome the complexity of the existing product management frameworks by empirical investigation of the core and supporting product management activities. This part of the thesis was done in close collaboration with product management practitioners worldwide and it was done primarily to meet their needs. The identified six core product management activities should be of interest to almost all product managers, regardless of the product and the business domain. Therefore, they can have a positive impact on product management education and the way it should be organized to meet the expectations of product management professionals. Consequently, these activities create a necessary skill set required of a product manager, and therefore the results have an impact on the common understanding of product managers' recruitment requirements. It is reasonable to expect that every product manager is familiar with the core product management activities, while the other skills may vary depending on the background, business domain, and product type.

Overall, the major implications of the results for practice can be summarized as follows:

- The company size is an essential characteristic having an impact on which SPM activities should be adopted, e.g. SMEs should concentrate on their technical excellence and tactical planning, while LEs should be more customer-oriented and think strategically.
- Regardless of the company size, companies have common problems in the adoption of SPM. Five problems were identified in the study. They can be

addressed by the adoption of lean principles at the enterprise level together with the adoption of SPM.

- The four identified roles of a product manager represent how the responsibilities can be shared among the product managers in the product management department. In addition, these profiles give guidelines for hiring new product managers, assigning them a set of responsibilities, and controlling the execution of their tasks.
- The six core product management activities represent a necessary set of product management activities for any company deciding to adopt SPM. These activities also define a necessary skill set to become a product manager.
- The results of the study have a practical impact on product management education, its content, and structure as well.

5.3. Threats to validity and limitations of the thesis

Each study has limitations and boundaries in its applicability, and this thesis is not an exception. The use of the same data set collected during the second phase to create two different frameworks may be criticized. Nevertheless, these frameworks represent very different viewpoints to software product management, and therefore the results could not be unified into one framework only. In addition, this dataset has a territorial bias, because all the interviews were conducted in Russia, mainly in St Petersburg and Moscow, but the companies were international companies, six of them with headquarters situated in the USA and Europe. Snowballing was an additional risk for the external validity because it may be not indicative of the actual and different viewpoints. There is a risk that snowballing produces inaccurate results because the data could be collected within a small sample of population sharing the same subjective viewpoints to the studied phenomenon (Lee, Liebenau & DeGross 1997; Denzin & Lincoln 2005). However, in this thesis only three of the seventeen interviewees were referrals from the previous one. In addition to snowballing, the other interviewees were selected using other methods.

The interpretive nature of the thesis is a source of a researcher's bias to the findings (Klein & Myers 1999). This bias is common for all qualitative studies, but we addressed this problem by using triangulation of various sources of data, such as interviews and supporting documentation, as well as by using different mixes of research methodologies, e.g. data analysis using the Grounded Theory with elements of the Theory of Constraints (Goldratt & Cox 2004) and a qualitative survey with the Grounded Theory approach as the tool for analyzing the responses.

In Phase 1 of the thesis, only one person in four organizations was interviewed and the interviewees were not product managers. It might be considered as another limitation but it was done deliberately because at this stage of the thesis the goal was

to investigate how people outside the product management understand this discipline. The interviewees were selected randomly and from different companies rather than from one companies in order to get a broader viewpoint to product management. This random selection allowed getting different viewpoints among companies representing various domains and software products. In Phase 2, this practice was continued because the goal of the thesis was to study software product management activities in the software domain rather than getting into the details of SPM activities in one organization only. The study on lean solutions to product management problems represents a detailed analysis of the common problems in adoption of product management. However, the proposed solutions are theorized based on the comparison of the identified problems with how these problems have been addressed in other domains. Therefore, the solutions to the existing product management problems require additional empirical evidence and should be studied more in the future.

In Phase 3, the qualitative survey has also several limitations and threats to validity. First of all, the LinkedIn group was public and each respondent saw the previous answers, which may be a source of respondent bias. The respondents' personal data, such as job title, domain, and country were collected from the public profiles of the respondents. Sometimes it was challenging to identify the company and position of the respondent from their publicly available profiles. This is a potential bias but we accepted it because getting full personal information was possible only through a direct contact with the respondents that would took too much time for a practical implementation. The open-ended survey question allowed us to avoid a predefined set of answers, but it may have been a source of a researcher bias due to the coding step. This effect was reduced by extracting the explicit categories from the answers without own interpretations.

Overall, the thesis is exploratory and the main question in evaluating its validity is to what extent can the practitioners' use the presented results? Companies from different domains and of various organization sizes were studied and similar problems were observed in all the companies. This made it possible for me to think that the solutions and the presented framework in Paper 4 would be beneficial to all of them. Peter Seddon & Rens Scheepers (2012) state that "if the forces within an organization that drove observed behavior are likely to exist in other organizations, it is likely that those other organizations, too, will exhibit similar behavior."

Strauss and Corbin (2008) state that with the Grounded Theory, the researcher creates a theory which is dynamic rather than static. In this regard, the developed frameworks would have possibly been improved by adding more cases. We stopped the data collection for two main reasons. Firstly, the categories emerging from the data saturated after fourteen interviews, but we conducted three more interviews to

have additional evidence that our categories are saturated. In the case of the qualitative survey, we also stopped the data collection when the categories had started to saturate. In the case of the survey the saturation was more obvious, because the respondents started referring to the previous answers, or, sometimes, just quote the answers of previous respondents. Secondly, there is always a practical limit when the data collection phase should be stopped and the results published.

The Grounded Theory tends to produce credible results, because the theory development is based on the method of constant comparison, in which categories and concepts repeatedly emerge and guide the continuous research (Glaser & Strauss 1967). The generalizability of the Grounded Theory is based on the increasing level of abstraction from open coding to axial coding, and then to selective coding. The more abstract the concepts manipulated, the wider the scope of the developed theory. In this study, we have discussed the generalizability from empirical statements to theory, or, in other words, type ET (from Empirical to Theoretical statements) of generalizability according to the classification of (Lee & Baskerville 2003). They say that this type of reasoning can be generalized with two methods: (1) generalizability of observations to theory and (2) generalizability of the theory beyond the sample or domain used for creating the theory (Lee & Baskerville 2003). Due to a limited set of studied companies, the question about the generalizability of the results stays open and may provoke discussion. However, the goal of this thesis was not to provide a software product management theory suitable for any company worldwide, but to show how to overcome the complexity of software product management. The developed frameworks identifying product managers' roles, core and supporting product management activities, SPM problems and solutions represent essential characteristics that should be taken into account in the adoption of SPM.

6. Conclusions

The complexity of software product management can be reduced or even overcome using the principles similar to other complex problems. We can interpret the conclusions of this thesis through the principle of *divide and conquer* (Chu, Strand & Fjelland 2003). Instead of creating complicated frameworks that could be used by any company regardless of its size and internal structure, the SPM activities were seen from different viewpoints that had impacts on SPM practices. This division included the focus on different SPM activities for SMEs and large enterprises (*Publication III)*, the focus on the core and supporting activities (*Publication V*), and the focus on the internal structure of a product management department and roles hold by product managers (*Publication VI*). Another principle that we can use as a lens is that *iteration reduces complexity.* This principle was particularly addressed in the study of the application of lean principles to software product management, which proposed constant iterations as suggested by the lean philosophy (*Publication IV*). The other publications also support the idea of evolution in the adoption of product management, as exemplified by how growing from medium-sized enterprise to large enterprise also requires shifting in the focus on SPM activities (*Publication III*). Overall, overcoming the complexity of product management is a common challenge and the principles developed for other domains than software can be applied to SPM as well. The main problem is often not that there are no solutions but that changes in business models, values, and especially culture, are very difficult for established companies (Christensen & Overdorf 2000).

6.1. Summary and contribution

This thesis proposes that the adoption of SPM activities may be simplified by decomposing the existing practices into several parts suitable for different companies. The criteria for decomposition can be different, e.g. size. In this thesis it was shown that only a few activities can be done similarly in SMEs and large enterprises. In addition, this thesis extends our understanding of the product manager as a "*mini-CEO*" to several other roles, which also play an essential function in creating the winning product in the competitive market. The developed frameworks represent the first steps for overcoming the complexity of software product management practices. Each of the three phases of the thesis described sequentially the problems and possible solutions faced by organizations in day-to-day activities of adoption and practice of SPM. The first phase studied SPM as a discipline, and it was identified and empirically confirmed that SPM itself and the related activities are not consistently defined. Moreover, company representatives may mean very different things when they talk about management of their products. During this first exploratory phase it became obvious that SPM requires more research with a goal to simplify SPM and make its adoption easier and more transparent. The second phase contributed to the SPM body of knowledge and practice through the development of two frameworks and description of the existing SPM problems and their solutions, by adopting lean practices for SPM at the enterprise level. The last, third, phase aimed to clarify the SPM activities by separating them into core and supporting activities. In the following, a short summary of the phases is given, together with the results achieved at each phase.

The first phase consisted of two studies including both research and practitioner overview to the field of SPM. As a result, two publications (*Publication I* and *Publication II*) summarized the existing state-of-research and state-of-practice in SPM. The systematic mapping study showed that the number of papers on SPM limited in number had started to increase from 2006 onwards. However, only 25 papers concerning this topic were identified in 2010. At the same time, representatives of companies showed an interest in adopting SPM activities in their companies due to the importance of this discipline for the business (Dver 2003; Haines 2008; Steinhardt 2010). This preliminary study allowed us to develop the research framework we used in the following studies. Already at this stage, it was identified that companies face difficulties in the adoption of SPM due to its complexity, the fuzzy role of the software product manager, and activities which should be adopted. Moreover, at this preliminary study we already selected the *company context* as the central category that has an impact on how the company implements and adopts SPM.

The second phase included in-depth studies of the problems, roles, and activities related to SPM in companies of different types. The company size was identified as an essential characteristic having a critical impact on how the company should adopt

SPM. Although activities like *development*, *lifecycle management*, and *business analysis* are independent of the company size, other activities, like *market* and *product analysis*, *resource planning*, and *portfolio management* are specific for SMEs or LEs only. Moreover, there is a group of activities, including activities like *marketing*, *release planning*, *roadmapping*, *strategic* and *tactical planning*, which evolve together with the company growth. Therefore, SPM should be adopted differently, taking into account the company size. In addition, this framework proposes an approach to SPM studies where SPM activities are not synthesized from the studied companies but decomposed according to the identified essential characteristic of the company.

The second framework extends our understanding of the role of a software product manager from a "*mini-CEO*" only to a *strategist*, *leader*, *expert*, and *problem solver*. In the literature the product manager has often been described as the "*mini-CEO*" (Dver 2003; Haines 2008), but this has been rarely observed in practice. Companies have faced difficulties in assigning and controlling the product manager's responsibilities, and this has made the role fuzzy (Haines 2008; Steinhardt 2010). The developed framework proposes a tool for assessing and evaluating product managers along four dimensions. According to this assessment, the role of the product manager in the company varies from an *expert* to a *mini-CEO*. Overall, the framework describes 81 different product manager profiles, but in practice only four profiles have been identified so far. The framework explains the variations in the product manager's work and has therefore both a practical and a theoretical impact. Taking the different profiles into account, the product managers' tasks may be easily shared within the product management department. This makes the hierarchical and organizational structure more transparent for the top management. It also shows how the product manager's tasks and roles may evolve from one role to another by extending the responsibilities along the dimensions.

The third study in the main phase was devoted to identifying the problems arising in the adoption of SPM. It was found that five problems were common for the studied companies, and these problems can be avoided by the adoption of lean principles at the enterprise level. Taking into account that the company may use *Kanban* (Poppendieck & Poppendieck 2006), which uses the lean principles as well, as the software development process, extension of these principles to the whole company should not be a disruptive change. As a positive result, using the lean principles, the company may avoid problems in the adoption of SPM activities.

The third, last, phase of the research project included identification of six core product management activities to overcome the complexity of the existing product management frameworks consisting of up to 40 activities (van de Weerd & Katchow 2009; Pragmatic Marketing 2010b). These core activities allow the company to concentrate on the most valuable SPM activities to get results sooner. Later on, other

activities may be adopted as well, incrementally increasing the efficiency of product management.

The results of the study for practitioners and researchers can be summarized as follows:

- Organizations consider product management as a way for increasing the predictability processes and the profitability of products.
- Product management activities are fuzzy in organizations due to their complexity and many competing frameworks and definitions.
- The company size is an essential characteristic of the company, having an impact on how SPM has to be adopted.
- SPM activities are different for companies of different size:
    - Large enterprises are more customer-oriented, while technical excellence is a must for SMEs to compete with LEs.
    - The product managers' authority is limited in SMEs, while LEs have powerful product managers.
    - Strategic planning is essential for LEs, while SMEs may survive relying on tactical planning only.
- Companies face common problems in the adoption of SPM, but they may be avoided or even solved by the adoption of lean principles at the enterprise level.
- The role of the product manager is not limited to that of a "*mini-CEO*" only. The product manager may also act as an *expert*, *leader*, *strategist*, or *problem solver*.
- There may be different roles of a product manager, but we identified empirically only four of them as existing in practice in the studied companies.
- The roles of the product manager evolve with and within the organization.
- The roles of the product manager explain how their responsibilities are shared within the product management department.
- There were six core product management activities identified during the study by the practitioners. The other activities were supporting activities.
- The core product management activities form the necessary skill set for a product manager regardless the product and business domain.

In summary, this thesis shows that even such a complicated discipline as software product management may be simplified by decomposing its roles, activities, and problems and taking account of the essential characteristics, such as the company size, the responsibilities of the product manager, and the core and supporting activities.

6.2. Future research topics

Many research implications were already discussed in Chapter 5.1. In this section the main ideas for further studies are listed.

Firstly, the comparison of SPM activities in SMEs and large enterprises may be extended by studying the adoption of SPM activities in very small companies with up to 10-15 people and in small companies, e.g. with up to 50 people. The differences and similarities in SPM activities in SMEs and LEs raise questions about the birth of SPM as a separate discipline within the company. It is also beneficial for practitioners and researchers to know how the role of the product manager evolves within the company since its birth, and how the responsibilities are extended and shared with the growing product market share. Another direction to continue this research is to identify other essential characteristics of the company, such as size in our case, which should be taken into account in the adoption of SPM.

Secondly, the applicability of lean principles in software product management requires additional research. Currently, it has been found that the lean principles address the issues of the adoption of SPM fairly well, and these issues can be solved or even avoided by the application of the lean principles at the enterprise level. However, the impact of lean principles to the whole organizational structure of the company and to the role of the product manager has not been studied. Recently, agile product management (Pichler 2010) has received attention from practitioners, mainly as a result of its successful applicability to the management of the software development process. In the software development world *Kanban*, which is based on the lean principles, is often described as an evolution of agile management processes (Poppendieck & Poppendieck 2006). Similarly, agile product management may evolve to lean product management. Therefore, the applicability of lean principles to SPM in companies may be continued using the Action Research method (Baskerville & Wood-Harper 1996; Baskerville & Myers 2004; Sein et al. 2011).

Thirdly, out of the 81 theoretically possible roles suggested by the framework, only four were identified empirically. Currently, we have no evidence that new roles in addition to these four exist in practice, but also this requires confirmation. The framework itself requires development of a more precise scale for the dimensions as well. This can be done by an additional quantitative study, e.g. a survey that studies these scales in depth and develops a precise scale replacing the ones developed during the qualitative study.

Fourthly, the identified core and supporting activities should be validated by an independent study with the same goal. This can be done by conducting a study using quantitative methods in addition to the "qualitative survey" described in this thesis.

Overall, the work described in this thesis was done in 19 months. Therefore, there is still room for extending the results using complementary research methods. Moreover, the industry evolves at a record speed, challenging companies in their day-to-day activities for winning a market share in the competitive and turbulent market conditions. These challenges and opportunities faced by companies in practice are an endless source of research topics for such a practice-oriented discipline as software product management.

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Appendix I: Publications

Publication I
What Do We Know about Software Product Management? – A Systematic Mapping Study

Maglyas, A., Nikula, U., Smolander, K. (2011). "What Do We Know About Software Product Management? – A Systematic Mapping Study", Proceedings of the 5th International Workshop on Software Product Management (IWSPM). Trento, Italy, pp. 26–35.

What Do We Know about Software Product Management? – A Systematic Mapping Study

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Abstract—**Software product management (SPM) offers tools and practices for achieving business goals of a company as well as for increasing the predictability and profitability of software product development. Despite the importance of this topic, the studies of SPM have this far been fragmented. The goal of the present study is to summarize the existing knowledge in software product management and identify the areas which need further research. The paper reports the conduct and the results of a systematic mapping study which identified 25 studies on SPM. Still, most of the papers had only hypotheses and theories that were not empirically confirmed or the confirmation was based on a small set of cases. The existing knowledge of software product management consists of small and unconnected pieces. In addition to this, our specific interest, software product management in the cloud environment has not been studied at all. However, since both researchers and practitioners find research in SPM important, this area needs more research in the future.**

Keywords: systematic literature review; systematic mapping study; software product management; cloud environment; services

I. INTRODUCTION

Software product management (SPM) is "the discipline and business process governing a product from its inception to the market or customer delivery and service in order to generate the largest possible value to a business" [1]. This definition includes all essential activities related to software products. The success of a product depends on all the activities from strategy and marketing to product launch and customer support as well as on the development activities. An empirical investigation of the projects in the industry suggested that focus on software product management allows the company to reduce cycle time in the business unit by 36% compared to the initial estimation [2]. SPM also has a positive impact on delays and quality which, according to the same study, can be improved by 80% with product management practices [2]. Other benefits of SPM include increasing the profitability and predictability of software product lifecycle in accordance with business goals of a company [3]. And finally, software product management plays a critical role in managing and achieving business goals by providing practices for the winning strategy in the market [4].

The principles of how software products are introduced and delivered are changing rapidly. For example, today many companies are moving their business to the cloud environment which means a change from selling products to providing services. Services can be seen as higher level products comprised of the software product and its service shell delivering the product as a service to the user [5]. The intersection of software product management and cloud environment is an important area for every company that provides or uses services, because software product management attempts to give an answer to the question of how to improve the product success rate in terms of predictability, quality and efficiency [2].

We started the research with an idea to summarize the existing information about SPM in the cloud but it soon became evident that even traditional SPM studies are fragmented. Thus the purpose of our study was refined to analyze systematically the existing literature on SPM to establish a solid basis for future research.

The rest of the paper is organized as follows. Section II provides a description of the research process. In Section III we justify the selection of databases and search queries. In Section IV we describe the pilot search and its results and the actual search. Then, in Section V, we show the results of our literature analysis. In Section VI we discuss the implications and limitations of the study. Section VII concludes the paper.

II. RESEARCH PROCESS

The conducted systematic literature review followed the formal process described by Kitchenham and Charters [6]. In particular, this review can be classified as a systematic mapping study (or scoping study) that is "designed to provide a wide overview of a research area, to establish if research evidence exists on a topic and provide an indication of the quantity of the evidence" [6]. We chose the mapping study because the goal was to explore the existing studies in software product management. The results of the mapping study will help us to identify research areas within this topic where primary studies are required.

In the beginning we defined three research questions as follows:

1. What research questions in software product management are being addressed?
2. What original research exists in the intersection of software product management and cloud (service) environment?

3. What areas in software product management require more research?

We started our research with developing a protocol including all steps, research questions, inclusion and exclusion criteria, and analyses procedures. This enabled us to conduct a pilot search for tailoring the search terms. In general, the process progressed along the following steps:

1) *Protocol preparation which included defining*
   a) *the process*
   b) *the research questions*
   c) *the inclusion and exclusion criteria*
   d) *the analysis procedures*
2) *Conduct of a pilot study*
   a) *defining search queries*
   b) *choosing the digital libraries and other sources of materials*
   c) *searching*
   d) *reviewing the results*
   e) *summarizing and analyzing the results*
   f) *refining the queries for the actual search*
3) *Conduct of the actual search*
   a) *selection of databases and search queries based on the pilot study results*
   b) *searches*
   c) *removal of duplicates*
   d) *application of inclusion and exclusion criteria*
   e) *classification of excluded articles*
   f) *summary and analysis of the results*
4) *Data extraction*
   a) *review of the articles*
   b) *gathering information from the articles*
   c) *classification of the articles*
   d) *identification of primary studies*
5) *Analysis of the results*
6) *Development of conclusions*
7) *Reporting*

The described process is based on the review process described in the guidelines for performing systematic literature reviews [6], but some steps such as quality assessment and data synthesis were excluded because of their unsuitability for the mapping study.

Classification of included and excluded articles is a challenging task for every mapping study [7]. To ensure consistency in this task we used an approach described by Budgen et al [7], but we reviewed the papers twice. The first round focused only on the titles, abstracts, and keywords of the papers to identify the fundamental topics of each study, the units of analysis [8]. The articles where units of analysis were not related to SPM were excluded from the next round. In the second round, we read the full text of the remaining papers and extracted additional information such as research questions, research approaches, and number of participants. We also checked that the units of analysis were identified correctly and refined them as appropriate.

III. Selection of Databases and Search Queries

The results of a literature study are heavily influenced by the databases and the keywords used in the searches. To get an idea of the available articles, we did a quick search on Google Scholar with default options using *software product management* as the keywords and got about 1,940,000 hits including articles, patents, citations, etc. However, putting quotes around the keywords decreases the number of hits to 474 indicating that "*software product management"* as a single concept has raised considerably less interest than software, product, and management as distinct keywords. Since the present study focused on software product management, we further explored the literature base by narrowing the searches to articles having this phrase in the title, and got down to 62 articles. This appeared like a reasonable basis for a literature review, so we moved on to continue our study in scientific databases since Google Scholar searches across many resources including "articles, theses, books, abstracts and court opinions, from academic publishers, professional societies, online repositories, universities, and other web sites" [9].

The actual literature searches were conducted in two phases: pilot search and actual search. The purpose of the pilot search is to identify appropriate sources of information (conferences, databases, journals) and refine the search queries. We started the searches with looking at conferences on the main topics of interest – software product management, cloud, and service computing – which resulted in four conferences:

- International Workshop on Software Product Management - IWSPM (2006, 2008, 2009)
- Service-Oriented Computing: Consequences for Engineering Requirements - SOCCER (2006, 2008)
- IEEE International conference on cloud computing - CLOUD (2009, 2010)
- World Congress on Services (2008, 2009, 2010)

We studied the prior reports on systematic literature reviews [7],[10],[11] in our field and learned that they had found the IEEE, ACM and ScienceDirect databases as the most useful ones. Thus we decided to include these databases our searches, too, but added two new ones, ABI and Ebsco. Thus the initial list of the digital libraries was as follows:

1) *IEEE Xplore (http://ieeexplore.ieee.org/Xplore/dynhome.jsp)*
2) *ACM DL (http://portal.acm.org/dl.cfm)*
3) *Science Direct (http://www.sciencedirect.com)*
4) *ABI/Inform (http://proquest.umi.com)*
5) *Ebsco (http://search.ebscohost.com).*

The keywords are used to find the most relevant papers in the databases. Since we had two topics of interest, we also used two kinds of keywords – the first one focused on the main topic of the study, "software product management", and the second one explored the cloud computing area. Cloud computing has been defined to cover three service models [12]: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). In our search we used only the term SaaS because PaaS is a special part of software (middleware) and IaaS is only a method of providing infrastructure. In both cases software is only a part of solution, and therefore we excluded these terms from the search queries. The second keywords were further combined with product management related keywords since especially the *cloud* word is in no way constrained only to the software engineering context. In the end we used the following keywords in the searches:

- "software product management"
- SPM AND (cloud OR SaaS)
- "product management" AND (cloud OR SaaS)

In the pilot search we did not put any further limits on the publication year etc. because we wanted to get as many results as possible before refining the queries and removing irrelevant queries. During this stage we included all papers about software product management or management problems in the cloud and papers that describe management issues and/or differences between products and services. Three kinds of papers were excluded from the study at this point of time: first, papers about technical issues of moving to the cloud such as virtualization, development and architectural issues, and other problems. Second, business articles that had too general business point of view. And finally, papers not related to the studied topic or only available in the form of abstracts or presentations.

IV. Search Results

This section summarizes the results gathered during the pilot and actual searches.

A. Pilot Search

The results of the search are presented in Table I. The numbers in the table show the total number articles and the number of included articles according to criteria described above. As can be seen from Table I, the term "SPM" did not produce any relevant results so we excluded it from the search. We do not report the ACM papers because these papers were found in the other databases. The search in the ABI/Inform digital database produced a result where most of the articles were already found from the other databases and some other articles were published in journals like Business Wire that had too much business emphasis from this study point of view. Thus ABI/Inform database was excluded from the actual search and, instead, Springer digital library was added there (http://www.springerlink.com /home/main.mpx).

During the conference paper review (Table II) the following observations were made:

- Many articles used different terms for the same concepts. Thus, in addition to the "cloud" and "SaaS" terms, the term "service" was added to the list of search terms. At the same time the term "service" is widely used in any field, therefore we searched this term together with additional context words only in titles.
- There was no need to search in the conference proceedings separately because the conferences were included in the IEEE Xplore digital database and were found during the search in the database.

During the pilot search we did not remove duplicates so the results include some articles several times.

B. Actual Search

The actual search was done in four digital databases (IEEE Xplore, Springer, Ebsco, and Science Direct) with the following queries:

- "software product management"
- "product management" AND ("cloud" OR "SaaS" OR "services")

Searches were conducted on May 3rd, 2011. During the actual search the queries were searched in document titles and abstracts. In our case full-text search gave irrelevant results because *product management, cloud,* and *SaaS* are general enough terms to be found in most software engineering articles. The results of the actual search are shown in Table III. As a result of the actual search we found 52 articles and after removing duplicates we had 41 unique papers.

The final decision about including a paper in the review was done based on the study of the title, abstract, keywords, and availability. We identified six categories for excluding the articles from the final review (Table IV). "Support materials" mean that keywords were found in the title pages, workshop introductions, and posters. "Not relevant articles" refer to articles from other research areas such as mathematics, stochastic processes, and medicine. At the end of this step we got 25 articles that were related to the software product management issues.

TABLE I. The number of found and included papers based on the pilot search in digital libraries

Search terms	IEEEXplore	ACM	ABI	Science Direct	Ebsco	Total
"software product management"	39/32	21/12	49/12	6/5	10/2	125/63
SPM cloud	0/0	0/0	12/0	7/0	2/0	21/0
SPM SaaS	0/0	0/0	8/0	0/0	0/0	0/0
"product management" and cloud	0/0	2/0	50/6	0/0	0/0	52/6
"product management" and SaaS	2/0	1/1	22/0	0/0	12/4	37/5
Total	41/32	24/13	142/18	13/5	24/6	235/74

TABLE II. RESULTS OF PILOT SEARCH IN THE CONFERENCES

Conference	Total	Included	Excluded
IWSPM‘2006	9	7	2
IWSPM‘2008	7	6	1
IWSPM‘2009	8	7	1
SOCCER‘2006	8	3	5
SOCCER‘2008	8	3	5
World Congress on Services 2008	137	10	127
World Congress on Services 2009	120	3	117
World Congress on Services 2010	117	5	112
CLOUD‘2009	33	7	26
CLOUD‘2010	3	0	3
Total	**450**	**51**	**399**

TABLE III. RESULTS OF THE ACTUAL SEARCH

	IEEEXplore	Ebsco	ScienceDirect	Springer	Total
“software product management”	28	9	7	0	44
“product management” and cloud	0	1	0	0	1
“product management” and SaaS	0	0	0	0	0
“product management” and services	1	2	1	3	7
Total	**29**	**12**	**8**	**3**	**52**

TABLE IV. ARTICLES EXCLUDED FROM THE FINAL REVIEW

Reason	Number
General issues of cloud computing	2
Support materials	3
Architecture and development issues in the cloud	4
Not relevant articles	7
Total	**16**

V. DATA EXTRACTION

A. Summary of Included Articles

Each of the included articles was reviewed for studying the context of the article, research questions, and empirical confirmation of the results. Table V summarizes the information about included articles. Only 4 of 25 articles were published in journals and other articles were conference papers. In addition, only 6 of 25 articles had clearly presented research questions that could be reliably extracted from the paper, for example, as a list. The empirical approaches in the papers consisted mostly of case studies in small companies or studies where only one project was studied for theory creation. Many of the studies were made in companies providing telecom services, which left other industry fields less studied. We extracted the main keywords from the articles and classified papers by authors and units of analysis. Clustering by authors showed that there are three clusters which include at least 3 articles: Brinkkemper (7 articles, [3],[13],[16],[19],[30],[31],[36]), van de Weerd (5 articles, [3],[13],[19],[36],[37]), and Kilpi (3 articles, [21]-[23]). Van de Weerd and Brinkkemper have 4 articles written together so these two clusters are overlapping. The Kilpi articles were written in 1997-1998 indicating that the point of view to software product management is not very recent, but it still provides insights into the evolution of SPM.

TABLE V SUMMARY OF INCLUDED ARTICLES

Units of analysis	Research questions	Research approach	Type, Year, Ref
company context, key success factors	”What are the most important situational factors influencing the selection of the method fragments for software product management processes? “	case study, one company with many projects	conf, 2006, [13]
company context, key success factors	”What skills do client organizations seek in their employees regarding the utilization of IT? “ ”What skills do IT software and service providers seek in their employees regarding their IT service offerings? “	survey, 104 responses	journal, 2008, [14]

	”Are there any differences in desired skills between client organizations and IT providers? “		
project management, agile project management practices, software product line engineering	”How can potential benefits and challenges [of software product line engineering] be managed in practice? “	case study in the medium-sized Norwegian software company	journal, 2008, [15]
project management, agile project management practices	”In which way can software product management be performed in a SCRUM development context? “	field interviews and document study	conf, 2009, [16]
defect management	”How to integrate defect management with software product management in distributed environment? “	case studies, small Dutch ISV and international ISV	conf, 2009, [17]
company context, quality goals	”Does the method [lightweight elicitation of quality goals] work in practice and if not, how should it be improved? “	case studies, 4 cases	conf, 2009, [18]
company context, key success factors	-	surveys, 178 projects	journal, 2007, [2]
reference framework	-	field interviews and discussions with experienced product managers	conf, 2006, [19]
reference framework	-	field interviews, literature reviews	conf, 2006, [3]
company context, decision making	-	field interviews, document study	journal, 2010, [20]
software configuration management	-	case studies in the three small-sized Finnish companies	conf, 1997, [21]
software configuration management	-	case studies in the three small-sized Finnish companies	conf, 1997, [22]
software configuration management	-	case studies in the three Finnish companies	conf, 1998, [23]
release planning, project management, agile project management practices	-	case study, telecom project	conf, 2006, [24]
project management, holistic approach	-	case study, telecom project	conf, 2007, [25]
finance	-	case study, a project in the experimental physics	conf, 2008, [26]
company context, decision making	-	case study in a large company	conf, 2009, [27]
company context, decision making	-	case study	conf, 2010, [28]
software product line engineering	-	case studies, two companies	conf, 2010, [29]
company context, quality goals	-	case studies, two companies	conf, 2010, [30]
improvements in software product management	-	case studies, seven companies	conf, 2010, [31]
improvements in software product management	-	case studies	conf, 2010, [32]
finance	-	own experience in the company	conf, 2009, [33]
project management, distributed environment	-	-	conf, 2008, [34]
project management, distributed environment, value chain approach	-	-	conf, 2008, [35]

B. Units of analysis

The analysis of the papers revealed 16 units of analysis. Two of them served as contextual units of analysis for other units of analysis:

1) *release planning [24]*
2) *company context*
   a) *key success factors [13],[14]*
   b) *decision making [27],[28],[36]*
   c) *quality goals [18],[30]*
3) *software configuration management (SCM) [21]-[23]*
4) *finance [26],[33]*
5) *defect management [37]*
6) *reference framework [3],[19]*
7) *project management*
   a) *value chain approach [35]*
   b) *distributed environment [34],[35]*
   c) *holistic approach [25]*
   d) *agile project management practices [15],[16],[24]*
8) *software product line engineering (SPLE) [15],[29]*
9) *improvements in software product management [31],[32]*

When the units of analysis were identified and systematized, we compared how it fits with the Software Product Management Framework suggested by Kittlaus and Clough [4]. The framework presents the major functions involved in product management with tasks to participate in or to orchestrate [4]. The tasks are divided into two levels: corporate level and product (family) levels which are differentiated by the level of authority and strategic impact to the company business. In total, there are nine functions in which product manager participates: Market Analysis, Product Analysis, Product Strategy, Product Planning, Development, Marketing, Sales and Distribution, Support and Services. The first two functions (Market Analysis and Product Analysis) are the sources of the raw qualitative and quantitative data for a product manager who makes decisions regarding the product based on this basis. Product Strategy and Product Planning are the core functions of product management which include business-oriented tasks. Other four functions (Development, Marketing, Sales and Distribution, Support and Services) do not directly related to a product manager and thus he/she needs to collaborate with the respective departments about decisions concerning these functions.

The identified articles during the systematic mapping study can be divided into two groups. The first group includes articles about software product management as a separate discipline. These articles consider possible approaches to software product management and its improvements as well as development of frameworks and tools for understanding the processes and functions of product management. In our taxonomy these studies are presented as *reference framework, improvements in SPM, and software product line engineering*. *Company context* could be included into this group too, because these studies focus on the context of the company affects the product management processes inside the company. The second group includes studies about the departments orchestrated by a product manager (Development, Marketing, Sales and Distribution, Support and Services). These studies consider a special function of product management and discuss issues in software product management within this separate function.

Figure 1 shows the relationships between the major functions involved in product management and the units of analysis identified in systematic mapping studies. Only two units of analysis (Finance and Release planning) are related to the core product management functions [4]. Three other units of analysis are related to the Development function which is orchestrated by a product manager. In this regard, a product manager can only collaborate with this function but not manage it. The same way of collaboration is related to Marketing, Sales and Distribution, Support and Sales, but we did not find studies in these areas. The top four units of analysis in the figure are related to research in software product management as a discipline and these studies include general aspects of product management in software industry which are not specific for the presented functions.

Comparing this framework with two others developed by Ebert [2] and van de Weerd et al. [19], we observe similarities as well as differences. Ebert considers product management processes and competencies in connection with life-cycle phases. He identified 18 processes and 10 competencies related to product management based on the experience of product managers from different industries worldwide [1]. The reference framework for software product management, on the other hand, includes four process areas with sub functions related to internal and external stakeholders [19]. These process areas are portfolio management, product roadmapping, requirements management, and release planning. Although several product management components such as strategy, portfolio management, and roadmapping are considered in these three frameworks as core components of software product management, the boundaries and relationships between other components appear fuzzy and they are handled differently by these frameworks.

VI. Discussion

This section addresses research questions defined in the beginning and discusses areas where further research is needed. We also consider trends in the studies of software product management as well as limitations and threats of validity of our study

A. RQ1: What research questions in software product management are being addressed?

The main problem identified during our mapping study was that only few articles were available on software product management. Even though a quick search on software product management in Google Scholar found about two million articles, customization of the search options for gathering more reliable result drops the number of articles to 62. The search in the scientific digital databases started with 235 articles but quickly narrowed down to 52. After the manual search, we identified only 25 articles, but even some

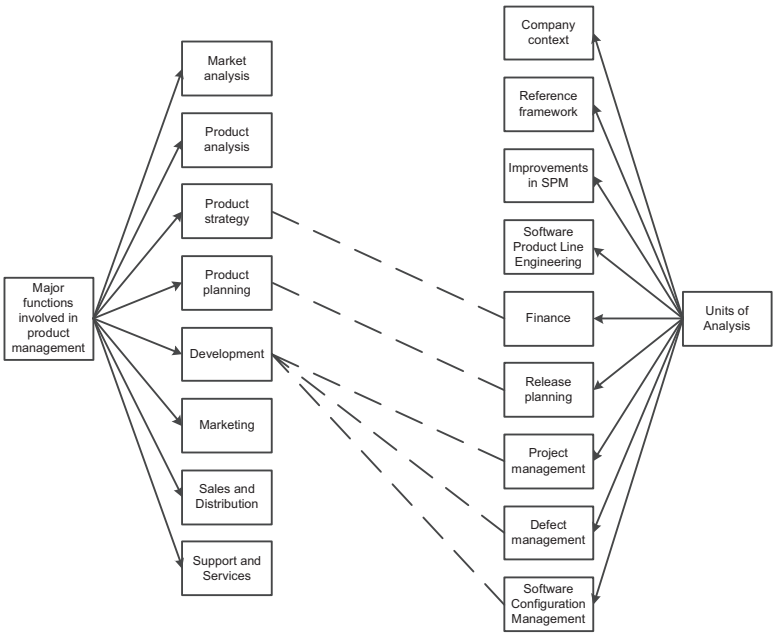

Figure 1. Relationships between the Software Product Management Framework [4] and the inductively identified units of analysis in the research on SPM

of these articles referred to software product management issues only indirectly. We included these articles for two reasons. First, we considered every piece of information important in an unexplored area. Second, the definition of SPM seems to be still under discussion and it is not clear which functions should be done and which orchestrated by a product manager. 19 of the 25 articles did not have a clearly presented research question and four of them presented hypotheses without any empirical confirmation. We can conclude that SPM knowledge is fragmented and even the definition of SPM is not yet well established. The research area is immature and more research is required, especially in the areas such as product strategy, product planning, and product analysis.

In the rest of this section we will summarize articles with clearly defined research questions separately. For each paper we reviewed the unit of analysis, the ways in which the results were empirically confirmed, and the main conclusions. In the last sentence of each summary we discuss the role of the paper for SPM.

Goles et al. [14] has three research questions focusing on the different employee skills in product and service companies. The units of analysis in this paper are company context and key success factors. The authors used a survey to study which skills are most important and will be important in the nearest future. The paper shows how the processes vary between different types of companies depending on the people skills. At the end of the paper, authors made a conclusion that the technical skills for the IT professionals play as important role as the understanding of the business goals of the company for creating successful products or services. The importance of people management for a company raises the question whether it should be included in product manager responsibilities.

Two articles [16],[18] discuss agile or lightweight approach to quality goals and SPM process. The units of analysis in these two articles are project management and company context which play central roles in agile methods [16]. The authors used field interviews and case studies as research methods. Vanhanen et al. [18] claim that elicitation of quality goals helps in improving the software product management process and that a well thought strategy defined before the development stage helps to avoid critical issues later on. Vlaanderen et al. [16] focus on the integration of software product management and agile practices and present a model of agile software product management which is based on SCRUM principles. The applicability of agile principles for the SPM should be studied in more detail because agile SPM covers only development activities but other activities such as marketing, customers support, and strategy formation are left out of the scope in the current version of the agile SPM.

Hanssen and Fægri [15] made an attempt to combine agile practices with software product line engineering (SPLE) and investigated the potential benefits of this approach. SPLE is an "approach to software engineering in

which a set of products is built on a common set of core assets" [38],[39].The authors studied a mix of different practices such as agile project management, SPLE, and activities of product management in the one company as a case study. SPLE approach is claimed several benefits: "large-scale productivity gains, decreased time-to-market, increased product quality, increased customer satisfaction, more efficient use of human resources, and improved ability to apply mass customization, maintain market presence and sustain unprecedented growth" [15]. In this regard, SPLE and SPM are similar in the way of managing software as products.

Bekkers et al. [32] studied the most important situational factors of SPM. The unit of analysis was the company context in one company but many projects were taken into account in the conducted case study. According to this study, it is impossible to study software product management without taking into account the situational company context, which affects all SPM processes.

The last article with a clearly presented research question makes an inquiry into the integration of SPM with software defect management in a distributed environment [37]. The unit of analysis in this study was defect management and it was conducted in independent software vendors (ISVs) as a set of case studies. The goal of the study was to create a conceptual model helping to support "product managers in their SPM and defect management practice" [37]. The authors conclude that it is still an open question whether defects should be managed in the product or project level, and the model requires future investigation.

Overall, the reviewed studies vary a lot and they approach SPM from the perspective of business problems focusing essentially on the organization of production and strategic development of the company.

B. RQ2: What original research exists in the intersection of software product management and cloud (service) environment?

The number of empirical studies in software product management is very limited. Many articles, such as [2],[19], emphasize that SPM plays a crucial role in implementing successful products. One of the recent changes in the software industry is that many companies are shifting their business from products to services [40]. Even though the difference of environments [33],[37] may lead to dramatic changes in management processes, only few studies have been carried out in this area so far (cf. [5]). In our survey we faced two difficulties: lack of research in SPM in general and lack of research in SPM in the cloud. There are only individual and unrelated studies in these areas, often without any empirical confirmation.

C. RQ3: What areas in software product management require more research?

The functions presented in the Software Product Management Framework [4] can be divided into three groups: functions that provide market and product analytical information, core functions of product management followed by the business oriented goals of the company and functions orchestrated by product management. The existing studies consider general aspects of product management (4 of 9 units of analysis), relationships between product management and development (3 of 9 studies), finance (sometimes referred to as pricing) and release planning. At the same time, pricing is considered as a separate discipline which works in close collaboration with product management. Taking this into account, only one of nine units of analysis is related to the core functions of product management. Other studies focus on relationships between product management and development and sometimes the studies go deeply into the details of development forgetting that it is a separate discipline orchestrated but not managed by product management.

Many studies (4 of 9 units of analysis and 13 of 25 papers) concentrate on understanding software product management by developing frameworks and assessment tools for improving product management practices. The existence of these studies show that the area is immature, which produces many discussions on the content, context, and place of software product management in software development.

Software product management in the cloud environment is a broader area where the lack of research is evident. The development of an SPM theory applicable to both cloud and product companies seems challenging because SPM is tightly coupled with business processes and models of each company. Still the intersection of these two areas offers great opportunities for research because there is evidence that the number of services will grow [40] and we have to know how to manage this kind of development with a new set of problems and conditions. Thus studying the differences and similarities of traditional and cloud SPM is an unexplored area for future research.

D. Trends in Software Product Management

We conducted the actual search procedure twice, first in November 2010 and then half a year later in May 2011. During this time thirteen new papers had been published. Four of these papers were removed from the further considerations for the following reasons: the paper was written in German language, the paper included software product management in its keywords but then it was missing from the full-text, the paper presented a service for managing products (an experience report from Microsoft), and the paper was an introduction to the Fourth International Workshop on Software Product Management. The nine articles on software product management were published at the proceeding of one conference, IWSPM. Five of the articles were full research papers, one was an industry paper, and three were short papers. For our purpose we chose only full research articles that added five more articles to the systematic literature review half a year earlier.

From 1998 to 2006 only few new papers were published on software product management. In the late nineties product management was studied in relation with software configuration management [23]. Since these were the earliest publications we found, we can consider this as a basis of software product management. In 2006 a new wave of

interest to software product management started and after that the concept has been studied from many viewpoints, such as agility, success factors, and company context.

The latest trend in software product management research appears to be an observation that the maturity of product management in the organizations is low and it requires more research. The papers concentrate on the problems of improving software product management in an organization by providing special tools and frameworks such as the SPM maturity matrix [31],[32]. It helps in assessing the current situation and gives guidelines for necessary activities for achieving the next level of maturity in product management.

E. Limitations and Threats to Validity

Our study has several limitations:

- We used only six digital libraries in our research;
- The used libraries cover only scientific articles;
- We did not include books about product management.

By increasing the number of digital libraries we could get more studies to review, but as we already found out with the ABI/Inform and ACM libraries, most of the studies would be duplicates. Thus, it seems that it would not improve the set of articles significantly [7],[10],[11].

The chosen databases include scientific articles and, at the same time, have limited coverage of industrial experience reports from practitioners like product managers. Even though industry reports are very helpful in defining the starting points of a study, they were excluded from the present study in the favor of scientific articles to assure replicability of the studies.

We did not include books about product management in the survey. In software engineering primary studies are typically published in scientific journals and conferences rather than in books.

The study has several threats to validity. The first threat is search conditions. The problem is that digital databases do not have the same options for searching. Therefore, we adapted the queries for each digital database to conduct the search as similarly as possible. In addition, search engines in the digital databases work differently and we cannot be sure that all articles were found. We mitigated this risk by using several digital libraries hoping that the papers will be found at least by one search engine. The next problem connected with the previous is the publication bias. There is a chance that we missed relevant articles because our search queries are based on the general words such as *services* and *cloud*. We mitigated this risk by reviewing the conferences proceedings before the pilot search in the digital databases. The last threat is related to data extraction process. It could be done in many ways, so we described how we did it as detailed as possible. Anyway, it is impossible to fully mitigate this threat because the procedure of data extraction and classification is conducted by researchers who influence the results.

VII. CONCLUSION

To start research in an area that does not even have clear definitions is challenging. In the beginning of our review we expected to find unexplored topics which are related to the software product management practices in the cloud environment but we soon found out that even the traditional software product management has not yet been studied extensively and many fundamental questions are still open. Lack of standards and common definitions can confuse a newcomer. Ebert [2] states that a body of knowledge similar to Project Management Body of Knowledge (PMBoK) [41] is required for product management as well as formal education certifications such as Project Management Professional (PMP). However, in addition to such long-term goals it is important to have short term goals like defining what software product management is and what is included in the set of its key functions. Software product management in the cloud and the differences between traditional and cloud software product management form a special issue that may, after a closer study, improve our understanding of the nature of SPM.

The reviewed studies showed that a definition of SPM is unclear and sometimes authors mean very different things when they talk about SPM. This conclusion is supported by van de Weerd et al. [3] who state that the existing frameworks are immature and require additional research. Most of the hypotheses found in this systematic literature review require empirical confirmation. Based on that we can say that software product management has not been studied fully and this area offers many opportunities for research. The importance of conducting studies in software product management cannot be overestimated because SPM offers tools and practices for achieving business goals as well as increasing the predictability and profitability of developing software products and services.

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Publication II
Software Product Management in the Russian Companies

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Software Product Management in the Russian Companies

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***Abstract*—Software product management discipline helps in managing software products from its beginning to support. It covers strategic issues of managing products including technical and business roadmapping, resource planning as well as strategic and tactical planning. In this qualitative study, we interviewed six organizations to understand how software product management is implemented in the organizations. Based on our observations, we conclude that organizations understand importance of product management processes and want to improve them but these processes are still immature. The companies need guidelines and models in product management to avoid the problems identified during the study.**

Keywords-software product management; grounded theory; qualitative research

I. INTRODUCTION

Christof Ebert [1] defines software product management (SPM) as "the discipline and role, which governs a product (or solution or service) from its inception to the market/customer delivery in order to generate biggest possible value to the business". In his research of the projects in telecommunication industry Ebert demonstrated [1] that software product management plays an important role in increasing the success rate of projects. There is no formal education in product management, so the researchers and industrial experts are discussing ([1]-[3]) about summarizing knowledge in a form of Body of Knowledge similarly as in Project Management Body of Knowledge (PMBoK, [4])

In our research, we studied six software development organizations and their product management. We tried to understand how the activities related to product management are realized in the organization and how these activities are mixed with product development, project management, marketing and strategic planning. Our purpose was to understand how the organizations manage their software products and how their product management processes are implemented. In this regard, our research questions were as follows:

1) What is the role of product manager in practice?
2) What are the problems of software product management in practice?
3) What factors affect software product management practices?

In this paper, we present the preliminary results of our research about the current situation in software product management in the industry. The goal of this study is to clarify what organizations are doing in managing their software products. The results help to identify the useful direction of research and practice development in this area.

The rest of the paper is organized as follows: Section II introduces the basics and research of product management in general and software product management in particular. Then, in Section III we describe the research methodology. Section IV describes the results of our research. In Section V we discuss the limitations of our research. Finally, Section VI concludes the paper.

II. RELATED WORK

A. A brief history of product management

Product management is not a new discipline. Originally, the concept of product management was introduced in Procter&Gamble in 1931 [5]. The company hired a special person, a brand manager, who was responsible for managing one product. After this successful experience the practice of assigning product managers to a product or a product line was copied inside the company. Later, the practice of hiring product managers spread also outside the company and was shared between competitors [5].

As product management was adopted in many business organizations, the concept gained popularity and became a topic for scientific research. In the early 1960s, Borden [6] created a model of four P's of marketing, consisting of *product*, *place*, *price*, and *promotion*. In this model, *product* includes issues related to the creation and development of a product. *Place* is a process of defining right markets in

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which the product would be marketed and sold. *Price* considers financial issues in collaboration with financial analysts. *Promotion* includes activities related to advertisement [6]. The model describes how the products should be managed and therefore it can be seen as one of the first theories about product management.

Product management has become widely spread for new product development in many industries (e.g. [7],[8]) but it has not been established solidly in the software industry. One of the first works about software product management was written by Kilpi in 1997 [9]. He considered software product management as "a process consisting of version control (VC), configuration management (CM), product management (PM) and total product management (TPM)" [9]. His research is concentrated on the process of organizing version and configuration management for delivering software products. Although several books (e.g. [10],[11]) were written, the topic did not attract much attention in the research community. A new wave of interest to software product management has appeared in 2006 as a result of high competition in software market in which software product success depends on skills and competence of product manager [1]. Since that time the number of papers about software product management has been increasing.

B. Software is different

Software has several features which distinguish it from other products. These differences include (a) limited importance of production processes and logistics [12]; (b) relatively easy changes in software [12], and (c) complexity of software [13]. The first characteristic takes into account two activities (production and logistic) which play an important role in goods production, but it is less important for software which, in general, is "knowledge" rather than physical artifacts [12]. The cost of producing and delivering of an additional copy of software is small compared to the other costs. Usually, logistics is also simple because the existing infrastructure including the Internet and retailers is used.

Software can be relatively easily changed and this leads to challenges where several versions of products are available in the market [14]. This also leads to tough competition in the market, because new features are easily reproduced and improved by competitors.

It has been claimed that software is the most complex and sophisticated product of human invention that we currently know [12],[13]. The source of the complexity is the nature of software consisting of many blocks from different vendors along with the possibility to run the software at a hardware manufactured by other vendors. This leads to incompatibilities between components, which should be taken into account in product development and decision making. To respond those challenges, a huge number of factors should be considered in software product development. This leads to the division of responsibilities among developers, testers, project managers, product managers, and many other roles supporting software development.

In the described conditions, one of the product manager activities includes identification of the features which provide significant value for the customers by communicating and defining customer needs, market trends, competitors and markets for selling. Product manager plays a role of facilitator between different departments; he is a "mini-CEO" [1] who is responsible for one or several products. He is working in close collaboration with product development team, marketing team, project managers, financial analysts and managers, engineering and sales teams. He uses these departments as resources to produce successful products. His role is to determine the product strategy including product roadmap, pricing and the entire value chain [1].

C. Software product management components

There are three software product management frameworks, which explain the structure of software product management. There are many overlapping parts in these frameworks, but the terminology is different. Software product management components are defined as functions [12], activities [15], or process areas [16] depending on the framework.

The Software Product Management Framework suggested by Kittlaus and Clough [12] presents the major functions involved in product management with tasks to participate in or to orchestrate [12]. The tasks are divided into two levels: corporate level and product (family) levels which are differentiated by the level of authority and strategic impact to the company business. In total, there are nine functions in which product manager participates: Market Analysis, Product Analysis, Product Strategy, Product Planning, Development, Marketing, Sales and Distribution, Support and Services. The first two functions (Market Analysis and Product Analysis) are the sources of the raw qualitative and quantitative data for a product manager who makes decisions regarding the product. Product Strategy and Product Planning are the core functions of product management which include business-oriented tasks. Other four functions (Development, Marketing, Sales and Distribution, Support and Services) are not directly related to a product manager and thus he/she needs to collaborate with the respective departments about decisions concerning these functions.

The second framework is developed by Ebert [15]. According to his definition, software product management provides leadership to activities like portfolio management, strategy definition, product marketing, and product development [15]. These activities are supported by product management processes like portfolio analysis, positioning, strategic planning, product and technology roadmapping, risk management, product definition and requirements [15]. Processes show the formal content of product management or, at least, the activities in which a product manager is heavily involved.

The third framework is the reference framework for software product management [16]. The framework defines four main process areas with their inputs and outputs. These process areas with processes are portfolio management,

product roadmapping, requirements management, and release planning [2].

All these frameworks were developed empirically by interviewing and working with experienced product managers worldwide [1],[2], and the frameworks have similarities as well as differences. Software product management seems still to be an immature area [1], where the lack of body of knowledge and guidelines for product managers can be observed.

Other authors have proposed that activities such as finance [17], defect management [18], and software configuration management [19] should be taken into account as the parts of SPM. Evidently there are still many discussions regarding the components of software product management [1],[2],[17]. The source of this problem is the nature of product manager work. Product manager collaborates and provides leadership to many other departments including development, marketing, sales and others, depending on the corporate structure. At the same time, a product manager should be familiar with all these activities. Sometimes product manager unites several of these roles (e.g. product manager + analysts, product manager + marketer). This leads to discussions about how the product manager's responsibilities are penetrated to other activities, which activities are unique for the role of product manager, and which activities could be fully delegated to other roles.

III. Research Methodology

The goal of our study was to clarify how product management is organized in the different organizations. The study was an interpretative qualitative study based on two critical assumptions [20]. The first critical assumption was that every software company has some kind of software product management. Usually the role of product manager exists in the large companies only. Small- and medium-sized companies do not have a special person, who is responsible for "delivering the right products at the right time for the right markets" [15] but it does not mean that they do not have product management. In these companies the responsibilities of a product manager are distributed among other roles. The second critical assumption was that internal company culture affects software product management processes.

Every company has a process of running and delivering the products (or services) but sometimes it is not seen as a separate discipline. Therefore our aim was to identify and clarify the concept of product management even if an interviewee was not familiar with product management as defined in the existing literature.

We included organizations of different sizes from small to large, doing business in telecommunication, software products and software services fields. In these organizations our units of analysis [21] were product management and product management processes. Building the study on the presented assumptions, we designed a study to explore product management in the organizations and chose grounded theory [22] approach as the research method.

A. Grounded theory

The grounded theory method was developed by Glaser and Strauss in 1967 [23] as a pragmatic approach for conducting social science research [24]. The approach is built upon two main concepts: *constant comparison* and *theoretical sampling*. The first concept is based on the idea that every piece of new information is compared with collected data to find similarities and differences. Therefore, data are collected and analyzed simultaneously. The concept of theoretical sampling shows an iterative process of theory building in which the next data sample is chosen based on the analysis of the previous samples.

In this study we follow the Strauss and Corbin version of grounded theory [22] because it relies on systematic codification and categorization process for observations. That is especially important for us because we conduct the study in the field in which speculations are possible. The formal procedures defined by Strauss and Corbin help to decrease possible biases.

In grounded theory coding is the fundamental process for analyzing data and generating a theory. There are three basic types of coding: open, axial, and selective coding. Open coding is "the interpretive process by which data are broken down analytically" [25]. Its purpose is to understand what data really means, find the similarities and differences between the pieces of data, and give a conceptual label to each event/action/phenomena. Then, the concepts are grouped together to form categories with subcategories which present a higher level of abstraction than the original data. In axial coding relationships between categories are emerged and tested against data. A single test is not enough to prove or discard a hypothesis; therefore each relationship should be indicated in the data over and over again. If the hypothesis is not supported by new data, it does not mean that the hypothesis is necessarily false but the context and conditions in which it occurred should be critically evaluated to determine what really happened. The selective coding is the process of defining the core category. The core category shows the central hypothesis of the study. All other categories with subcategories are unified around this core. Strauss and Corbin [22] suggest identifying the core category by asking the questions: "What is the main analytic idea presented in this research? If my findings are to be conceptualized in a few sentences, what do I say? What does all the action/interaction seem to be about? How can I explain the variation that I see between and among the categories?"

The presented coding procedures show the growth of the degree of conceptualization from description to theory through interpretation. The degree of conceptualization is tightly coupled with the theory scope: the higher degree of conceptualization achieved, the more formal concepts are used for the theory building. At the description level, the researcher works with *seed* categories and properties which are gathered directly from the data (open coding). Manipulating with these categories the researcher can create a theory within bounded context with the narrowest scope because seed concepts simple represent situations from the experience. At the interpretation stage, categories and

TABLE I. COMPANIES PROFILES

Company	Business domain, type of product	Size (people)	Founded
A	International developer and supplier of a wide range of software, integrated solutions and hardware technologies	1800	1990
B	Developer and provider of telecommunication solutions, software and hardware	800	2007
C	Integrator and developer of software for SME	350	1994
D	International provider and developer of interactive media solutions	150	2002
E	Developer of software tools	120	2000
F	Developer of software products for servers	15	2009

TABLE II. ROLES OF INTERVIEWEES

Interview	Company	Role
1	A	Deputy Managing Director for R&D, Base Development Department Manager
2	D	Team Lead
3	D	Project Manager
4	E	Product Marketing Manager
5	B	Manager of Mobile Development Department
6	F	Technical Director
7	F	Sales Director
8	C	Deputy Director of Software Development Department

properties are analyzed by using grounded theory procedures and it allows creating a theory with substantive focus which is more abstract than the theory with bounded context. In addition, the substantive theory has significant empirical support. The latest stage is a theory creation from the formal concepts. It presented the highest level of abstraction and it is the purpose of the grounded theory approach. This type of theory has the widest scope and it can be applied to many different situations [26].

B. Research strategy and sample

In this study, we interviewed six companies (Table I) and conducted eight interviews (Table II). We conducted the interview in Saint-Petersburg, Russia, but all companies are international companies. The interviews were conducted and transcribed in Russian language, but the analysis and further work has been done in English. Our units of analysis [21] were product management processes in the selected companies as well as the role of a product manager. We selected the companies which differ in their business domain, size, and types of produced products. The company sizes varied from 15 to 1800 people. We chose the companies of different sizes to support our first critical assumption that every software company has product management regardless its size.

The selection of interviewees was guided by our existing contacts and snowballing [22] in which the next interviewee was a referral from the previous one.

The data for the analysis was collected by interviews that lasted from 40 to 80 minutes with an average of 48 minutes. The semi-structured interviews [27] were guided by a list of questions whose order was flexible depending on the flow of the interview. Additional questions were also asked and explanations appropriate for the concrete situation and company context were given.

We preferred interviewees from middle and top management, because, as our results showed, they have deeper understanding of business and management processes in the organization. People responsible for technical details of implementation are usually familiar with development processes, but our main focus was usually out of their scope. However, we included their point of view, because it completes our problem analysis.

All interviews were recorded and manually transcribed. The transcribed text takes 82 A4 pages with standard 12pt font and single line spacing interval. We performed the

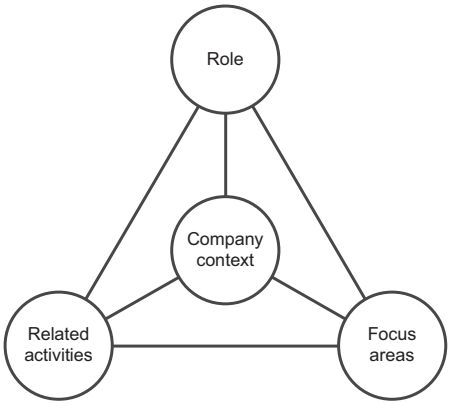

Figure 1. Product management in the organizations

TABLE III. SUMMARY OF OBSERVATIONS FROM THE INTERVIEWS

Interview	Company context	Role	Focus areas	Related activities
1	Orientation to certification and implementation of best practices	Two levels of product managers: business product manager (BPM) and technical product manager (TPM)	BPM – sales and support TPM – scrum meetings, problems solving	BPM – market analysis, collaboration with TPM TPM – reports to BPM
2	Distributed company with headquarter in the USA and development office in Russia	Product manager is a specialist in marketing	Marketing, collaboration with customer	Reports to top management
3	Small telecommunication company surviving in the highly competitive market	Product manager defines and implements strategy and products having only high-level business goals	Strategy, portfolio management, customers' feedback	Collaboration with marketing, analysts Delegation of projects to project management team
4	All in the company take a part in decision making and have the same rights in voting	Product manager is responsible for all activities which are not related to technical details	Strategy, pricing, customers' feedback, marketing, release planning	Collaborates with team lead of the product
5	Telecommunication company with a strict hierarchy and well-established processes	Product manager is a representative of the market	Work with end users, requirements management, features balance	Product manage uses other departments including analysts and marketing as services for own tasks
6	Small company surviving in the competitive market which sells the product through a partners' network	Product manager is responsible for the product success in the market	Building a network of partners	Participation in the decision making process
7	Small company surviving in the competitive market which sells the product through a partners' network	Product manager is a person who unites business and technical vision of the product and has no relations to project management	Business goals, customers' requires, decision-making	Collaborates with technical staff for implementing the required features
8	Strategy is a central part of all activities and a base for roadmapping	Product manager is a specialist who implements a strategy defined at the top management level	Strategy, roadmapping, requirements management, marketing	Reports to top management Collaborates with sales department

analysis of the collected data using a special software tool for qualitative researchers, ATLAS.ti [28].

IV. RESULTS

In the analysis, our purpose was to understand how the organizations manage their products. This question includes issues related to the role of product manager, his/her responsibilities and activities as well as to the whole process of developing, running, and maintaining software products. As a result of our analysis, we developed a model (Figure 1) which explains software product management processes in the organizations.

The model is created based on four identified categories. We already observed theoretical saturation because the last two interviews did not introduce new categories and previously identified categories were used during their coding procedure. This suggests that the presented model is valid and can be used for explaining the current situation with managing software products.

In the following subsections, the identified categories, observations, and problems supported the model are described, but before we go into the details of our analysis, there are couple of things should be mentioned about our observations made during the interviewees. First of all, as it can be seen from Table II, we did not find people with the title *product manager.* In all studied companies, we observed the lack of product manager as a separate position. Secondly, one of the interviewee presented a good metaphor explaining the difference between project and product management. In his own words, *"project management is a ladder that helps you to climb somewhere and product management is a wall for the ladder. If the wall is wrong, it does not matter which ladder you use, because you climb to the wrong place"*. The third observation is that product management is a very business oriented discipline and it does not pay too much attention to the technical background of the products. We asked questions about strategy, roadmapping, and resource planning in the interviews and very often interviewees said that these issues are out of their scope and they are not familiar with the process of making these decisions. These questions are in scope of top management and a problem of delegation is observed.

A. Categories

We identified four main categories: *role*, *focus areas*, *related activities* and *company context* (Figure 1). We consider the last category as a core category that explains the phenomenon under observation and has a relation to all observations. In our case, these categories are tightly coupled and the full picture is formed by these four categories altogether.

The first category is *company context,* which explains history and culture in the organization. The background and current situation in the organization affects the existing roles and processes. These factors should be taken into account in

studying software product management processes in the organization.

The second category is *role,* which describes characteristics of product manager as a separate role in the organization. This category is a result of synthesis of experience explained by interviewees based on their viewpoints to the role of product manager.

The third category is *focus areas,* which refers to the tasks and responsibilities which are specific for product manager and cannot be delegated to other roles.

The last category is *related activities*, which shows the relations between product manager and other roles. This category is intended to explain boundaries of product management and identify areas orchestrated or used by product manager for getting information, for example, from analysts, and providing leadership to other activities for achieving business goals of the companies.

Table III summarizes information about the studied cases with relation to the identified categories.

B. Observations

Based on the analysis of the interviews, we made four observations as follows:

1) Interviewees understand the necessity to have a product manager as a separate role

All of our participants showed the interest to the topic of product management regardless their current position and previous experience. It happens because management of software product is seen as a separate discipline that requires different approaches in comparison with project management.

"Software product management (SPM) is… probably…a set of valuable guidelines about what we can neglect in product management with respect to project management. In this regard, it is necessary to change your priorities, but people involved in product management were project managers in the past and they try to manage products in the same way as projects" – Interview 7.

As a product manager, project manager still tries to manage projects instead of developing strategies, roadmapping, and resource planning. The product manager work is characterized by a high level of uncertainty. Mistakes at this level have a critical impact to the company business. Therefore, it is necessary to have a separate role, which will concentrate on the strategic issues and will not disturb other activities.

Five of interviewees mentioned that it would be good to have a special person who is responsible for the product and who is able to answer to questions about the product. In the current situation, all decisions about products were related to top and/or business management, depending on the company.

2) Organizations want to establish product management to increase processes predictability and profitability of their products

Organizations consider product management as a new way of increasing the profit from their products. They understand that there is no silver bullet, but systematization and standardization of processes such as strategy definition, roadmapping, and resource planning as well as making other decisions is required.

"I would be really happy if new product managers appear, because I observe many projects which do not have even a vision. It means that they do not know what their business is from the beginning and they have no chances to be successful. There should be somebody, who shows the way." – Interview 4.

3) Product management activities are fuzzy in the organizations because of the lack of understanding of core processes in product management

According to the Kittlaus and Clough framework [12], product strategy and resource planning are two core activities of product management. We observed that the organizations were lacking the positions of product managers. Therefore, core activities were distributed between activities which should have been orchestrated by a product manager. When product management is decentralized, it complicates decision making and strategy definition. All existing frameworks claim that there should be a person who knows the whole picture [1],[2],[12]. In case of decentralization, the overhead needed for communication and coordination consumes a lot of time and leads to mistakes. This viewpoint is supported by Table III in which eight people defined the role and focus areas of a product manager and focus areas in different ways.

4) Company context is the main factor affecting product management

All companies are unique as it was directly said by six of eight interviewees. However, only three of these six interviewees agreed that there are product management practices that could be applied in any product organization regardless its internal characteristics. Based on this observation, we concluded that *company context* is the main factor which affects product management. Product manager has to work in the prevailing culture and corporate structure of the existing organization. The citation from the fourth interview shows that each company thinks about its uniqueness. Other interviewees also mentioned this, but this example clarifies the phenomenon well:

"*This is a very specific company. We are the worldwide leader in the production of … so the company employs the best people in its field, including marketing and development. Planning does not work well here, because we are a very specific company and our best people know better what they do and how they do it without any written plans"* – Interview 4.

It is always difficult to change something in the companies, especially when the existing processes work somehow. The results of product manager work have a long-term impact on increasing profitability of the company. It makes the work of product manager work challenging, because she/he needs to develop strategic solutions, sometimes breaking the existing culture, but her/his results cannot be measured immediately.

C. Problems

Continuing our analysis, we identified three problems which exist in product management as follows:

1) Lack of delegation from top management to product managers

In all studied organizations, we observed that all decisions about strategy and plans regarding to the product are done in close collaboration with the top management. In fact, nobody in the company has the authority for making decisions about products except the top management. It is only possible to prepare a plan and get an acceptance from the top management.

"*Strategic management is implemented in the company very well, so the strategy is determined at the company level and each department acts as an independent unit, which has its own strategy. Then, this strategy is defended by the head of department to the top management of the company"* – Interview 8

"*[Who is responsible for the strategy? Product managers?] No, product managers are responsible for conversations, demonstrations, and gathering requirements. Strategy is developed by top management in our company*" – Interview 2.

As a result, the product manager does not act as "mini-CEO" [1] of the product, because she/he has no tools and authority for creating the right product mix, implementing right projects, and defining the winning strategy.

2) Lack of knowledge about product management

We observed that software product management is a topic of interest for software companies. Each of our interviewees showed interest to the topic and especially to the formalization of the existing best practices in product management.

"*I would be very interested to know how product management is implemented at the companies that are experienced and have a long history. Moreover, formalization of the existing knowledge is always helpful."* – Interview 6.

At the same time, there are still discussions about special characteristics of software in comparison to other products.

"*We need to show a difference between software products and software projects… I suppose that Body of Knowledge can be already drawn, which splits immediately into two parts: technological part and business part. If we are talking about software products, business part is the same to other products, but the differences in the technological parts are really huge… huge-huge"* – Interview 7

The problem of creating body of knowledge for product management or any other guidelines is a problem of balance between business and technology. It is necessary to find equilibrium between business and technology where product management takes place.

3) Mixing of product and project management

Lack of knowledge about product management leads to a mix of product and project management. Only one of our interviewee mentioned that these two types of management cannot be mixed together. Moreover, mixing could be dangerous, because managing software products after managing a software project requires *"changes in your mind and priorities"* (Interview 7). In the situation of the lack of the role of a product manager, his/her tasks are distributed between top managers and project managers.

"*Very often I observe a lack of product managers, because they are project managers… But these roles are completely different. It seems to me as a stable mistake. I really cannot say that I saw at least one company with a separate role of product manager… Sometimes, it happens, but when you begin to speak, it becomes clear soon that he is responsible for the project, release dates and other stuff like this. It happens, that there is a product manager that is a team leader, but it is not the right way."* – Interview 4.

V. Discussion

In this study we used the grounded theory method to understand product management. The number of interviews is rather small and therefore we consider the current results as preliminary. Despite of this small number of interviews, we observed theoretical saturation at the last two interviews. This suggests that our theory is valid in the parts we have reported here. Other parts of product management are still under observation and they will be reported later. We assume that the core category may be extended too, and new hypothesis will be generated.

The generalization of a grounded theory is often difficult and the results should be rather seen as general information for companies outside the study. Other limitations of qualitative research include its interpretive nature. The models and theories generated during qualitative studies are a result of description and interpretation conducted by a researcher. In our study, we have decreased this threat by the collaboration between the researchers and the participants: our final results are checked by other researchers and industrial experts who took a part in our research.

The necessity of having a product manager as a separate role has been discussed previously [1],[2],[12], but in practice this role is not well established in the companies. Companies understand that product manager should be responsible for a long-term product strategy [5] as well as tactical steps [8] that help to increase profitability of the products. At the same time, the companies do not have clear ideas about what product manager should really do at work. As a result, we observe a lack of understanding of product management and mixing of project and product management.

VI. Conclusion

In this paper, we presented the preliminary results of our empirical study on software product management. The focus of this study was in observing how software organizations of different size and business areas are managing their products. Our results showed that the companies are not familiar with software product management, but they showed an interest to the topic. Software companies faced the difficulties with introducing and managing software products in the competitive market. To survive in these highly competitive conditions, organizations have to change their priorities from implementing more and more new features to identify and satisfy their customer needs.

Product management by itself is quite an old discipline, but software product management has not been extensively studied empirically before. As a result, the knowledge is fragmented. Software product management is young and each company tries to find its best way of managing software products. We identified four main observations regarding the implementation of product management in organizations as follows:

1) Interveiwees understand the necessity to have a product manager as a separate role

2) Organizations want to establish product management to increase processes predictability and profitability of their products

3) Product management activities are fuzzy in the organizations because of the lack of understanding of core processes in product management

4) Company context is the main factor affecting product management

We also found three existing problems in software product management:

1) Lack of delegation from top management to product managers

2) Lack of knowledge about product management

3) Mixing of product and project management

An implication for future research from this study is that organizations need models, guidelines, and best practices for software product management. Our future research will continue by introducing, designing, testing and implementing new models for increasing the knowledge about managing software products. As a next step, we plan to conduct more interviews to better understand the implication of different software product management practices and activities on software products. Then, we plan to compare the results with the European companies. It will help to understand which problems are specific for the concrete region and which problems in software product management are unbiased regardless of company and cultural context.

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Publication III
Comparison of Software Product Management Practices in SMEs and Large Enterprises

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Comparison of Software Product Management Practices in SMEs and Large Enterprises

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Abstract. The aim of this interpretive qualitative study was to understand how software product management (SPM) activities differ in SMEs (small and medium-sized enterprises) and in large enterprises (LEs). We studied thirteen software organizations representing various types of software products and analyzed the collected data by applying the grounded theory method. As a result, we summarized the observations, explaining the main differences between SMEs and LEs and identified SPM activities that are size-dependent, size-independent, and specific for SMEs and LEs only. Our results indicate that the company size affects goals and activities of SPM. Therefore, companies of different size require different approaches in the adoption of SPM activities.

Keywords: Software product management, qualitative study, large enterprises, SMEs, grounded theory.

1 Introduction

Software product management (SPM) can be defined as "the discipline and role, which governs a product (or solution, or service) from its inception to the market or customer delivery in order to generate biggest possible value to the business" [1]. An empirical investigation of the projects in the industry suggested that focus on SPM allows the company to reduce cycle time in their business by 36%. SPM has also a major positive impact on quality [1]. From the business perspective, SPM plays a critical role in managing and achieving business goals by providing practices for the winning strategy in the market [2].

The existing software product management frameworks [2, 3] present a synthesis of SPM practices from observations and studies of companies regardless of their size. In general, organizational practices in enterprises of different sizes differ. For example, the studies [4–6] report on the differences in business activities between small and medium-sized enterprises (SMEs) and large enterprises (LEs). Similarly SPM practices are most probably different in organizations of different sizes. Understanding of these differences in the adoption of SPM practices by different kind of companies can offer a new viewpoint on further adoption of SPM practices.

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In this study, our specific objective is to identify the differences in the adoption of software product management practices in SMEs and LEs. We analyze the difficulties that product managers and organizations face in their day-to-day activities and how these difficulties vary depending on the company size. Another goal of this study is to identify activities related to software product management in different sizes of organizations. To achieve these goals, we chose the grounded theory research method introduced by Glaser and Strauss [7] and extended by Strauss and Corbin [8]. The grounded theory method allowed us to develop and verify our findings iteratively and identify new issues that have not been reported earlier [8].

The paper is organized as follows: we introduce the related work in Section 2. The research process and grounded theory method are described in Section 3. The developed categories and findings are presented in Section 4, following by discussion of the results in Section 5. Finally, Section 6 concludes the paper.

2 Related Work

Software product management is a complex discipline. There are many frameworks that identify its key areas [1–3]. These frameworks have overlapping parts, but their structure and terminology vary. For example, software product management components have been defined as functions [2] and process areas [3] in different frameworks.

The Software Product Management Framework suggested by Kittlaus and Clough [2] presents the major functions involved in product management with tasks to participate in or to orchestrate. The tasks are divided into two levels: corporate level and product (family) level that are differentiated by the level of authority and strategic impacts to the company business [2]. Another framework is the reference framework for software product management [3], which defines four main process areas with their inputs and outputs. These process areas are portfolio management, product roadmapping, requirements management, and release planning [3]. Other authors have proposed that activities such as finance [9], defect management [3], and software configuration management [10] should be considered as parts of SPM, too.

Both frameworks were developed empirically by interviewing and working with experienced product managers from the companies of different sizes worldwide [3]. Therefore, the frameworks are a result of synthesis of product management practices at these particular companies. However, goals, strengths, weaknesses, and other factors in SMEs and LEs are different [4] and therefore they may require different kinds of frameworks and approaches of SPM.

A study of software enterprises of the different sizes in Austria [4] compared strengths, weaknesses, opportunities and threats faced by the companies and concluded that “every identified discriminating endogenous success factor is viewed more negatively by managers of micro-enterprises compared to larger firms” [4]. The study also concluded that one of the main competitive advantages of SMEs is the ability to adapt rapidly to external changes. The main problem faced by SMEs is financial support, because their ability to attract venture investments decreases with

the company size. For large companies, the study identified three main strengths: financial resources, internationalization capabilities, and the business process of the organization. At the same time, the global business environment and competition in the global market were the barriers to further growth [4].

From the organizational viewpoint, SMEs seem to be more flexible and agile in reaction to the turbulent market changes. Large companies have all necessary resources including adequate human capital assets but they are unable to react effectively to external changes [11]. As the company grows, organizational processes and business model become well-defined. Christensen and Overdorf [11] discuss that changes in business models, values, and especially culture, are difficult, or even impossible, for large established companies. In contrast, smaller organizations are more flexible and their organizational structure can be easily tailored to achieve an advantage over larger organizations.

Overall, the studies on comparison of SMEs and LEs show the differences between these two types of enterprises. Most of these differences are related to business processes and activities [4, 11]. Thus a better understanding of the effects of company size to SPM practices is needed.

3 Research Method

Our goal is to identify common characteristics of software product management in the SME software companies in comparison with large software companies. We chose the grounded theory method because it allowed us to develop a study iteratively, without any assumptions in the beginning. The study is an interpretative qualitative study based on two critical assumptions [12]. The first assumption was that every software company has some kind of software product management, even if there is no special role of product manager in smaller organizations. In spite of this missing role, the tasks of a product manager must be handled and they are distributed to other roles. Our second assumption was that software product management processes in the companies are naturally progressing from chaos in SMEs to repeatable formal processes in LEs.

3.1 Grounded Theory

The grounded theory method was initially developed by Glaser and Strauss [7] as a pragmatic approach for conducting social science research [13]. Then, this method was divided into several branches. In this study we followed the Strauss and Corbin version of grounded theory [8], which relies on systematic codification and categorization process for observations. This approach is built upon two main concepts: *constant comparison* and *theoretical sampling*. The first concept is based on the idea that every piece of new information is compared with collected data to find similarities and differences. Therefore, data are collected and analyzed simultaneously. The concept of theoretical sampling shows an iterative process of theory building in which the next data sample is chosen based on the analysis of the previous samples.

The grounded theory approach contains three data analysis phases: Open, Axial, and Selective coding. During Open coding we coded the interviews with different aspects of software product management. Later we merged some of the identified categories and developed new categories. At the end of this phase we had 257 codes in 42 categories. In Axial coding, our focus was on the relations between the existing categories. We compared categories with each other and established relationships between them. These included associations, cause-effects, contradictions, and part–of relationships. At this stage, observations and codes became more focused on the phenomena under observation and we were able to continue with the identification of the core category. The purpose of Selective coding is finding the core category and explaining it [8, 14]. It may be one of the existing categories or a new category which has not been identified earlier. In our analysis we observed that most of our categories were grouped into four super categories. These super categories unite SPM activities in the context of company size as follows: *SME-specific activities, size-independent activities, size-dependent activities, and LE-specific activities.* Therefore, we identify the core category as *Effect of company size to the adoption of SPM activities*. Each of the super categories explains a part of the theory.

3.2 Research Sample

The companies in our study range in size from 15 employees to more than 10,000 employees and come from different business domains (Table 1). Nevertheless, all the companies were software companies developing commercial software products and systems for external stakeholders. We divided all the companies into two sample sets depending on their size. The first sample set represents LEs, while the second sample set consists of the SMEs. In this division we used the definition which classifies software companies as SMEs if they have less than 500 employees [15].

The interviews were conducted mainly in Moscow and Saint-Petersburg, Russia, but all the companies are international. The key informants were product managers and product marketing managers, but we also interviewed four technical specialists. Most of these companies have research and development departments in Russia and only two of them have local marketing and sales office only. In this study we did not collect information about the product management and development teams separately. Although our units of analysis [16] were product management and processes that support the product lifecycle, we did not provide any formal definition of software product management during the interviews. It allowed us to conduct flexible interviews with a focus on the interviewee's understanding of what product management means. Each interview started with asking the interviewee's view on the definition of software product management. Based on this definition, the interview continued with additional questions regarding these activities to identify activities which were perceived to belong to SPM.

The semi-structured interviews lasted from 40 to 80 minutes with an average of 52 minutes. The selection of interviewees was guided by our existing contacts and snowballing [8] in which the next interviewee was a referral from the previous one. The interviews were recorded and transcribed manually. The analysis of the collected data was performed with a special tool for qualitative research, ATLAS.ti [17].

Table 1. Company profile and interviewee role

Company	Business domain, type of product	Size (people)	Founded	Role of interviewee
Sample set 1: LEs				
A	Business and operational support systems	10,001+	1982	Product manager
B	International developer and supplier of a wide range of software, integrated solutions and hardware technologies	1,001-5000	1990	Deputy managing director for R&D
C	Internet applications	1,001-5000	1997	Two product managers
D	Security solutions	1,001-5000	1997	Product manager
E	Storage management solutions	501-1,000	2002	Product manager
F	Developer and provider of telecommunication solutions, software and hardware	501-1,000	2007	Department manager
Sample set 2: SMEs				
G	Date security and storage management	101-500	1994	Product manager
H	Integrator and developer of software for SME	101-500	1994	Deputy director of software development
I	In-house development of IT solutions	101-500	2000	Senior business analyst
J	Developer of software tools	101-500	2000	Product marketing manager
K	Provider and developer of interactive media solutions	101-500	2002	Team lead, project manager
L	Banking software	101-500	2004	Two product managers
M	Developer of software products for servers	11-50	2009	Sales director, technical director

4 Results

The main feature of grounded theory is that findings are tested and revised during the research, so at the end of research these findings are verified by new observations [18]. We compared our observations of the SMEs and LEs with each other and developed the results based on the constant comparison guidelines [14].

4.1 Categories

We focused on the comparison of software product management practices in SMEs and LEs. This resulted to four super categories with subcategories (Figure 1) showing how company size affects on SPM activities.

Size-independent activities, which include *development, lifecycle management, business analysis, product requirements,* and *sales,* were done similarly in both SMEs and LEs. Both types of companies knew these activities and implemented them similarly taking into account their own specific characteristics.

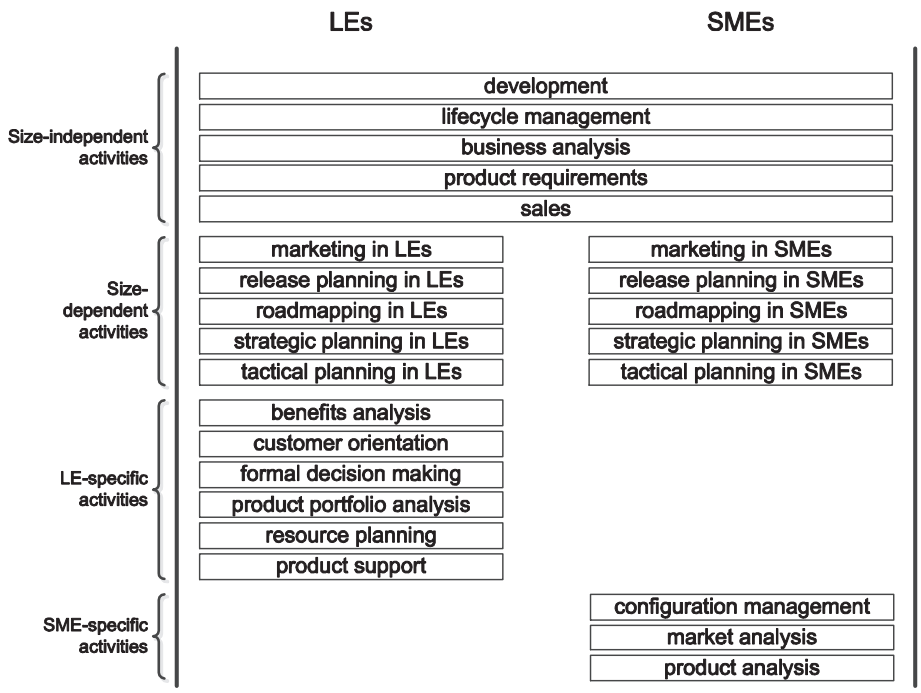

Fig. 1. Central categories explaining the differences and similarities in the activities of SMEs and large enterprises (LEs)

SME-specific activities such as *configuration management, market analysis,* and *product analysis* were typical for SMEs only. Although configuration management has been described as a necessary part of SPM [10, 19], recent frameworks [2, 20] do not separate this activity from *development*. We observed that when talking about SPM activities product managers in SMEs concentrated on technical aspects of product development rather than on business aspects. They described *development*, *configuration management*, *product requirements* and *release planning* as the central parts of SPM. Business oriented activities such as *market analysis* and *product analysis* were not considered as important as technical details of the product development. All interviewees in SMEs mentioned *market analysis* as a part of SPM but this activity was sporadic and informal. We also found out that SMEs are focused on *product analysis* in comparison with *product portfolio analysis* observed in LEs. SMEs have a limited number of products, usually only one product, so *product analysis* defines the company revenue and the possibility for further growth. This explains why our interviewees paid so much attention to talking about revenue as a result of *product analysis*. LEs usually have a large portfolio of products, so they conduct *product portfolio analysis* to analyze the total balance. Even if some products were unprofitable, the companies had other products and, in the end, the company balance was positive.

LE-specific activities include *benefits analysis, customer orientation, formal decision making, product portfolio analysis, resource planning,* and *product support.* In comparison with SMEs that concentrated on development issues, LEs were

different. Product managers in LEs were focused on the *benefits analysis* and *customer orientation* with much less emphasis on *development*. They considered *development* as a black-box with a specification as the input and the new version of product as the output. In comparison with SMEs, which seem to be more technically oriented, LEs practiced customer oriented approach with the focus on *benefits analysis,* which the product provides to the customers. The product managers in LEs were responsible for the identification of customers' needs, collaboration and communication with the customers rather than for technical details of product implementation. *Resource planning* in the LEs was also considered as an important activity for product management. Usually this was supported by Enterprise Resource Planning (ERP) systems that helped to distribute resources between existing products [21]. Another specific characteristic of SPM in the LEs was the increasing role of *product support*. SMEs did not pay much attention to *product support* because the number of products and versions was limited and the products were not very old. LEs had to support all products and versions they had launched for a long period of time. Therefore *product support* had become an activity requiring deep analysis and attention. Another characteristic of the LEs was that because of broad responsibilities, the top management had to delegate their power and authority to product managers and other roles. Therefore, product managers in the LEs had power and authority for making decisions without consulting with higher management. Moreover, the procedure of decision making was formal in comparison with SMEs with their informal procedures of decision making. *Product portfolio analysis* in *LEs* consisted of many formal procedures and methods such as Quality Function Deployment (QFD) [22], Porter Five Forces analysis [23], and Delta model [24]. In addition, all studied LEs had a separate department that conducted market and customer analyses and provided necessary data to product managers. Overall, LEs were more advanced and sophisticated in adoption of SPM practices. They also used more formal techniques and methods than SMEs.

Finally, *size-dependent activities* unite five SPM activities: *marketing, release planning, roadmapping, strategic* and *tactical planning*. The adoption of these activities was significantly different in different-sized organizations. *Marketing* in LEs consisted of global, local and product marketing. In SMEs this kind of division was rarely observed and their understanding of marketing resembled closely to public relations (PR) [25]. SMEs did not make a difference between *release planning* and *roadmapping* because their number of products was limited and they did not have enough resources for long-term planning. Therefore, they typically created a release plan for one to three iterations. This issue was related to lack of investments and additional resources for long-term planning. In LEs *roadmapping* included all products for a period from one to three years. This roadmap was the outcome of *strategic planning* representing tactical steps for achieving the defined business goals. *Release planning* in LEs was seen in a frame of one product. In SMEs we also observed poor *strategic planning*. It was explained by these companies as a high level of uncertainty in the market environment. SMEs were market-driven and tried to adjust to the existing conditions. In opposite, LEs developed their strategic and tactical plans according to internally defined vision and goal. External conditions did not play as important role as for SMEs because LEs usually had enough resources for ignoring transient fluctuations in the market. As a result, SMEs were more flexible than LEs, but LEs had an advantage of concentrating in *strategic planning*.

4.2 Findings

Based on the described categories and analysis of observations we summarized them as three findings that generalize and explain the main differences and similarities between SMEs and LEs.

Finding 1: LEs are customer-oriented while SMEs are technically oriented
LEs consider their customers as the central part of their business. Their product management activities are customer focused that means close collaboration with the customers from requirements to support. Moreover, LEs pay more attention to usability issues than SMEs. In LEs software product managers are eager to talk about customers, their needs and wishes and how the company is satisfying these needs.

"I would like to tell you about our customers, because they are important to us. We have several channels to collaborate with them. First of all, our support is responsible for the rapid feedback to simple questions. The more complex issues they redirect to me. The second channel is an analysis of user actions, i.e. maps of their movements at the website, requests, and actions. A lot of analytical information that helps us to understand what is wrong and should be improved." - Product Manager A, Organization C

SMEs seem to be more technically oriented. They consider their technologies as the core competence in the business. Therefore, software product management in these companies is focused more on managing product development than strategic planning and collaboration with customers. Many software companies have grown from small technological companies run by engineers and technical people, which possibly explain this behavior.

"I think it is important to start by describing our product. Our product is a system consisting of hardware and software. The hardware is a standard server, which is mounted in a rack full of hard drives. This server runs our special software that implements algorithms for reliable preservation of data. So, let me briefly describe the technical side of our solution…" - Sales Director, Organization M

Our observations suggest that customer orientation is a must for LEs while SMEs can survive in the market by concentrating on technical excellence in their products.

Finding 2: LEs have strong and powerful product managers while in SMEs product managers have a limited authority
LEs have a multitude of products, projects and other issues to manage. Therefore the top management must delegate their power and authority in management of products to product managers who usually act as a product "mini-CEO" [1]. Sometimes the top management limits decisions of product managers to small tactical decision only, but despite of that the power and authority of product managers are much stronger in LEs when compared to SMEs.

"Product manager should be a director of a small enterprise within the company. It is a small independent company with its own budget and resources. After all, the most efficient scheme is when the responsibility and authority are not shared between people. The worst thing that can happen in a software company, in any company, is when the people who use resources and the people who are responsible for product management are different. Moreover, a product manager should have power of

decision making. Otherwise, he is not a product manager." – Product Manager B, Organization C.

The roles of product managers in SMEs are often unclear because they are not allowed to make decisions and their influence on strategic planning, product roadmapping and other activities related to the product is limited. Therefore, their role varies from being an adviser to a facilitator who orchestrates activities between departments.

"No results of our work are obligatory for implementation. We are just doing some research and recommend things, explaining what is wrong and providing solutions on how it should be done. The final decisions are made by the top management or an engineering team." – Product Manager, Company G

The limited role of product managers in SMEs is usually an outcome of lack of delegation from the top management. It seems that SMEs hire product managers too early, when the top management is not ready to delegate their own power and authority to product managers who are responsible for the product. This makes the role of a product manager in the company unclear.

Finding 3: LEs rely on strategic planning while SMEs are tactically oriented

Even several unprofitable years may not be a problem for LEs, but for SMEs they can be critical. LEs also have their long history of product releases that makes it necessary to concentrate on long term support as well.

"There is a big difference between releasing once and creating a product, which will get 4-5 service packs and 10-11 patches in the future. Therefore, we cannot rely on the short term cost cutting actions. We always think strategically, sometimes we skip possibilities to get easy money now, because we understand that it affects our long term strategy." – Product Manager, Organization D.

SMEs are more vulnerable to external conditions. Therefore their market environment requires more reactive orientation. SMEs must pay more attention to new technologies and trends in the markets. This leads to more tactical orientation and a shorter-term view on strategic planning where the horizon is rarely longer than one year.

"Roughly speaking, product management is not concerned with planning, but with the feedback from our users, our plans depend on what they want and need… We operate on this basis meeting their needs, using a problem-oriented approach. In our case, the risks are much greater than if we did planning. I mean that our competitive advantage is to react to the users requests as fast as possible, so planning is useless…" - Project Manager, Organization K

"*This is a very specific company. We are the worldwide leader in the production of [Product] so the company employs the best people in the field, including marketing and development. Planning does not work well here, because we are a very specific company and our best people know better what they do and how they do it without any written plans."* – Product Marketing Manager, Organization J

SMEs try to be agile and flexible in the turbulent market and, therefore, long strategic planning may be reduced in this type of companies. The strategic and tactical planning are tightly coupled together, but the main problem is the balance between them. Strategic planning provides a bird-eye view to the company business in the future, while tactical planning suggests steps in achieving this strategic vision. We

observed that all the companies faced difficulties in finding the right balance between strategic and tactical planning, but SMEs are in a worse position because their resources are limited and they have to react to changes faster.

5 Discussion

The results of this study consist of activities and three findings that describe the differences between software product management practices in SMEs and LEs. In this study we identified empirically the activities related to software product management. We concluded that the viewpoints to software product management activities are different for SMEs and LEs. For example, SMEs considered configuration management as a part of SPM in contrast to LEs. The idea about close relationships between configuration management and SPM has already been suggested by Kilpi [10], who also studied small companies. Other identified activities specific to LEs as well as activities common to both SMEs and LEs have also been mentioned in existing frameworks [2, 20].

We observed that SMEs have a tendency to be more technically oriented in their product development processes than LEs, which are more customer oriented. This finding fits well with the Christensen and Overdorf claim [11] that lack of resources in SMEs is not so important because their organizational structure allows managers to proceed intuitively and "every decision need not be backed by careful research analysis" [11]. The technical excellence for SMEs is a must for competing with LEs. We identified that three activities *configuration management, market analysis* and *product analysis* are specific for SMEs only. As company grows, these activities shift to other departments such as development and marketing.

Literature on software product management describes a product manager as a "mini-CEO" [1, 2, 26, 27] of the product. In this study, we found that this is possible in LEs only. In LEs, top management must delegate part of its power and authority to product managers. In SMEs this did not happen. The product managers in SMEs are responsible for operational and tactical activities rather than for strategic activities and decision making. Another study [28] shows that in SMEs decisions about strategy and plans regarding to the product are done by the top management or in a close collaboration with the top management. Our study supports this with new observations from software companies.

In [4] it was shown that LEs have a better position for attracting capital, including venture capital, than SMEs. In addition, LEs have a long-term product portfolio generating a steady cash flow. This allows LEs to think strategically and to plan their roadmap for the next three to five years. Moreover, LEs usually have internal resources allowing them to survive during unprofitable periods. This is not possible for SMEs, which are more dependent on a short term external turbulent situation in the market [28].

There are several threats to the validity of this study [29]. Strauss and Corbin [18] emphasized the fact that using a grounded theory approach we create a theory, which is dynamic rather than static and can be extended by adding new data. Therefore, by increasing the number of the studied companies, we could reveal more details. However, already this number of companies enabled us to identify the differences

based on company size. In addition, we noticed that the coding started to saturate – the late interviews did not bring any essential new details to the analysis. We did not have a goal to identify all possible differences but to show that these differences exist. Our study also has a territorial bias because we conducted the interviews in Russia only. We tried to decrease this bias by choosing international companies with offices in Russia. The snowballing is an additional risk for the external validity but in this study only three of seventeen interviewees were referrals. Grounded theory tends to produce credible results, because the theory development is based on the method of constant comparison in which categories and concepts repeatedly emerge and guide the continuous research [7].

6 Conclusion

The objective of this study was to understand how SPM practices differ in SMEs and LEs. Based on the empirical observations, we identified and verified three findings, which represent these differences between SMEs and LEs.

We found that LEs are more customer oriented and pay more attention to strategic planning. SMEs are more technically oriented and they rely on tactical planning. Their plans depend on the external conditions and on the situation in the market. We also observed strong and powerful product managers in LEs who acted as the products "mini-CEO". In comparison, their colleagues from SMEs did not have authority to make decisions. In SMEs most decisions were made by top management and product managers acted as advisors and facilitators in solving problems arising between departments.

We also identified activities related to software product management. Although there are several activities that are common to all companies regardless of their size, there are also SPM activities that are specific for SMEs and LEs only.

The results of this study show that SPM activities and goals are different for the companies of different sizes. Therefore, product management cannot be implemented in the same way in every company. There are specific characteristics, such as size in our case, which should be taken into account in the adoption of software product management.

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Publication IV
Lean Solutions to Software Product Management Problems

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Lean Solutions to Software Product Management Problems

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// Although the discipline of software product management plays an important role in the development of successful products, each company adopts its practices in its own way. This article identifies five problems that lean principles to software product management can help an organization avoid or solve. //

THE CONCEPT OF product management was introduced in 1931 when Procter and Gamble hired a specific person to take the responsibility for managing one product.[1] After this successful experience, other companies began adopting the practice of assigning product managers. Software product management (SPM) is "the discipline and role, which governs a product (or solution or service) from its inception to the market/customer delivery in order to generate biggest possible value to the business."[2] SPM has a positive effect on software products' quality, profitability, and predictability and plays a critical role in managing and achieving business goals by providing practices for winning strategies.[3] For example, Christof Ebert reports that emphasis on SPM helped a telecommunications company reduce its release cycle time by 36 percent and improve quality by 80 percent compared to the initial estimates.[2]

SPM covers many disciplines, such as strategy, release planning, pricing, software configuration management, and road mapping.[4] Implementation of SPM practices suggest a long and thorny road in adopting many processes, tools, and components with results in a distant future. We studied 13 software organizations that had already started adopting SPM practices. By observing these organizations, we identified some of the common problems they face and concluded that implementing lean principles would make SPM adoption easier.

Lean Principles

Lean management philosophy focuses on increasing value by eliminating waste. The five principles of lean philosophy are value, value stream, flow, pull, and perfection.[5] These describe the central concepts of lean thinking for implementing a way to deliver products that satisfy customers while using fewer resources. These principles have been developed on the basis of the 14 original principles of the "Toyota way"[6] and provide a straightforward mapping to continuous process improvement. Other research has adapted the original principles to software development,[7] but because SPM isn't limited to development only but also covers disciplines such as product management, business development, marketing, sales, and support,[2] we wanted to take a broader view of lean. Scrum-based agile product management has also gained increasing interest in industry lately;[8] following the theme of this special issue, we offer a complementary view on SPM from the lean principles

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viewpoint that we hope will fill the gap in current literature.

Value

The main purpose of each product or service is to provide additional value to a customer. Identifying product value for a specific customer is coupled tightly with the product development vision and strategy. It's also the first step in understanding why a company exists in the market. A company's lack of understanding its own business and the value it provides to customers leads to it focusing on short-term issues and minor cost-cutting actions.[5] As the company grows, these actions will take more and more time without providing additional value to customers.

Value Stream

After the value has been identified, it's necessary to establish a value stream map that includes all the steps from concept to delivery. Mapping the value stream aims to identify and remove any steps that don't create value. It allows the company to eliminate superfluous steps and decrease the cycle time. Eventually, the company's efficiency grows, and it can provide more value to customers using fewer resources.

Flow

After the steps that don't create value have been eliminated, a company must smooth out the value creation process. To achieve this, lean suggests focusing on the whole value creation process instead of working in isolated departments. Reorganizing the production from a department and batch-and-queue fashion to a continuous flow increases productivity and decreases errors and the amount of resources needed. The main problem here is that "flow thinking is counterintuitive"[5] because we're used to working in departments with function separation. This leads to a situation in which each department works as effectively as possible on its own batches, but the whole production efficiency is defined by the least efficient link of the chain, manifested by intermediate storages between the departments.

Pull

Pull means that the customer sends a product request and the company provides the product, satisfying the customer's needs as soon as possible. Adopting the flow process reduces the time from concept to delivery. Moreover, because of customer pull, the company avoids production and storage of unwanted products. As a result, the company's products satisfy the customer's needs and wishes.

> The lean philosophy suggests concentrating on a set of principles and a way of thinking to increase efficiency.

Perfection

The final step is to analyze the results and plan for any implementation. Whereas the other four lean principles focus on what to do, this fifth focuses on how to actually do the actions. The lean philosophy suggests concentrating on a set of principles and a way of thinking to increase efficiency and profitability gradually and incrementally with a long-term focus.

Software Product Management in 13 Organizations

We studied 13 organizations to get a general understanding of how SPM practices are adopted. The organizations varied in size from 15 to more than 10,000 employees and represented the telecommunications, software product, or software service sectors. All the organizations were Russian R&D units of international corporations except in two cases where only marketing and sales offices were available. The study was based on 17 interviews and 12 documents from the studied organizations. We started the interviews with operational personnel (from Organization K in Table 1), but because their knowledge of product management issues and processes was limited, middle and top management became the key informant group for the study.

We audio recorded the interviews and transcribed them for qualitative analysis using the grounded theory method.[9] The interviews lasted from 40 to 80 minutes, averaging 52 minutes. The 12 documents included descriptions of strategies, release planning, positioning, road mapping, and other SPM-related activities.

Our first analysis focused on the main problems in adopting SPM practices. The analysis indicated that the problems weren't company specific, so we continued with a root-cause analysis, using the current reality tree (CRT) technique from the theory of constraints.[10] Compared with other root-cause analysis tools, such as cause-and-effect diagrams, CRTs make it easier to follow "if-then" logic to precisely identify root-cause

TABLE 1

Organizations studied for software product management–related problems.

Organization size	Organization and business domain	Interviewee role(s)	No. of employees
Extra large	A. Business and operational support systems	Product manager	10,000 +
Large	B. International developer and supplier of software, integrated solutions, and hardware technologies	Deputy managing director for R&D	1,001–5,000
	C. Internet applications	Two product managers	1,001–5,000
	D. Security solutions	Product manager	1,001–5,000
Medium large	E. Storage-management solutions	Product manager	501–1,000
	F. Developer and provider of telecommunication solutions, software, and hardware	Department manager	501–1,000
Medium	G. Data security and storage management	Product manager	101–500
	H. Integrator and developer of software for small- and medium-sized enterprises	Deputy director of software development	101–500
	I. In-house development of IT solutions	Senior business analyst	101–500
	J. Developer of software tools	Product marketing manager	101–500
	K. Provider and developer of interactive media solutions	Team lead and project manager	101–500
	L. Banking software	Two product managers	101–500
Small	M. Developer of software products for servers	Sales director and technical director	11–50

problems. Our analysis showed that the main problems that we addressed with lean principles are typical.

Problems in Software Product Management

Our problem analysis surfaced five problems that lean principles can address.

Problem 1: Long Release Cycle

Even product managers had difficulties describing the product life cycle from concept to delivery. The companies were organized as separate departments, contradicting the lean principle of flow. Because an organization can't easily change its existing structure,[11] the first step in implementing lean principles is to effectively organize collaboration among units. The main source of waste here is the sequential nature of work in units, which leads to constant switching between activities for each department. One product manager described the product life cycle as follows:

> *When the product is accepted for implementation, the next step is release planning. When all this preliminary work has been done, the product manager initiates development and waits until the product is ready. When the product is ready, marketing starts to prepare the positioning strategy. Then, support and analytics provide feedback about the product.* —Product Manager 1, Organization C

In the described situation, every department was an isolated unit acting independently and focusing on its own work instead of thinking about the whole product. We observed a lack of understanding on how the product life cycle worked and where the main sources of waste were hidden.

The most common bottleneck was development. For people outside the development department, it looked like a black box with a feature list as an input and the product with partially implemented features as an output. Our interviewees mentioned several times that the development process was unpredictable. Therefore, development prevented other departments from proceeding, because they didn't know the product they would get after development:

> *Toward the end of product development, product marketing starts to work because they have to describe what was developed. During the development, many features are cut off, changed, or skipped, and that is why they cannot start their work earlier.*

They just do not know the outcome of the development stage. Even predictions look like speculations here because, in our experience, it has never worked. The product always changes very much before the release compared to the initial estimations.
—Product Manager, Organization D

Altogether, these issues lead to a long release cycle (see Figure 1). Out of the 13 organizations, we found this problem in all the organizations except G, J, and M, which were small- and medium-sized companies. In small Organization M, all the processes were chaotic and immature, which led to short-cycle parallel activities of product analysis, development, marketing, and sales. Moving from sequential to parallel implementation of activities would improve the situation in large organizations as well. For example, regarding the quote from the product manager of Organization D, marketing wasn't able to do its work because it didn't know which features would be implemented in the next product version. In general, this problem can be solved by applying the lean principle of flow, which underscores the importance of a smooth value creation process.

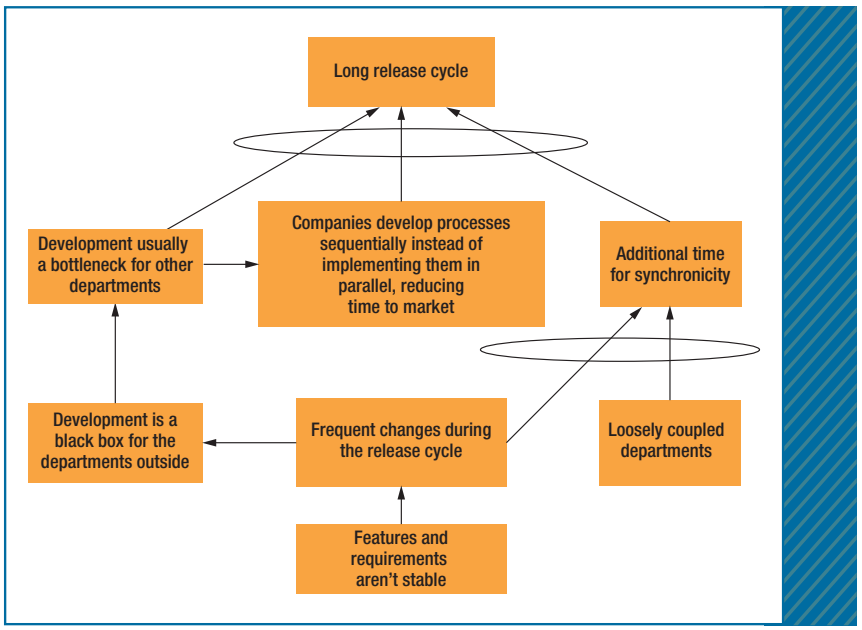

FIGURE 1. A current reality tree for the long release cycle problem. Arrows indicate causality, and ellipses represent the logical AND operation between them.

Solution 1: Using Flow to Decrease Time to Market

Lean practices can make the development process more predictable in terms of implemented features at the end of iteration, because iterations are short, features for implementation are known at the beginning of the iteration, and adding new features during the iteration is forbidden.[7] This knowledge helps the marketing department start its work earlier without needing to wait until the end of the iteration. Consequently, the time to market is reduced. Therefore, lean practices at the enterprise level allow a smooth flow for each product in which all units work together. The main problem of such adoption is the necessity for synchronization among all the units; the product manager can solve this by acting as a release-planning specialist.

Problem 2: No Metrics for Evaluating Work

In all the organizations, the product managers responsible for the whole product had no key performance indicators (KPIs). Some used a related practice, management by objectives, but the procedure of identifying these objectives was open for speculation. The most common comments can be summarized by the following two quotes:

I do not have any KPIs for evaluating my work. My work is about preparing everything on time and on budget… mean[ing] product releases and technical specifications of the product and everything that is connected with it.
—Product Manager 2, Organization C

Nobody thinks about our performance. It is not estimated. Our main goal is to release the product on time. I was responsible for that, together with the project manager. When we failed the release, nothing awful happened. We have continued to work without any penalties. So, in reality, no KPIs are used. I think that the KPIs should be related to the financial indicators.
—Product Manager, Organization G

Although the product managers were positioned as product owners, in reality, their authority was limited. Moreover, it's difficult to evaluate product managers' performance because there are no generally accepted measurements for their work and their effect on the developed product:

There were people doing a lot of work in small and difficult projects. There were also people who did little work, but [whose] projects were already

successful in the market. From the higher management perspective, they could not measure anything because both products were successful. It did not matter for them that the amount of work differed by a factor of five; they did not even realize it. No, we did not have universal KPIs. —Product Manager, Organization D

Solution 2: Using Value to Identify Key Performance Indicators

Lean thinking advocates the use of metrics for evaluating and improving activities and the whole value stream.[5] The product manager's KPIs should represent the company's goal for the product in a numerical form and should show the performance of the whole team that the project manager orchestrates. Concerning these two criteria, the product managers' KPIs are related to their products rather than to their personal characteristics. Therefore, the steps in identifying the KPIs include understanding the company's goals, identifying numerical indicators for tracking goals, performing as a team, and succeeding with the product.

Problem 3: Collaboration between Organizations and Customers

Some of the organizations were very customer oriented, but not all of them. In an extreme case, we observed speculations about customers' needs and wishes when there was no collaboration with the customers at all:

The decisions about new product development were made internally. Development was based on our own assumptions about the customers' needs. We did not test this product with the customers. We did not conduct surveys; we did not speak with the focus groups. We did not do anything to understand the customers' requirements and the niche for this product in the market. We hoped that when we released the product, someone would buy it and provide feedback. Based on this feedback, we would fix the product so that it fit the customer. —Product Manager, Organization G

Consequently, fitting customer needs takes a lot of time. The product release will possibly be delayed, and the organization might lose the opportunity to hit the market earlier than its competitors. We found this problem in eight of the 13 organizations, which were all small and medium sized, but not in the five large organizations (A–E).

Solution 3: Using Pull to Develop Products Faster and with Fewer Resources

According to the lean principle of pull, a product's life cycle starts with a customer request. Relatively new organizations usually indicated that product analysis takes too much time. They considered it a waste, because they thought it would be easier to fix and tailor the product after the first release, based on customer feedback.

> According to the lean principle of pull, a product's life cycle starts with a customer request.

More mature companies knew that this is a myth. Their representatives reported that it is much faster and easier to start working with customers from the beginning, understanding their needs, and developing a product based on the design developed in close collaboration with them. It saves time, the product will be delivered faster, and there will be more functionality to satisfy customers. As an experienced product manager noted, "Each euro invested in the product analysis saves 5–10 euros in the following development and support steps"—(Product Manager 2, Organization C).

Problem 4: Short-Term Thinking

We expected to see problems in organizational visions and strategies, but we didn't realize how common these issues were. Almost all the studied organizations concentrated on short-term actions, such as implementing trendy, new, and modern development processes without a deep analysis of their outcomes, or developing many products in parallel without understanding the company's core business. Even the top managers weren't ready to discuss their plans on the one-year horizon:

Frankly speaking, I have never seen road maps that would have lasted for over a year. I do not know of such examples. By the way, a road map is always an assumption, and it has its own credibility. In our dynamic internet environment, the product plans change every week, but they consist of small tasks. This has an impact on the major releases. The environment is so dynamic that you should react to it immediately. You do not have six months or more for a major release. Therefore, you have only a week to implement something and you do not have time for detailed analyses. —Product Manager 1, Organization C

All but one of the studied organizations (F) developed strategies for one year only. Consequently, the organizations frequently change their vision and strategy, trying to match it with external conditions. Therefore, they lose the opportunity to create a niche, to fill it,

to get expertise in it by protecting the intellectual property, and to achieve excellence in the chosen field, leaving competitors behind.

Solution 4: Using Perfection to Adopt Long-Term Thinking

The topic of long-term thinking versus short-term actions for gaining quick profit is widely discussed in the lean literature.[5,7] Adopters of lean thinking[5] as well as the classics of strategic management[12] have discussed the advantages of long-term strategies. Short-term actions often occur as reactions to external conditions, such as new features implemented by competitors. When a company follows its competitors closely, it finds it difficult to achieve its own excellence in any area. A long-term strategy lets a company simultaneously deliver unique value to the customer, reduce its own costs, and increase efficiency. More importantly, the company acts independently according to its internal goals, rather than just reacting to its competitors.

Problem 5: Trying to Change Instantly

Product management is a complex discipline consisting of many activities. For example, the Pragmatic Marketing Framework (www.pragmaticmarketing.com) consists of 37 activities, but, in reality, each product manager is only responsible for three to five of them, according to the annual survey. Hans-Bernd Kitlauss and Peter Clough's Software Product Management Framework includes 49 activities orchestrated by a product manager.[3] Although small, medium, and large organizations have many differences in their adoptions of SPM practices,[13] the decision to introduce all SPM activities at once causes many difficulties regardless of the company size. In one interview, a department manager mentioned the following:

> *We have just hired product managers, but we have not defined their activities yet. Our main area for improvements is to tune our production processes based on the customer and market needs…. We also have to implement software product management in a new way, because currently we have only a business team consisting of about 10 people who are responsible for all business, marketing, and sales issues.* —Department Manager, Organization F

The problem of radical changes didn't come up in extra-large and large organizations (A–D). It seemed that they know from previous experiences that radical changes are risky.[11,14] Therefore, they're more comfortable with carefully planning and preparing for each initiative for a change, and even learning to manage the increasing complexity of SPM within their large organizations.

Solution 5: Using Perfection for Incremental Changes

Although radical changes, or *kaikaku*, can sometimes be necessary, lean doesn't advocate it. Instead, it suggests *kaizen*, or small, simple, incremental changes that allow the organization to identify existing problems early and nip future problems in the bud. Large organizations might have the necessary resources to do this, but could lack the ability to react effectively to external changes. Moreover, for large organizations, changes in business models, values, and especially in culture are difficult or even impossible.[11] Therefore, radical changes can have critical

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negative consequences, whereas practicing kaizen philosophy allows the organizations to manage small changes more smoothly and carefully.

In the competitive software market, it has become increasingly important to deliver products on time and to decrease the cycle time from customer request to delivery. SPM suggests practices, methods, and tools for achieving these goals, but the adoption of SPM includes challenges that are common for most organizations. Using lightweight lean practices for SPM enables companies to concentrate on the most important and easy-to-implement practices of product management with constant incremental improvements.

Product management and lean have similar features, such as the central role of value and attention to customer needs. Thus, the unification of these two approaches could benefit the software industry. If your organization already practices lean software development,[7] we invite you to extend this approach in the broader context of SPM, including strategy, marketing, sales, and support activities, to achieve excellence in the marketplace.

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Publication V
What Do Practitioners Mean when They Talk about Product Management?

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What Do Practitioners Mean When They Talk about Product Management?

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***Abstract*—This industrial experience paper presents the results of a survey with an open-ended question designed to clarify how product management practitioners understand the term product management. The survey was conducted through a public LinkedIn group for a period of nine months. During this timeframe it received 201 responses. The responses were analyzed qualitatively to identify the essential components and properties of product management from the practitioners' viewpoint. In comparison with the existing product management frameworks and definitions, the responses showed a tendency to mix product management and product marketing. Although the respondents had difficulties in naming all product management activities, we identified six that represent the core activities of product managers in the industry. The findings have implications for the evolution of product management frameworks to address the interests of a wider range of product managers and the development of common understanding on the necessary skill sets for the education and recruitment of product managers.**

Keywords-product management; grounded theory; qualitative research; survey

I. INTRODUCTION

Practitioners and researchers mean very different things when they talk about product management [1]. The lack of standards and common definitions leads to misunderstandings between professionals and to attempts to explain the phenomenon of product management through the prism of the product manager's role. For example, Gorchels [2] describes the product manager's job "to *oversee all aspects* of a product or service line to create and deliver superior *customer satisfaction* while simultaneously providing *long-term value* for the company". To create a successful product, the product manager is involved in the process of requirements elicitation, prioritization, and selection [3]. In this regard, product management overlaps with requirements engineering in general and market-driven requirements engineering (MDRE) in particular [4]. However, the product manager's role is not limited to selection of features. The role has a strategic and tactical impact on all the aspects related to product analysis, development, marketing, and sales. Therefore, the product manager is often described as a *mini-CEO* of the product [2], [3], [5], but, in practice, "even within the software industry, the definition and role of the Product Manager varies widely" [3]. Product managers may have various job titles while doing the same things and the same job title when doing very different things.

The inconsistency and fuzziness of product management have been discussed widely before [1–3]. For practitioners, the lack of common understanding of product management leads to difficulties in communication and collaboration, because their scope of work varies from one organization to another. It also has a negative impact on product management education because there may be a gap in understanding the product management activities between the product manager and the provider of training. This unclear nature of product management led us to design a survey on product management. The purpose of the survey was to find inconsistencies and gaps in the understanding of product management among practitioners and to compare the definitions given by practitioners with the product management literature, to identify differences in understanding between researchers and practitioners. Our research question was "*What is product management from the practitioners' viewpoint*?" To answer this question, a survey with one open-ended question was published in a public LinkedIn group for product management professionals, allowing them to answer this question freely but briefly.

The paper is organized as follows: we introduce the theoretical background in Section II. The research process and the method are described in Section III. The results are presented in Section IV, followed by a discussion in Section V. Finally, Section VI concludes the paper.

II. THEORETICAL BACKGROUND

Product management is described as a complex discipline which includes many activities, such as requirements engineering, release planning, finance, and others [1]. Moreover, the components of product management and the product manager's responsibilities vary a lot from one organization to another. The Annual Product Management and Marketing Survey [6] explores the responsibilities of product managers worldwide. According to the 2010 survey, the most frequent responsibilities of product managers were *product roadmap (91%), requirements (86%), market problems (77%), use scenarios (74%),* and *competitive landscape (73%).*

The survey [6] also indicated that product managers' main responsibilities included a selection of features or requirements for the next product release. MDRE as a

discipline focuses on issues of requirements elicitation, analysis, and documentation under the pressure of time-to-market [4]. As in product management, in MDRE requirements are gathered externally from customers and partners and internally from developers, marketing managers, and sales managers [7]. In this regard, we may consider MDRE as a part of product management and as the main area where the product manager works to make the product successful in the marketplace.

In the literature, a product manager is described as a *product champion* or *mini-CEO* responsible for the success of the product. The product manager's responsibilities vary from engineering tasks, such as requirements engineering and close collaboration with an engineering team to marketing tasks, such as communication with the customers for defining their needs, wishes, and market trends [2], [3], [5].

The framework developed by the International Software Product Management Association (ISPMA) [8] represents a consensus between academic and industrial experts in software product management and integrates three product management frameworks developed earlier [9–11]. The Software Product Management Framework suggested by Kittlaus and Clough [9] presents the major functions involved in product management with tasks to participate in or to orchestrate [9]. The product manager's tasks are divided to the corporate level and product level, which represent the strategic and tactical levels of product management. In total, there are nine functions in which the product manager participates. Product managers are differentiated from each other by the level of involvement in each of these functions. The framework proposed by Ebert [11] is similar to the framework of Kittlaus and Clough [9], but Ebert emphasizes the leading role of the product manager in providing leadership to activities like portfolio management, strategy definition, product marketing, and product development. The reference framework for software product management defines four main process areas with their inputs and outputs [10].

Although the frameworks have been developed mainly by observing software products, the product management activities are not specific to software. Moreover, most of the activities are the same as in the Pragmatic Marketing Framework [12], which is applied by product management practitioners worldwide.

III. Research Methodology

The survey presented in this paper was conducted among product management professionals through a public LinkedIn group consisting of around twenty thousand professionals. 47% of the group included members who indicated product management as their primary function. Other members were from consulting (5%), marketing (5%), and program and project management (5%). Other functions, such as human resources and sales, did not break the five-percent level. From the seniority viewpoint, the group was almost equally divided between senior positions (Senior, Director, Vice President, and Owner) and less experienced professionals (Manager, Entry level position). Professionals from the following high tech industries dominated the group: Computer Software (18%), Information Technology (14%), Telecommunications (7%), Internet (6%), Marketing and Advertising (4%), and Financial Services (4%). Other industries were represented by less than four percent. The survey consisted of only one open-ended question, and there were no constraints to the way of answering the question. The demographic data was extracted from the members' LinkedIn profiles. As a result, we got 201 practitioner definitions of what product management is. Our unit of analysis [13] was the definition of product management regardless of its application domain. The responses were analyzed qualitatively using the grounded theory approach [14] as the research method.

A. Data Collection

The question for the LinkedIn group was the following: *"A very basic question for my fellow group members. What is Product Management? Please try to limit your response to 3 bullet points or as short as possible."* The survey started in March 2011 and finished in January 2012. Overall, the survey was answered 201 times by 179 unique respondents worldwide.

The respondents were not limited by providing any predetermined options, because the problem was approached in an inductive fashion to keep the meanings as open as possible. Moreover, the answers in the survey were open for the respondents, so they could read and see the answers of previous respondents. Sometimes this provoked discussions between two or three respondents, which illustrated the differences in understanding the product management discipline. We had no geographical or domain limits, so the survey was available for anyone interested in the product management discipline. However, the goal was to focus on the main discussion topic and keep the responses as short as possible.

The respondents were mainly product managers (84 of 179, 47%), and 52% of them had a senior product management position such as Senior Product Manager, Vice President of Product Management, or Director of Product Management. Other respondents were consultants, project and business development managers, Chief Executive Officers (CEOs), and managing partners. The titles of the rest of respondents included Purchasing Manager, Requirements Manager, Technical Agent, Program Manager, and Administrator. These positions were met only once in the survey, and therefore we have united them under the group Other in Table 1.

The biggest group of participants was from the field of information technology (47.5%), including the following domains: Computer software, Information technology and services, Internet, Telecommunications, and Computer hardware (Table 2). The survey also attracted the attention of professionals from Marketing and advertising, Banking, Financial services, Professional training and coaching, as well as other domains.

From the geographical point of view, the majority of participants (73.7%) were from the USA, India, and the UK

TABLE 1. JOB TITLES OF RESPONDENTS

Position	*Responses*	*Percent*
Product manager	40	22.3
Senior product manager	18	10.1
Director of product management	13	7.3
Vice President, product management	13	7.3
Consultant	7	3.9
Product marketing manager	6	3.4
Project manager	5	2.8
Business development manager	4	2.2
Chief Executive Officer	4	2.2
Marketing communication manager	3	1.7
Managing partner	2	1.1
Other	64	35.8
Total	**179**	**100.0**

(Table 3). In addition to these countries, there were respondents from Canada, China, Italy, Pakistan, Brazil, Nigeria, Oman, France, Finland, Singapore, and Australia. Therefore, the survey was global with representatives from all continents.

B. Data Analysis Method

The grounded theory method was initially developed by Glaser and Strauss [15] in 1967 as a pragmatic approach for conducting social science research [16]. In this study we followed the Strauss and Corbin version of grounded theory [14], which relies on a systematic codification and categorization process for observations. In the grounded theory, coding is the fundamental process for analyzing data and generating a theory. There are three types of coding: Open, Axial, and Selective coding. Open coding is "the interpretive process by which data are broken down analytically" [17]. The purpose of Open coding is to understand what the data really means, to compare the pieces of material with each other, and give a label to each significant piece of material, such as event/action/phenomenon. Then, the concepts are grouped and analyzed together to form a higher level of abstraction than the original data. In this study, we identified 106 codes during the Open coding. Then, in Axial coding the relationships between categories are created and tested

TABLE 2. INDUSTRY DOMAIN OF RESPONDENTS

Domain	*Responses*	*Percent*
Computer software	39	21.8
Information technology and services	27	15.1
Telecommunications	19	10.6
Marketing and advertising	8	4.5
Internet	7	3.9
Banking	6	3.4
Financial services	6	3.4
Professional training and coaching	5	2.8
Computer hardware	4	2.2
Consumer goods	4	2.2
Wireless	4	2.2
Electrical/Electronic manufacturing	3	1.7
Machinery	3	1.7
Semiconductors	3	1.7
Other	41	22.9
Total	**179**	**100.0**

TABLE 3. GEOGRAPHICAL DISTRIBUTION OF RESPONDENTS

Country	*Responses*	*Percent*
USA	100	55.9
India	21	11.7
UK	11	6.1
Canada	7	3.9
China	5	2.8
Italy	4	2.2
Pakistan	3	1.7
Other	28	15.6
Total	**179**	**100.0**

against the data. Axial coding is devoted to the comparison of the categories with each other and to the establishment of the relationships of different types, such as associations, cause-effects, contradictions, and part-of relationships. At this stage, the observations and categories become more focused on the whole picture of the phenomena, which allows the generation of a hypothesis for testing. At this stage, the codes were distilled into 39 categories with established relationships. The next step is Selective coding, which is devoted to finding of the core category and explaining it [14], [18]. The core category may be one of the existing categories or a new category, which has not been identified earlier. We identified the core category as *Product management* because all the categories explained this category in detail. Overall, the Grounded Theory coding procedures are based on the growth of the degree of conceptualization from description to theory through interpretation. At the description level, the researcher works with categories and properties identified directly from the data. At the interpretation phase, the categories and properties are analyzed at a higher level of abstraction. This allows creating a theory that has a significant empirical support, with a substantive focus [19].

IV. RESULTS

Figure 1 presents the relationships between the categories identified during the analysis. We considered *Product management* as the core category from the beginning, but during the analysis we observed that the respondents switched easily from talking about the product management discipline to discussing the product manager's role. Therefore, the categories of *Product manager* and *Product management* are to some extent interchangeable.

In total, we identified 14 activities related to product management from the practitioners' point of view (Figure 1). Six of these activities were discussed more often and in more detail than the others. A majority of the answers were related to the discussion of product analysis, which consists of the identification of unstated customer needs, understanding competitive offerings, and identification of customer needs and wishes. The participants also discussed actively issues related to roadmapping, and especially to aligning problems with business goals. Product analysis and roadmapping were tightly coupled with strategic management and vision, which have also been considered as core activities in product management. Day-to-day routines in product management consist of mainly product lifecycle management and internal

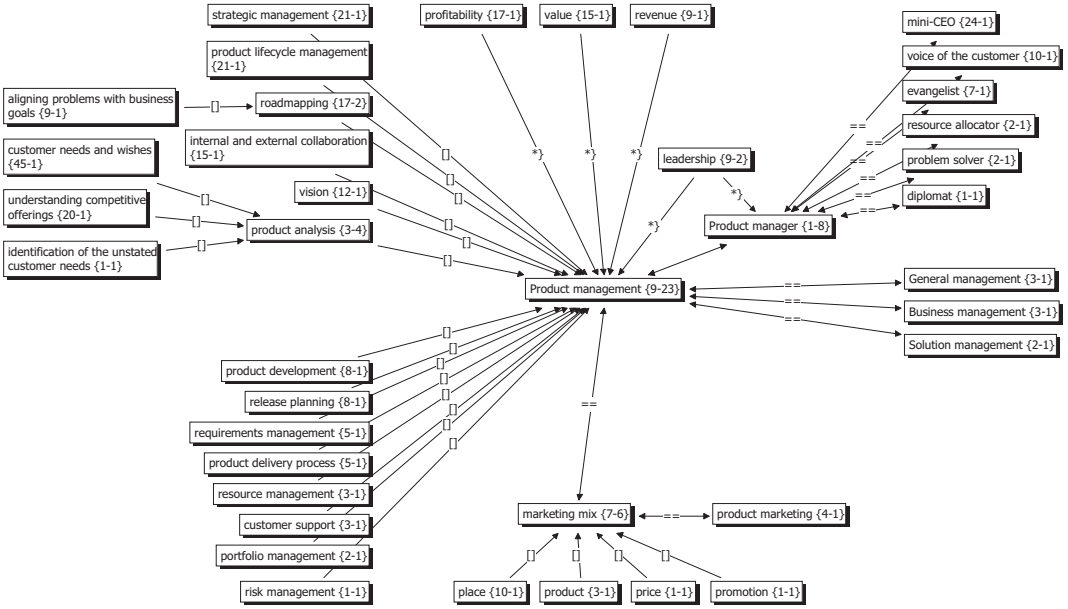

Figure 1. The relationships between the categories ([] – is part of, *} – is property of, == – is associated with; the numbers in the brackets {} near the categories represent the frequency of the category and the number of connections)

and external collaboration. Depending on the industry and the managed product, product management may include release planning, risk management, customer support, and resource management. There are also other activities, but in comparison with the six activities mentioned above, these activities varied a lot from one answer to another.

Ten respondents were not comfortable with the term *product management*, and replaced it with the terms *Business management, Solution management,* and *General management.* However, the respondents could not properly explain the meaning of these terms either. *Product management* was also associated with the *marketing mix* [20] or *product marketing*, when the understanding of product management was limited to *promotion, place, product,* and *price.* Activities like *resource management, risk management,* and *portfolio management* were more rarely mentioned as related to product management.

There were also attempts to explain the meaning of product management by using the product manager's role. The absolutely dominating viewpoint was that the product manager is the product *mini-CEO* (the category was identified 24 times), also referred to as the product champion. The main problem with these responses was that after attaching the label *mini-CEO* to the product manager, there were no explanations to what the *mini-CEO* should do. All the comments were quite similar and limited to the viewpoint that "*he does everything the product needs to be successful.*" It was also noted that the product manager is the *voice of the customer,* who represents the customer in internal discussions. Other roles like *evangelist, resource allocator, problem solver,* and *diplomat* were mentioned a few times.

We identified four properties of *product management*, which represent the main goals of this discipline: *revenue, profitability, value,* and *leadership.* Profit generally implies the revenue minus total expenses in a given period, and can therefore be seen as a subcategory of *revenue.* The respondents used both these terms actively. Although it seems that these terms were used interchangeably, we decided to separate them because we did not have full evidence of whether these two categories were already saturated. The identification of the product *value* for a specific customer is the first step in understanding why the company exists in the market. All improvements and changes are evaluated from the *value* and *revenue* viewpoints.

Overall, all the respondents agreed that *leadership* is the central characteristic of the role, regardless of its main responsibilities and title. According to the responses, the product manager is the product leader of the product internally in collaboration with other departments, and externally in collaboration with customers and other external stakeholders.

V. DISCUSSION

The survey showed that there is a lot of variation in the way how product management practitioners understand the product management discipline. Overall, the situation of product managers is similar to business analysts, who are also involved in many activities without a clear scope of their work [21]. Moreover, these two roles seem to overlap with each other. Both business analysts and product managers are responsible for collecting and analyzing product requirements and defining the product scope.

As the result of this study, we discuss three main findings having an impact on our understanding of the product management discipline and the product manager's role. The section is closed with a discussion on the validity of the study.

A. Six Core Product Management Activities

Based on the analysis, we identified six core product management activities empirically: *product analysis, roadmapping, strategic management, vision, product lifecycle management,* and *internal and external collaboration.* These activities are also included in the existing product management frameworks [9–12]. This study confirmed that practitioners and researchers understand the core product management activities similarly, but outside these similar core activities, there is a variety of other activities considered as related to product management. In [1] we showed that activities like finance, defect management, and configuration management might be included in product management as well. In this study, the respondents included *customer support, risk management,* and *requirements management* as parts of product management rather than considering them as separate disciplines, which makes the boundaries of product management fuzzy. It seems that product management contains a strategic-oriented core, consisting mainly of strategic management and roadmapping, and a tactical-oriented shell, which depends on the company and product, and may include almost any activity supporting the product lifecycle.

Since the issues related to strategic management play an important role in the survival of the company in the market, only experienced professionals are allowed to develop the strategy, while less experienced product managers concentrate more on tactical issues. For example, in our sample set the category *strategic management* was mentioned 21 times, of which 17 were by executive product management professionals such as seniors, directors, and vice presidents of product management.

B. Product Management Is Mixed with Product Marketing

In the software business, product marketing is often separated from product management [9], [10], but the Pragmatic Marketing Framework [12] considers product marketing as a necessary part of product management. We also observed a situation where some respondents had a tendency to replace the term *product management* with *product marketing* or *marketing mix.* In total, both categories appeared 11 times (Figure 1). We assume that this is a result of a geographical bias. Almost 56 percent of the respondents were from the U.S., where Pragmatic Marketing [12] is very active in providing training in product management. The Pragmatic Marketing Framework divides all activities into three areas: Strategy, Marketing, and Technical [12]. This may merge product management with product marketing. These terms seem to be often used interchangeably.

C. A Mismatch between the Mini-CEO Role and Responsibilities

The viewpoint that the product manager is a *mini-CEO* or *product champion* dominated the survey. This viewpoint is also described widely in the literature [2], [3]. However, the category *leadership* was identified only 9 times (Figure 1). Therefore, the role of the *mini-CEO* should be considered as a normative statement rather than a description of the reality. In practice, the role of the *mini-CEO* is possible for senior product managers only, while less-experienced product managers concentrate on the customers' needs, wishes, and requirements. Moreover, the role of the product manager as the *mini-CEO* may be limited by the top management due to political and organizational constraints in the organization.

D. Threats to Validity

Several threats to the validity of the study can be found [13]. The product management forum in the LinkedIn social network, where the survey was conducted, consists of over 20,000 people who are aware of the product management discipline. In the studied public group roles, such as business analysts and requirements engineers were not represented widely, but they could provide useful insights into product management activities. We accepted this issue in the survey design because the current study is the first step in understanding product management activities in general rather than going into details of particular activities. The group was public and each respondent saw the previous answers, which may be a source of respondent bias. Sometimes the open discussion of product management provoked useless debates between two or three group members, but overall the experience of doing the survey with open answers was useful.

In addition to the responses, personal data, such as job title, domain, and country were collected from the public profiles of the respondents. Sometimes it was challenging to identify the company and position of the respondent from their publicly available profiles. We accepted this as a potential bias, because our goal was to get answers from as many different domains as possible.

The open-ended survey question allowed us to avoid a predefined set of answers, but it may have been a source of researcher bias due to the coding step. We attempted to reduce this effect by extracting the explicit categories from the answers without own interpretations of what it could mean. Strauss and Corbin [17] emphasize that using the grounded theory approach we create a theory, which is dynamic rather than static and can be extended by adding new data. Therefore, by increasing the number of respondents from various domains, we could reveal more

details. However, already this number of responses allows us to suggest that we have developed a general picture of practitioners' viewpoints to product management. In addition, we noticed that the coding started to saturate, because after coding of about a hundred answers we did not identify new codes any longer, and our coding was mostly devoted to understanding which codes and meanings were the most important.

VI. Conclusion

The study suggests that the product management discipline is understood differently among professionals in the industry. Although the respondents agreed on the core activities of product management that have a strategic impact on the product success, the operational product management activities varied a lot from one respondent to another. The difficulties in defining the product management discipline led to attempts to replace the term product management with other terms like product marketing, general management, or solution management. Unfortunately this did not clarify the nature of product management.

In total, we identified six activities described by the practitioners as the core activities of product management: *product analysis, roadmapping, strategic management, vision, product lifecycle management,* and *internal and external collaboration.* These activities were repeatedly mentioned by the respondents as related to product management. Other activities were mentioned more occasionally.

The analysis identified also the tendency to describe the product manager as the *mini-CEO* or *product champion*. This viewpoint is also supported by the product management books [2], [3], but in practice few product managers in senior product management positions can be seen as real mini-CEOs. Less experienced product managers are responsible for more operational and tactical activities, such as *requirements management, risk management,* and *product analysis*.

Our findings have implications for both the industry and the academia. From the theoretical perspective, the study shows how product management is understood by practitioners who may wear many hats, depending on the organization and the product. The identified six core product management activities are of interest for almost all product managers and provide important ingredients for evolving product management frameworks. Of the current SPM frameworks, all these core product activities have been identified only in The Software Product Management Framework [9]. The study should also have an impact on product management education and the way it should be organized to meet the expectations of product management professionals. The identified core activities form the necessary skill sets to become a product manager. In addition to the theoretical understanding and product manager education, the results have an impact on the common understanding of the product manager's role for included responsibilities and recruitment requirements. It is reasonable to expect that every product manager is familiar with the core management activities, while the other skills may vary depending on the organization and the product.

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Publication VI
What Are the Roles of Software Product Managers? An Empirical Investigation.

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What Are the Roles of Software Product Managers? An Empirical Investigation

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What Are the Roles of Software Product Managers? An Empirical Investigation

ABSTRACT

Software product management covers areas from technical and business roadmaps to strategic, tactical, and release planning. In practice, one product manager is seldom responsible for all these activities but several persons share the responsibilities. Therefore, it is important to understand the boundaries of product managers' work in managing software products, as well as the impact a product manager has on the company business. The purpose of the study is to clarify what roles of software product managers exist and understand how these roles are interrelated with each other and the whole structure and business of an organization. The study is designed as an interpretative qualitative study using grounded theory as the research method. Based on the gathered data we developed a framework that reveals the role of a product manager in the organization and shows how this role can evolve by extending the level of responsibilities. Using the framework, we identified four stereotypical roles of product managers in the studied organizations: *experts*, *strategists*, *leaders*, and *problem solvers*. The presented framework shows that product managers' roles are not limited to the conception of the "mini-CEO." The results allow product managers and top management to collaborate effectively by assigning responsibilities and managing expectations by having a common tool for understanding the role of product managers in the organization.

Keywords: software product management, stereotypical profile roles, qualitative research, interpretive study, grounded theory

1 INTRODUCTION

Software product management (SPM) is "the discipline and role, which governs a product (or solution or service) from its inception to the market/customer delivery in order to generate biggest possible value to the business" (Ebert, 2009). Previous research indicates that software product management plays an important role in increasing the success rate of projects (Ebert, 2007). In the telecommunication industry, the focus on software product management allowed a company to reduce the cycle time in a business unit by 36% compared to the initial estimation. SPM had also a positive impact on the quality, which was improved by 80% with product management practices (Ebert, 2007). Other benefits of SPM include increased profitability and predictability of software product lifecycle in accordance with the business goals of the company (Van de Weerd et al., 2006a). More generally, software product management plays a critical role in managing and achieving business goals by providing practices for the winning strategy in the market (Kittlaus and Clough, 2009).

Existing software product management frameworks describe many activities in which a product manager is involved, including strategy and vision definition, roadmap planning, release planning, pricing, product development and others (Ebert, 2009; Kittlaus and Clough, 2009; van de Weerd et al., 2006a). Due to the high number of activities, one person is not able to be responsible for all of them. This leads to a situation where responsibilities are shared in the organization, and therefore the role of a particular product manager, as well as the whole product management in the organization become difficult to track and understand.

The role of a product manager is often described as a product "mini-CEO" (Dver, 2003; Gorchels, 2000), who unites the technical and business perspectives on the managed product. In this regard, the role of the product manager may be compared with the Chief Information Officer (CIO) role, which has been studied earlier (Chun and Mooney, 2009; Johnson and Lederer, 2010; Sobol and Klein, 2009). A CIO as an executive-level manager focuses on the organization's strategy and processes and acts as a technical manager minimizing the costs of the existing infrastructure. Therefore, these two roles are similar in their responsibilities but differ from the management point of view: the CIO works at the corporate level while the product manager works at the product level. The CIO also plays an important role in cultivating a mutual understanding with the Chief Executive Officer (CEO) of information systems and IT infrastructure in the organization (Johnson and Lederer, 2010). The role of the product manager is similar to that of the CIO, but the product manager is responsible for developing a product strategy in agreement with the top management.

Although the role of product manager significantly varies from one organization to another, we need to understand the responsibilities and roles of product managers in software organizations in order to determine if the product manager "mini-CEO" role is the only possible role observed in practice or other roles exist as well. It would help us to draw conclusions on how the frameworks and SPM practices should be further developed in light of the new knowledge and new roles. The identification of product manager's roles would also help software product managers to find the direction for their career and skill development in alliance with the company strategy. Taking into account that organizations have more than one product manager responsible for the developed product, we aim in identifying the roles held by software product managers from junior to senior positions to clarify how the responsibilities may be shared in an organization. In order to identify and classify these roles, we studied product management practices in 13 organizations with the aim to answer the following research question:

RQ: "*Which common roles do software product managers fulfil in organizations??*"

The result of this study is a framework that allows researchers and practitioners to identify, describe and compare the responsibilities of software product managers. With this framework we identified four stereotypical roles for software product managers.

The rest of the paper is organized as follows: Section 2 introduces the theoretical background of product management in general and software product management in particular. In Section 3 we describe the research methodology. Section 4 presents the developed Software Product Management Roles Framework (SPMRF). Section 5 describes four stereotypical profiles of product managers. In Section 6 the results of the study and its implications are discussed. Finally, Section 7 closes the paper.

2 RELATED RESEARCH

2.1 Product management

Product management is not a new discipline. The concept of product management was first introduced in Procter&Gamble in 1931 (Gorchels, 2000). The company hired a special person, a brand manager, who was responsible for managing one product. After this successful experience the practice of assigning product managers to a product or a product line was copied inside the company. Later, the practice of hiring product managers spread also outside the company and was adopted by competitors (Gorchels, 2000).

As product management was adopted in many business organizations, the concept gained popularity and became a topic for scientific research. In the early 1960s, Borden (Borden, 1965) created the model of the four P's of marketing, consisting of *product*, *place*, *price*, and *promotion*. In this model, *product* includes issues related to the creation and development of a product. *Place* is a process of defining the right markets in which the product will be marketed and sold. *Price* considers financial issues in collaboration with financial analysts. *Promotion* includes activities related to advertisement (Borden, 1965). The model can be seen as one of the first theories about product management.

The Annual Product Management and Marketing Survey (Pragmatic Marketing, 2010a) explores the responsibilities of product managers. According to this survey in 2010, the most frequent activities of product managers included the *product roadmap (91%), requirements (86%), market problems (77%), use scenarios (74%), and competitive landscape (73%).* Except *market problems,* other activities are related to the technical discipline. The *market problems* activity is related to the strategic discipline (Pragmatic Marketing, 2010b). Therefore, product managers are typically involved in researching the market and writing requirements. In the case of a lack of a product marketing manager or another person responsible for planning the go-to-market strategy, product managers can take these responsibilities as well (Dver, 2003).

The product manager is described as a product champion who is responsible for the execution of the business plan to provide the biggest possible value for the customers (Dver, 2003). The literature describes a product manager as a leader and a champion who makes all the decisions and acts as a problem solver. The annual survey (Pragmatic Marketing, 2010a), however, shows that the role of a product manager is unclear, and he or she wears many hats, depending on the company size, business and domain.

The activities of a product manager include identification of the features that provide significant value for the customers by communicating and defining customer needs, market trends, competitors, and markets for selling. The product manager plays the role of a facilitator between different departments; he or she is a "mini-CEO" who is responsible for one or several products (Ebert, 2009). The product manager works in close collaboration with the product development team, marketing team, project managers, financial analysts and managers, engineering and sales teams, using these departments as resources to produce successful products. The role of a product manager varies widely from one organization to another. In some cases, the product manager focuses on marketing and his or her responsibilities include brand management, sales support and marketing (Dver, 2003). In other cases, brand management is a separate discipline within the organization, and the product manager works as a mediator between sales and engineering, gathering product requirements and creating specifications (Gorchels, 2000). The product manager can also have the function of a business manager who is responsible for a product and product team (Dver, 2003). As a result, it is difficult to define the role of the product manager in an organization, because the job title does not provide a clear idea of the role and the responsibility. Thus, the idea of product management has existed for a long time, but the role of the product manager in an organization is still not clearly defined.

2.2 Software product management

Software has several characteristics that distinguish it from other products. Firstly, software can be relatively easily changed, and several versions of a product are easy to introduce in the market (Cusumano, 2008). This also leads to tough competition, because new features are reproduced and improved by competitors. Secondly, it has been claimed that software is the most complex and sophisticated product of human invention that we currently know (Kittlaus and Clough, 2009; Messerschmitt and Szyperski, 2003). For example, one source of complexity is the nature of software, consisting of many blocks from different vendors along with the possibility to run the software at a hardware manufactured by other vendors. This can lead to incompatibilities between components, which should be taken into account in product development and decision making. To respond to such challenges, a huge number of factors must be considered in software product development. This leads to the division of responsibilities between developers, testers, project managers, product managers, and many other roles supporting software development. Thirdly, in software production, processes and logistics have only limited importance, even though they play an important role in goods production. In software development "knowledge" is more essential than physical artifacts (Kittlaus and Clough, 2009). The cost of producing and delivering an additional copy of software is small compared to the other costs. In addition, the existing infrastructure, including the Internet, makes the logistics simple.

The differences described above affect the application of product management to software. The existing software product management frameworks (Ebert, 2009; Kittlaus and Clough, 2009; van de Weerd et al., 2006b) can be used to explain the structure of software product management. There are many overlapping parts in these frameworks, even though the terminology is different. For example, software product management components can be defined as functions (Kittlaus and Clough, 2009), activities (Ebert, 2009), or process areas (Van de Weerd et al., 2006b), depending on the framework.

The Software Product Management Framework suggested by Kittlaus and Clough (2009) presents the major functions involved in product management with tasks to participate in or to orchestrate. The tasks are divided into two levels: the corporate level and product (family) levels that are differentiated by the level of authority and strategic impact to the company business. In total, there are nine functions in which the product manager participates: Market Analysis, Product Analysis, Product Strategy,

Product Planning, Development, Marketing, Sales and Distribution, Support and Services. The first two functions (Market Analysis and Product Analysis) are the sources of the raw qualitative and quantitative decision-making data for the product manager. Product Strategy and Product Planning are the business-oriented core functions of product management. The other functions (Development, Marketing, Sales and Distribution, Support and Services) are not directly related to the tasks of the product manager and thus he/she needs to collaborate with the respective departments about decisions concerning these functions.

Another framework has been proposed by Ebert (2009). According to Ebert, software product management provides leadership to activities like portfolio management, strategy definition, product marketing, and product development. These activities are supported by product management processes like portfolio analysis, positioning, strategic planning, product and technology roadmapping, risk management, product definition, and requirements (Ebert, 2009). The processes show the formal content of product management, or at least the activities in which the product manager is heavily involved.

The reference framework for software product management developed by van de Weerd et al. (2006b) defines four main process areas with their inputs and outputs. These process areas with processes are portfolio management, product roadmapping, requirements management, and release planning (van de Weerd et al., 2006a).

Yet another software product management framework has been developed by International Software Product Management Association (ISPMA, 2012). It is based on the frameworks of Kittlaus and Clough (2009), Ebert (2007) and van de Veerd et al. (2006b) and represents a consensus between academic and industrial experts in software product management and integrates three product management frameworks developed earlier (Figure 1).

Strategic management	Product Strategy	Product Planning	Development	Marketing	Sales and Distribution	Service and Support
Corporate Strategy	Positioning and Product Definition	Product Lifecycle Management	Engineering Management	Marketing Planning	Sales Planning	Service Planning and Preparation
Portfolio Management	Delivery Model and Service Strategy	Roadmapping	Project Management	Customer Analysis	Channel Preparation	Service Provisioning
Innovation Management	Sourcing	Release Planning	Project Requirements Engineering	Opportunity Management	Customer Relationship Management	Technical Support
Resource Management	Business Case and Costing	Product Requirements Engineering	Quality Management	Marketing Mix Optimization	Operational Sales	Marketing Support
Market Analysis	Pricing			Product Launches	Operational Distribution	Sales Support
Product Analysis	Ecosystem Management			Operational Marketing		
	Legal and IPR Management					
	Performance and Risk Management					
Participation	Core SPM		Orchestration			

Figure 1. ISPMA SPM Framework V1.1

Other authors have proposed that such activities as finance (Konig, 2009), defect management (Van de Weerd and Katchow, 2009), and software configuration management (Kilpi, 1998) should be taken into account as parts of SPM. Evidently there are many other opinions about the components of software product management (Ebert, 2007; Konig, 2009; van de Weerd et al., 2006a). This indicates that the role of the product manager deserves more attention and clarity.

2.3 Manager roles

We often have a simplistic view that managers organize, coordinate, plan, and control people and activities. Literature, however, contains many examples of different views (Dver, 2003; Mintzberg, 1990; Project Management Institute, 2008). Henry Mintzberg, who has studied a manager's job extensively, reached the conclusion that management work is contradictory and full of myths (Mintzberg, 1971). The attempts to explain manager roles in terms of competences are useless because "the manager who only communicates or only conceives never gets anything done" (Mintzberg, 1994). To provide a model of what managers really do, Mintzberg (1990) developed a synthesis model consisting of ten manager roles divided into three groups. He defined managers as persons in charge of an organization or a subunit with formal authority and status as obligatory characteristics. Formal authority brings a status, which is a necessary component of various interpersonal relations. These relations and communication are necessary for accessing information in the context of the organization, which includes the prior knowledge of historical, political, and organizational background of the

organization. Altogether, relations and information provide the basis for making decisions and developing strategies within an organizational unit. The formal authority gives rise to the first set of roles called *interpersonal roles,* which in turn give rise to the *informational roles.* These two sets of roles enable the manager to participate in decision making (Mintzberg, 1990). Ten roles have been identified by Mintzberg to capture the manager's activities during the workday (Table 1).

Table 1. Mintzberg's management roles (adapted from (Mintzberg, 1971))

Roles	**Description**
Interpersonal roles	
Figurehead	The manager is a symbol, obliged to perform a number of duties.
Leader	The manager acts as a leader, pervades all activities, encourages subordinates, and replies to requests.
Liaison	The manager establishes a network of contacts to bring information to the organization.
Informational roles	
Nerve Center	The manager has access to all information and each member within the organization. Therefore, the manager accumulates and generalizes information from all members of the organization.
Disseminator	The manager acts as a transmitter of information to other members.
Spokesman	This role is similar to the previous one, but the information is transmitted outside the organization.
Decisional roles	
Entrepreneur	The manager acts as an initiator and designer of all changes and improvements in the organization.
Disturbance Handler	The manager focuses on corrections, which he or she is forced to make.
Resource Allocator	The manager is responsible for allocation and control of all resources within the subordinate unit.
Negotiator	The manager is a participant in negotiation activities in the organization.

Mintzberg's roles have been the basis for studies devoted to understanding the nature of management positions, such as the position of a CIO (Gottschalk, 2002; Grover et al., 1993). According to these studies, Mintzberg's roles can be used for describing various management positions at different hierarchical levels in organizations. However, it has been pointed out that Mintzberg's research methodology has limitations, such as a small sample size, missing reliability checks, and a simplified coding method (Martinko and Gardner, 1990).

Grover et al. (1993) used Mintzberg's model as the basis of their own survey instrument for investigating the managerial roles of senior-level executives. They identified and studied only six of ten Mintzberg's roles: leader, liaison, monitor, spokesman, entrepreneur, and resource allocator. The other roles (figurehead, disseminator, disturbance handler, and negotiator) were not identified as separate roles because their activities were related with the activities of the other six roles.

2.4 Product manager as a middle manager

The product manager can be seen as an example of a middle manager who acts as a "linking pin" connecting the top management with the lower-level managers (Floyd and Wooldridge, 1992). In this role the product manager acts as an interpreter and implementer of the decisions made by the top management. As a connector between the top and the bottom of the organization, the middle manager has an ability to mediate between strategic and operational levels (Floyd and Wooldridge, 1997).

Therefore, his or her understanding of the situation in the organization is more comprehensive compared to that of the top management.

Floyd and Wooldridge (1992) have developed a typology of middle management involvement in strategy consisting of two dimensions: behavioral and cognitive (Figure 2). The behavioral dimension includes upward and downward influence, describing how the middle manager acts in the organizational hierarchy. The cognitive dimension unites integrative and divergent influence. Overall, the typology describes four roles: championing alternatives, facilitating adaptability, synthesizing information, and implementing deliberate strategy (Floyd and Wooldridge, 1992).

	Behavioral	
	Upward	Downward
Divergent	Championing alternatives	Facilitating adaptability
Cognitive		
Integrative	Synthesizing information	Implementing deliberate strategy

Figure 2. A typology of middle management involvement in strategy (Floyd and Wooldridge, 1992)

The middle managers have a unique opportunity to collaborate at strategic and operational levels at the same time. It allows them to act in close collaboration with a variety of people representing lower managers, customers, and top managers. The middle managers act as engines in facilitating adaptability (Floyd and Wooldridge, 1994). Without the efforts of middle management, organizational changes meet more resistance (Balogun, 2003). Another role of middle managers is providing synthesized information about external and internal events to the top management. Usually the ideas brought upward to the top management are not strategic proposals but observations and interpretations of events. The function of synthesizing information is integrative, because the middle managers know the strategic directions from the top management and are therefore able to interpret events in the organization within a given frame of strategic perspectives. Implementation of the top management's strategy is the main role conducted by the middle managers (Floyd and Wooldridge, 1992). It consists of the development of tactical steps to achieve strategic goals. Although this process is considered a mechanical process "where action plans are deduced and carried out from a master strategy conceived by top management" (Floyd and Wooldridge, 1994), the process is more complex due to constant changes in external and internal environments. Therefore, this process can be characterized as a continuous process of fighting with turbulent conditions to achieve the business goals defined by the top management of the organization.

The research of Floyd and Wooldridge (1997) emphasizes that the middle managers' impact on strategy is significant. Their role stays important even when the organizations move away from hierarchical to more horizontal business structures. The study of Floyd and Wooldridge (1997) was used as a basis for the further studies of the role of middle managers. Mantere (2008) has extended the functional view of middle managers by presenting a reciprocal view to their roles. The reciprocal view presents eight

factors (narration, contextualization, resource allocation, respect, trust, responsiveness, inclusion, and referring) enabling middle manager's ability to fulfil the role. These factors altogether are used for evaluation of the impact a particular middle manager has to the strategic initiatives within an organization (Mantere, 2008). Another study conducted by Balogun (2003) suggests four additional roles of middle managers as change intermediaries (Figure 3). In comparison with the Floyd and Wooldridge (1997) roles, which are mostly focused on the strategic impact of middle managers, Balogun (2006) considers the middle managers as key players in organizational changes.

		Nature of activity	
		Sensemaking	Coordination and management
	Peers/self	Undertaking personal change	Keeping the business going
Orientation	Team	Helping others through change	Implementing changes to departments

Figure 3. Middle managers as change intermediaries (Balogun, 2003)

Overall, the role of a middle manager in an organization is complex. They make a strategic contribution and implement the decisions made by the top management. In addition, the middle managers also perform such tasks as planning, controlling, and budgeting, which are common for all managers, regardless of their level in the organization hierarchy.

Although the role of managers has been extensively studied previously, the role of software product manager is rather prescriptive and has not been studied empirically. In this study, we attempt to fill this gap and present as a result a framework for assessing the roles of software product managers in organizations with an in-depth analysis of these roles.

3 RESEARCH PROCESS

Our research was carried out as a qualitative study using grounded theory as the research method (Strauss and Corbin, 2008). This allowed us to develop the theory inductively. The main instrument in the data collection was interviews with company representatives. In designing the study our critical assumption (Isabella, 1990) was that every software company has product management regardless of its size. Building on this assumption, we designed an inductive study to investigate the product managers' roles in the companies. The research process we followed is presented in Figure 4.

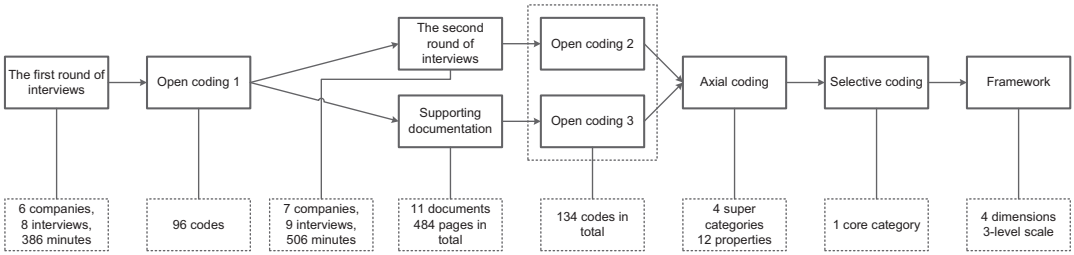

Figure 4. Research process

The studied companies ranged in size from 15 to more than 10,000 employees (Table 2) with different business domains, such as banking software, telecommunication solutions, and Internet applications. The interviews were conducted in two rounds (Figure 4) in a period of seven months between February and August 2011. The semi-structured (Charmaz, 2010) interviews were conducted mainly in Moscow and Saint Petersburg (Table 3), but all the companies were international with offices in Russia. Moreover, most of these companies had research and development (R&D) departments in Russia, and only two of them (Company A and L) were represented by marketing and sales offices only. However, the interviewees in these marketing and sales offices were also product managers. We interviewed them in order to understand what product managers do when they are distant from development. During the interviews the representatives of these companies mentioned that they plan to open R&D offices in Russia in the nearest future.

Table 2. Company profiles

Company	Business domain, type of product	Size (people)	Founded
A	Developer of software products for operational support systems	10,001+	1982
B	International developer and supplier of a wide range of software products for the marine industry	1,001-5,000	1990
C	Developer of Internet products and services	1,001-5,000	1997
D	Developer of security products for users and enterprises	1,001-5,000	1997
E	Developer of products for storage management	501-1,000	2002
F	Developer and provider of telecommunication products and solutions, software and hardware	501-1,000	2007
G	Developer of products for data security and storage management	101-500	1994
H	Developer and integrator of software products and solutions for small and medium enterprises	101-500	1994
I	In-house development of software products for internal use	101-500	2000
J	Developer of software products for software developers	101-500	2000
K	Developer and provider of the products for interactive media	101-500	2002
L	Developer of banking software products	101-500	2004
M	Developer of software products for servers	11-50	2009

Table 3. Roles of the interviewees

Interview #	Interview round	Company	Role
1	2	A	Product manager
2	1	B	Deputy managing director for R&D
3	2	C	Product manager
4	2	C	Product manager
5	2	D	Product manager
6	2	E	Product manager
7	1	F	Department manager
8	2	G	Product manager
9	1	H	Deputy director of software development
10	2	I	Senior business analyst
11	1	J	Product marketing manager
12	1	K	Team leader
13	1	K	Project manager
14	2	L	Product manager
15	2	L	Product manager
16	1	M	Sales director
17	1	M	Technical director

During the first round we mainly interviewed product managers and people who work with them in close collaboration, e.g. a project manager, a team leader, and a deputy director of software development (Table 3). We analyzed each interview as soon as possible, which helped us to tailor the questions for each following interview based on the experience from the previous ones. This allowed us to increase the quality of the collected material. Our units of analysis (Yin, 2002) were product managers, their tasks and responsibilities. During the analysis of the first round interviews we developed our theoretical understanding (Strauss and Corbin, 2008) about product manager roles. Based on this emerging theory we revised the interview questions for the second round to support or reject it. Therefore, the second round of data collection was directed by emerging concepts (Orlikowski, 1993). In the second round we conducted interviews primarily with product managers because we had already developed theoretical understanding that required checking and, therefore, our questions were clearer and focused more on product management activities. In total, there were eight interviews in the first round and nine in the second (Table 3). The interview questions for both rounds of interviews are available in Appendix A and Appendix B respectively.

The selection of interviewees was guided by our existing contacts, an open call for participation, and snowballing (Strauss and Corbin, 2008), in which the next interviewee was a referral from the previous one. In Companies C and L we interviewed two product managers and in both cases they replied to our open call for participation independently. In the other cases, when we interviewed two persons from the same company, they were referrals from previous interviews. In total the snowballing technique led to three interviews. The interviewees #16 and #17 were the referrals from the interviewee #9, and the interviewee #13 was the referral from #12 (Table 3).

Overall, we concentrated mainly on the middle and top management and preferred interviewees who held the role of a product manager. We asked questions about product strategy, roadmapping, product marketing and decision making processes of all the interviewees, but the questions were tailored for each interview as advised in Charmaz (2010) and Strauss and Corbin (2008). These variations were based on the role of the interviewee and his or her responsibilities, e.g. if an interviewee was not involved in the product marketing activities, we skipped these questions. Therefore, the questions were based on the activities the interviewee was involved but we also asked questions about responsibilities of the colleagues working in close collaboration with the interviewee in order to understand the links between different roles within a particular organization. We also asked additional questions on organizational, hierarchical, and product structure to understand the companies' context.

The interviews were conducted, recorded, and transcribed in the Russian language, but the coding, analysis and further work was done in English because two of the three researchers were not fluent in Russian. The correspondence and consistency of the terms were established and checked by the first author who is a native Russian speaker. During the transcription process we included as much information as possible by transcribing also non-verbal information such as hesitancies, pauses, and changes in intonation by taking necessary notes inside the transcripts. External events such as interrupted phone calls and small breaks in the interviews were also documented. When possible, face-to-face meetings with the interviewees were conducted, but we also used Skype video and audio interviews. The interviews lasted from 40 to 80 minutes, with an average of 52 minutes. The transcribed text resulted in 214 A4 pages with standard 12pt font and single line spacing. The interview data were complemented with supporting documents. We asked our interviewees if they were able to provide documents written by product managers. As a result, we received eleven documents, 484 pages in total (Table 4) and coded them separately. In addition, we used publicly available information about the company before the interviews to get a general understanding of their business. After the interview, we briefly reviewed sources such as annual reports, product announcements, and press releases to get additional information related to product management. Using multiple sources of evidence helped us to gain a deeper understanding of the company context and the influence of product managers on the products. This also increased the validity of our results and helped to mitigate the potential for bias of the interviewee's subjective viewpoint to the internal situation in the organization (Yin, 2002). For example, strategies were discussed with almost all interviewees, so it was possible to compare the discussions with the supporting documentations (e.g. Strategy, Table 4) and available product releases in the Internet.

Table 4. Supporting documentation obtained from the companies for analysis

D#	Document title	Organization	Type	Size
D1	Product plan	Organization C	Text document	132 pages
D2	Product specification	Organization C	Text document	61 pages
D3	Product vision	Organization C	Text document	35 pages
D4	Product plan	Organization D	Presentation	17 slides
D5	Positioning statement	Organization D	Text document	12 pages
D6	Features and advantages for the Client	Organization D	Text document	7 pages

D7	Release plan	Organization I	Presentation	6 slides
D8	Project status	Organization I	Spreadsheet	3 sheets (~13 pages)
D9	Release plan	Organization I	Spreadsheet	1 sheet (~3 pages)
D10	Strategy	Organization I	Text document	196 pages
D11	Application description with technical details	Organization L	Text Document	2 pages
	Total:			**~484 pages**

The analysis of the collected data was performed using two special tools. The first tool was software for qualitative research, ATLAS.ti (2011), supporting coding in grounded theory data analysis. The second tool CmapTools (Institute for Human and Machine Cognition, 2011) was used for creating concept maps, which are "graphical tools for organizing and representing knowledge" (Novak and Canas, 2008).

In this study we followed the Strauss and Corbin (2008) version of the grounded theory, which relies on a systematic codification and categorization process for observations. In the grounded theory, coding is the fundamental process for analyzing data and generating a theory. There are three basic types of coding: open, axial, and selective coding. Open coding is "the interpretive process by which data are broken down analytically" (Corbin and Strauss, 1990). Its purpose is to understand what the data really means, to find the similarities and differences between the pieces of data, and to give a conceptual label to each event/action/phenomenon. Then, the concepts are grouped together to form categories with subcategories, which present a higher level of abstraction than the original data. In axial coding, relationships between categories emerge and they are tested against the data. A single test is not enough to prove or discard a hypothesis; therefore each relationship should be indicated in the data over and over again. If the hypothesis is not supported by new data, it does not mean that the hypothesis is necessarily false, but the context and conditions in which it occurred should be critically evaluated to determine what really happened. Selective coding is a process of defining the core category. The core category shows the central hypothesis of the study. All other categories with subcategories are unified around this core. Strauss and Corbin (2008) suggest identifying the core category by asking the questions: "What is the main analytic idea presented in this research? If my findings are to be conceptualized in a few sentences, what do I say? What does all the action/interaction seem to be about? How can I explain the variation that I see between and among the categories?"

During the Open coding 1 (Figure 4) procedure of the first phase, consisting of eight interviews, we understood that the concepts could be easily grouped using the areas in which a product manager works but it was still unclear how many areas exist. This suggested us a scheme about questions that should be asked from other product managers in the next round. In the second round, we discussed with the product managers mainly about areas in which the product manager worked or collaborated with, and tried to identify new areas of their responsibilities by asking questions about various steps in the product lifecycle. An example of the Open Coding 2 is presented in Table 5. After six interviews in the second round it became obvious that we were no longer able to identify new areas of responsibilities. Our interviewees talked about the same areas, but their focus on each area varied depending on the

organization. From these interviews we could not extract new categories in the analysis. We considered this as a sign of theoretical saturation, but to be certain we conducted three more interviews.

Table 5. Example of open coding

Interview transcript (translated)	Codes
"Once again… product manager is not a person who decides everything. Yes, ***he has a power of the final decision making****. Nevertheless, a good product manager before* ***creating a product vision*** *generates the ideas for the following product releases. The goal is to create as big list of ideas as possible. By the way, this process of idea generation is a separate process, which is* ***well defined and formalized in marketing****. Then,* ***he asks a team leader to evaluate these ideas from the technological viewpoint****. I have never seen visions that were totally, 100%, right. Even if the developed vision will be implemented by 90% as it has been written, it is an amazing result. Anyway,* ***a product manager is a person who is fully responsible for the vision development and implementation****…"* – Product manager, Company C.	product manager as a decision maker, Task: creating a product vision, Marketing function of product manager, collaboration function of product manager, authority and responsibility.

In axial coding, our focus was on the relations between the categories identified at the open coding stage. For example, *Task* in Table 5 is one of these categories that unites tasks and responsibilities of product managers. Overall, 47 categories were identified and they narrowed down at the axial coding phase. We compared the categories with each other and established relationships between them. At this stage our observations became more focused on the identification of the core category. At the end of axial coding, we identified four super categories representing the characteristics of a software product manager and explaining his or her role in the organization. These super categories were *influence on the product, authority, access to resources,* and *influence on collaboration.*

Our theoretical understanding about the product manager's roles emerged when analyzing the interview data. Then, using the supporting documentation, we checked how our understanding was supported and reflected in this documentation. For example, we received a product vision as the supporting document primarily developed by the product manager whose quote is presented in Table 5, so we were able to check if a product manager had an impact to the described process of product vision creation in the company as we had interpreted. This was an additional confirmation that the processes in the company were described as they were really implemented. In this case, the product vision was presented in a structured document with all necessary data collected from analysts, developers, and top management. The vision was written in close collaboration with the marketing manager, product analyst, and product delivery professional. It confirms the statement in the quote above that the product manager relied on the inputs from the colleagues and worked in close collaboration with the specialists from other departments. The product vision was described in 35 pages using the structure in Figure 5.

- Vision Scope: Products
- Fit to Corporate Strategy
- Market Demand for *** Products
- *** Products – Current State
- Competitive Analysis – Current State
- Short-Term Vision Statement
- Long-Term Vision: Stages of Development and Key Technologies
- Competitive Strategy
- Why can we win the "Race to Simplify"
- Key Vertical Markets
- Bundling Strategy for Market Segments
- Individual Vision Statements for *** Applications
- Detailed Vision Action Plan for *** Applications
- Timetable and Actions form Implementation of the Vision
- *** Summary: Vision Roadmap

*** is a name for a product line hidden due to confidentiality.

Figure 5. An example of the product vision table of contents

From the interview and the product vision document we were able to identify the role of the particular product manager in the company as well as his day-to-day activities. This product manager had a significant *impact on the product* he managed, especially at the *strategic* level. In addition, he had an *influence on collaboration* because he was not relying only on his own expertise but worked in close collaboration with other departments. However, the pattern of the product manager's *influence on the product* dominated almost all the interviews. *Influence on the product* varied from minor to major influence including the full responsibility of the product strategy, vision, and roadmap depending on the organizational and/or political situation in the company. In the analysis *influence on the product* became a super category with four properties: *tactics, strategy, roadmapping, and development* (Figure 6), which emerged in the open coding.

In selective coding, the goal was to identify the core category. It can be one of the existing categories or a new category, which has not been identified before because it should be broad enough to cover the central phenomenon under observation (Strauss and Corbin, 2008). In our case, each of the super categories identified during the axial coding explained a part of the theory about the product manager's responsibilities; therefore the core category should have a broader scope to cover all these super categories to explain the product manager's responsibilities. We defined the core category as the *role of product manager in an organization.*

To represent the relationships between the categories we used diagrams, which played an important role in the analysis. Diagrams can be considered as analytical tools that force the researcher to understand the data deeply (Strauss and Corbin, 2008). The early diagrams were quite simple. They helped us to think about possible relationships between the concepts. Later they became more complex: new relationships between concepts arose and each concept got its own properties and dimensions. As a result, the whole picture of the phenomena under observation emerged. The part of the diagram that presents the concept map of the super categories altogether with their properties is shown in Figure 6.

The core category *the role of product manager in an organization* is connected to four super categories, each of them explains a part of the product manager role. For each of the super categories we identified a set of properties, which are "the characteristics that give specificity to and define an object, event, and/or action" (Strauss and Corbin, 2008), connected with the super categories by a link "*has property*". These properties describe the super categories from various viewpoints, providing an additional explanation to what is included in the category.

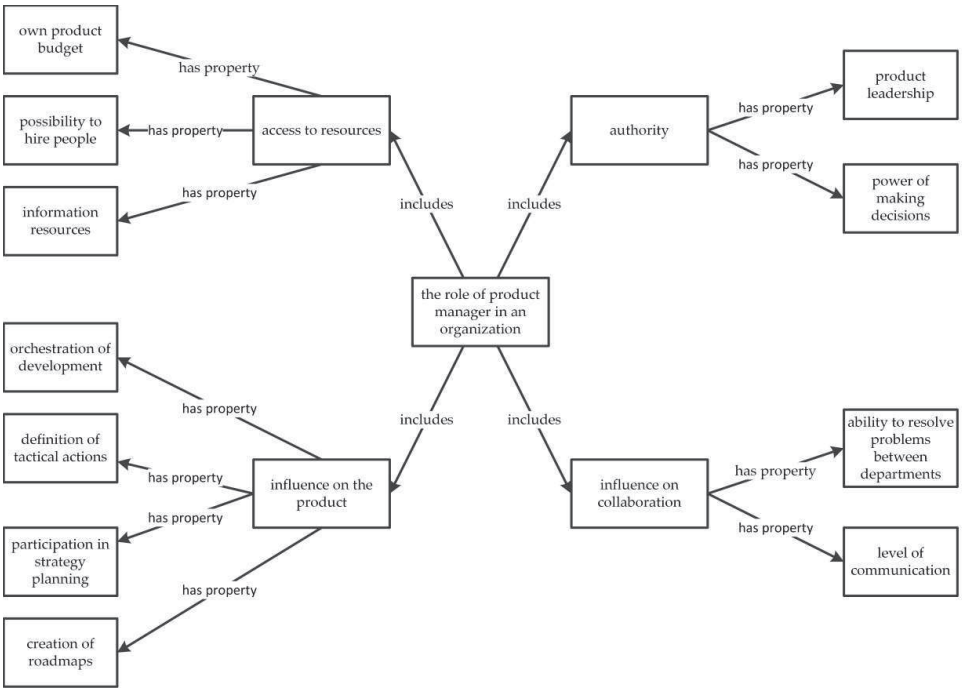

Figure 6. Super categories with properties based on the grounded theory analysis

4 THE ESSENTIAL CHARACTERISTICS OF A SOFTWARE PRODUCT MANAGER

In Section 3 we presented the core category and four super categories that emerged during the grounded theory analysis. In this section the four super categories with their properties and dimensions are explained in detail. Each of these categories represents the essential characteristics of a software product manager role, which define his or her areas of responsibilities and boundaries of the role. Based on these findings the Software Product Management Roles Framework (SPMRF) is developed and presented at the end of this section.

4.1 Super categories

4.1.1 Influence on the product

The first super category *influence on the product* describes the impact of a product manager to the managed product. The following quotations by two product managers show that the first considers himself as a strategy adviser while the second presents himself as a "mini-CEO."

"Generally speaking, all we do is not mandatory for engineering. It is rather a recommendation than a command. As far as I understand, this is a typical problem of product management in most organizations… The product manager is a person who can influence what happens only by persuasion and motivation. We cannot say what to do to in engineering, we can only recommend." –Product manager, Company G.

"The ideal situation is when a product manager is a person who acts as a director of a small enterprise within the company. It should be a small independent company with its own budget and resources. The most important point here is that the responsibility and the authority are not shared between people. This is the worst thing that can happen in a software company, in any company." – Product manager, Company C.

We observed that product managers in large organizations (Organizations C, D) had more *influence on the product* than their colleagues from smaller organizations (Organizations E, L). The product managers in large organizations took part in strategic, product, and release planning as we observed from the gathered supporting documentation (D1-D7, Table 4), while their colleagues from smaller organizations could not have so significant impact on the product. In the interviews, they mentioned (Interviews 11, 14, 16, 17) that the top management defines the product strategy and nobody else is allowed to make changes to it. Although we received a strategy document (D10, Table 4) from a relatively small Organization I, this document had been written by a consulting firm instead of product managers within the organization.

As a super category, *Influence on the product* shows the level of involvement of the product manager to the product tactics, strategy, roadmapping, and development. Participation in development does not mean that the product manager implements the product by herself, but it shows her involvement to product development through project managers and team leaders. In other words, product manager orchestrates the development team rather than directly contribute to their activities.

4.1.2 Authority

The super category *authority* unites two empirically identified categories of *leadership* and *power of making decisions*. The discussions about *leadership, authority,* and *decision making* were common for all the interviews. The product managers from the large organizations (Organizations A, C and D) described problems related to their position in the corporate hierarchy. Overall, these problems formed two different problem domains. The first domain included the problems they had in collaboration with other departments including marketing, sales, and development departments. Only one product manager from Organization C had a significant impact on the activities in other departments. Other product managers from all the interviewed organizations could not orchestrate other departments without support from the higher management. Therefore, the ability to orchestrate other departments without intervention from the higher management was assigned to the category *leadership*. The second domain consisted of the problems related to making strategic and tactical decisions about a particular product without permission from the higher management. In some cases decision making was considered as the main characteristic of a product manager.

"*If the product manager is not able to make decisions then he is not a product manager. He can be called a product marketing manager, analyst, or somebody else, but he is not a product manager… You have to have the power to decide, otherwise it is profanation."* – Product manager, Company C.

Together, the categories *leadership and power of making decision* formed the super category *authority.* The observations showed that *authority* was also a characteristic distinguishing technically oriented product managers from business oriented product managers. The product managers with limited authority usually were responsible for technical roadmapping and features prioritization while product managers who had higher level of authority were usually responsible for making strategic decisions related to the product vision and strategy.

4.1.3 Access to resources

The super category *access to resources* shows which resources, such as product budget and people in subordination, are under the product manager's responsibility. We also included *information* as a resource, because a product manager can use members of different departments or external consultants as a source of quantitative and qualitative information regarding the market and the product (Kittlaus and Clough, 2009).

"*… for example, as a product manager I get an idea about our product but I do not know how many people are interested in that. I go to the analysts and ask them to research the area and determine which features are necessary for our users and how many people are interested in our product. They study it and report the results to me."* – Product manager, Company C.

During the interviews we observed that the access to resources varies depending on the organization but 13 of 17 interviewees claimed that they would prefer to have more resources for managing the product in their hands. The main reason for this wish was difficulties and bureaucratic procedures for getting additional resources. In these cases the product manager must make a request to the higher management every time he or she needs extra resources for the product. In the other 4 of 17 cases interviewees did not mention problems with access to resources but discussed about interpersonal problems inside their teams and about the difficulties to change team members. In some cases, product managers could not ask for additional resources even if it was critical for the product success, because all resources were given by the headquarter office.

"*Our headquarter office is engaged in the distribution of budgets and people. I do not have influence on managing resources because our office has no influence on this at all."* – Product manager, Company L.

Overall, the category *access to resources* is an indicator of a product manager's ability to get resources instantly and plan the product vision and strategy relying on an available pool of resources rather than on the top management decision about their distribution.

4.1.4 Influence on collaboration

The tasks of a product manager include interaction and communication with many stakeholders. However, the involvement and commitment between tasks and organizations vary. We observed cases where the product manager was responsible for the communication function only. He or she was a facilitator between all departments including marketing, development, sales, and support, and was responsible for taking part in solving their problems. His role was to be an intermediate link for the top management level and to solve emerging problems without top management involvement.

"*There should be a person who will facilitate the collaboration between the departments within the company. This person should make peace between the financial and sales people. He is responsible for creating and approving sales plans that will address the requirements, as well as for observing what happens in the marketing and R&D departments. The top management expects from this person that people from all these departments stop to come to them and complain that they cannot agree.*" – Product manager, Company D.

This quotation shows an extreme case where the product manager worked only as a facilitator without any direct influence on the product. However, during the interviews we also observed less extreme cases where a product manager united orchestration of the departments and direct influence on the products (Interviews 3 and 11). In these cases, they managed a product from its inception to development, marketing, sales, and maintenance phases, which would not be possible without a close collaboration with other departments. For example, we received a product specification (D2, Table 4) written by a product manager in collaboration with the research and development department. The same product manager also provided us a positioning statement (D3, Table 4) for the same product written by him and the marketing department. Based on the document dates, the product plan (D1, Table 4) had been written by the product manager himself based on the previous two documents. This example illustrated us how a product manager can collaborate with other departments in order to create a product plan and subsequently release the product on time and budget.

Generally, the nature of product manager's work is in collaboration and facilitation of many, if not all, departments in the organization but due to differences in organizational structures of the companies, product manager's *influence on collaboration* may be limited.

4.2 Properties and dimensions

The identified categories are characterized by properties and dimensions that define and describe them in detail. A *dimension* represents the variation of a *property* along a range. In the qualitative analysis we used a three-level scale for dimensions, which, of course, can be considered arbitrary. However, even this coarse-grained scale provides the practical benefit of differentiating between different possible values of the property and this way it supports detailed analysis of the software product manager role. The identified properties (P) are presented in Table 6 with the super categories (SC) in the first column.

Table 6. Framework properties and dimensions

Super category (SC) with properties (P)	**Scale**		
	Low (1)	**Medium (2)**	**High (3)**
SC1: Influence on the product (IP): - **P1.1**: orchestration of development - **P1.2**: definition of tactical actions - **P1.3**: participation in	Product manager develops strategy and roadmaps but it is considered as advice only.	Product manager develops and implements product strategy and roadmaps, which should be discussed with the top management. Product manager has an impact on the changes	Product manager develops and implements product strategy and roadmaps. Product manager is fully responsible for strategic and tactical actions.

strategy planning - **P1.4**: creation of roadmaps		in strategy, roadmaps, and tactical actions.	
SC2: Authority (A): - **P2.1**: power of making decisions - **P2.2**: product leadership	Product manager is an adviser for other departments; he can make only minor tactical decisions.	Product manager agrees decisions with the top management and needs its support in orchestration of other departments.	Product manager is responsible for both strategic and tactical decisions in the frame of the developed product and only strategic actions require approval from the top management.
SC3: Access to resources (AR): - **P3.1**: own product budget - **P3.2**: possibility to hire people - **P3.3**: information resources	Product manager has no access to resources; all resources are provided by the top management.	Product manager has access to one or two resources only, e.g. he is fully responsible for the product budget.	Product manager has all the resources needed for product development, including product budget and possibility to hire new people.
SC4: Influence on collaboration (IC): - **P4.1**: level of communication - **P4.2**: ability to resolve problems between departments	Product manager works in isolation from other departments responsible for the product release and does not resolve problems arising between departments.	Product manager communicates with a few other departments and needs a support from the top management to solve the problems arising between departments.	Product manager orchestrates all the people responsible for the product and solves all the problems arising between departments.

The super category *influence on the product (IP)* has four properties (P1.1-P1.4, Table 6) that describe the areas in which the impact on the product is possible, such as strategy planning and roadmapping. Strategic and tactical actions are both important and finding a balanced point between thinking strategically and acting tactically is an issue for many companies:

"*We have only an informal product manager. Unfortunately, we don't have a position for a person who thinks about strategy only. Therefore, our product manager is a specialist in both business and technology. Our strategic initiatives come from me, CEO, or this product manager but we are also responsible for tactical steps, so this balancing point between tactics and strategy is unclear.*" – Sales director, Company M.

This leads to the situation where the top management is responsible for strategic actions only. In that case, the product manager acts as an intermediate person who has impact on the strategy and is responsible for tactical decisions. We could not identify any patterns related to strategic and tactical

decisions based on our interviews. We observed the situations when product managers were responsible for both strategic and tactical actions in small companies (Organization L) and large companies (Organization C, D). However, we also observed that all strategic decisions might be made without product managers (Organization B). The impact of product managers to development may also be limited due to the importance of research and development department for the high-tech companies (Organizations C, D). The scales for measuring the properties P1.1.-P1.4 may be defined as a binary *yes/no* scale.

The property *orchestration of development* represents a connection between product management and product development, showing how management and development are coupled together and how actions are synchronized.

The super category *authority (A)* is characterized by two properties: *power of decision making* and *product leadership* (P2.1-P2.2, Table 6). Although the importance of leadership for managers is widely discussed in the literature [43]–[45], in practice, the power of making decisions by product managers may be limited due to the hierarchical and political issues within an organization. In our study, we observed that in the small companies (Organization M and L) all strategic and tactical decisions were made by the top management while product managers were responsible for their implementation only. However, as a company grows, the top management is not able to manage all the products and processes within the organization and therefore these responsibilities are delegated to product managers, who start acting as responsible leaders for the particular product. This situation existed in large organizations (Organization A, C, D, F) while in SMEs the authority of product managers varied from very limited (Organization J) to very powerful (Organization G).

The super category *authority (A)* was difficult to measure because *power of decision making* and *product leadership* rarely have any feasible characteristics to be measured. Therefore, our approach in evaluation of these properties was based on a comparison of different cases, e.g.
"*Moreover, a product manager should have power of decision making. Otherwise, he is not a product manager.*" – Product manager, Company C.

"*No result of our work is obligatory for implementation. We are just doing some research and recommend things, explaining what is wrong and providing solutions on how it should be done. The final decisions are made by the top management or an engineering team."* – Product manager, Company G

We paid attention to the types of decisions that can be made by the product manager without an intervention from the higher management. The situation when product manager is responsible for all tactical and strategic was not observed in the collected data. Therefore, we defined the level of authority as an ability of product managers to make at least tactical decisions regarding the managed product without an intervention from the top management. As a result, we defined the scale for the properties P2.1 and P2.2 as *adviser, advocate,* and *responsible leader.*

The third super category, *access to resources (AR)* is mainly characterized by three properties (*own budget, possibility to hire people,* and *informational resources)* that show the amount of resources available to the product manager.

"*From the process viewpoint, I had difficulties with resource management. It was a problem for our company because I, as a product manager, could not ask as many resources as necessary for my*

product. Moreover, I could not be sure that these resources would not be asked to return back to the resource pool for another product. Therefore, even if I had people working on the product this week, it did not mean that they were working for the same product next week. The top management could redistribute any resources including people and budget at any time." – Product manager, Company D.

The super category *access to resources (AR)* has three properties (P3.1-P3.3, Table 6). The first two properties include possibility to hire people and own budget for the developed product (P3.1 and P3.2, Table 6). It shows if the product manager has all the resources needed for creating and running the product or whether he or she asks for additional resources from higher management when needed. Therefore, these two properties have a binary *yes/no* scale. The resource management was especially a problem for medium-size companies, where product managers had very limited access to any resources (Organization I, J, K). Moreover, they claimed about difficulties in requesting additional resources from the top management. In the small and large companies the situation with resources was better. In the large companies (Organization B, D) there was a pool of additional resources from where product managers could take more resources in case of their critical importance to the product success. In the small company (Organization M) due to its flexibility resources could be redistributed at any phase of product development. The third property (P3.3.) includes information resources that are considered as sources of valuable information for a product manager. For example, the product manager may request a market analysis either from the marketing department or from internal or external consultants or analysts. In this case, they can be seen as resources from the product manager point of view. Based on the interviews, we identified three possible values for the property: *no information resources, only internal information resources, both internal and external information resources.*

The fourth super category, *influence on collaboration (IC)* is described by two properties: *level of communication* (P4.1, Table 6) with other departments, and *ability to resolve problems between departments* (P4.2, Table 6). The category describes two sides of the work of a product manager. First, the product manager acts as general caretaker delegated by the top management to manage the issues within the organization. Second, it shows the involvement of the product manager in the collective process of creating the product.

"*In my work I work in close collaboration with our offices worldwide. Since our product is international, it is almost impossible to solve all the problems in our office only. Therefore, I spend a lot of time talking with our colleagues in other offices to facilitate them and make decisions together in alliance with the corporate strategy*." – Product manager, Company L.

The scales for these properties have also been established based on comparison of different patterns observed during the interviews. However, these patterns were unspecific to a company size or any other company characteristic. We have seen product managers who collaborate and resolve problems in very different companies, e.g. Organization L and A, but we also talked with people who worked in isolation from other departments, e.g. Organization E and J.

As a result, we defined a scale for the property *level of communication* as *isolation*, when a product manager works in isolation from other departments, *introversion,* when a product manager collaborates with a few departments only, and *extroversion,* when a product manager works in close collaboration with almost all the departments that have an impact on the managed product. The scale for the second property *ability to resolve problems between departments* (P4.2, Table 6) consists of three points as well: *no,* meaning that a product manager does not resolve any problems between departments, *facilitator,* meaning that a product manager needs to have a support from the higher management in

order to resolve problems, and *orchestrator,* meaning that a product manager resolves independently most of the problems between departments.

Table 7 presents all the described properties with scales.

Table 7. Framework properties with scales

Property code	**Property description**	**Scales with points**
P1.1	Orchestration of development	No (0)-Yes (1)
P1.2	Definition of tactical actions	No (0)-Yes (1)
P1.3	Participation in strategy planning	No (0)-Yes (1)
P1.4	Creation of roadmaps	No (0)-Yes (1)
P2.1	Power of making decisions	Adviser (0)-Advocate (1)-Responsible leader (2)
P2.2	Product leadership	Adviser (0)-Advocate (1)-Responsible leader (2)
P3.1	Own product budget	No (0)-Yes (1)
P3.2	Possibility to hire people	No (0)-Yes (1)
P3.3	Information resources	No (0)-Only internal (1)-Internal and External (2)
P4.1	Level of communication	Isolation (0)-Introversion (1)-Extroversion (2)
P4.2	Ability to resolve problems between departments	No (0)-Facilitator (1)-Orchestrator (2)

Based on the comparison of the collected data with the properties and dimensions, we defined an indicative three-level scale for each category: low (1), medium (2), and high (3). The description of each level is presented in Table 6. The descriptions of each level in Table 6 are based on the patterns identified in the analysis. These qualitative descriptions may be used for the evaluation of product manager profiles only if the pattern descriptions are very similar to the evaluated profiles. To make this procedure more explicit and independent from the already observed patterns, we used scales for each property (Table 7) and assigned numeric values to these scales. Therefore, each super category can be measured based on its properties with scales. The scores in Table 8 are defined by matching the patters in Table 6 and comparing and evaluating the scales with the patterns in the data.

Table 8. Scores for measuring super categories along scales

Super categories	Scale		
	Low (1)	Medium (2)	High (3)
SC1: Influence on the product (IP)	0-1	2-3	4
SC2: Authority (A)	0	1-2	3-4
SC3: Access to resources (AR)	0	1-2	3-4
SC4: Influence on collaboration (IC)	0	1-2	3-4

Then, to present the role of the product manager in different companies graphically, we used polar charts with four dimensions corresponding to the categories and the three levels (Figure 7). In the next section we will show how the Software Product Management Roles Framework (SPMRF) was used for identifying the product manager roles in the organizations.

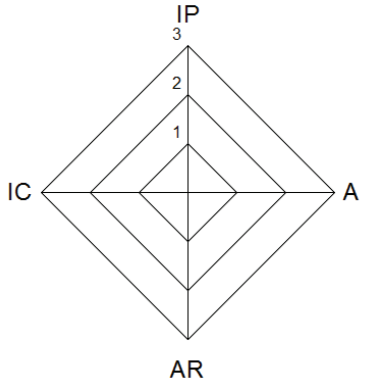

Figure 7. Software Product Management Roles Framework (SPMRF) (IP = Influence on the Product, A = Authority, AR = Access to Resources, IC = Influence on Collaboration)

5 STEREOTYPICAL PROFILES

As mentioned in Section 4.2, we used dimensions to evaluate the variation of the super categories' properties along ranges. We developed these dimensions by finding the similarities and differences between the roles and actions of the product managers. In the second round of analysis, we traced back to the initial categories to identify what dimensions were specific for the particular product manager. In total, we evaluated eight software product managers (Interviews 1, 3-6, 8, 14, 15) and one product marketing manager (Interview 11) with SPMRF and identified four profiles for software product managers that repeated in the data (Figure 8). The results of this evaluation are presented in Table 9. In the last row of this table, we present the sources of evidence that were used in the evaluation. These sources consist of interviews, but we also used the supporting documentation when it was available.

Table 9. The product managers' evaluation with the SPMRF framework

Super category	Roles of the interviewees								
	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PMM9
SC1 (IP)	1	3	3	3	1	3	1	1	3
SC2 (A)	3	3	2	3	1	2	3	3	3
SC3 (AR)	1	2	1	2	1	1	1	1	2
SC4 (IC)	3	1	1	1	1	1	3	3	1
Sources of evidence (I – interview, D – supporting document)	I1	I3, I4, D1, D2, D3	I3, I4, D1, D2, D3	I5, D4, D5, D6	I6	I8	I14, I15, D11	I14, I15, D11	I11

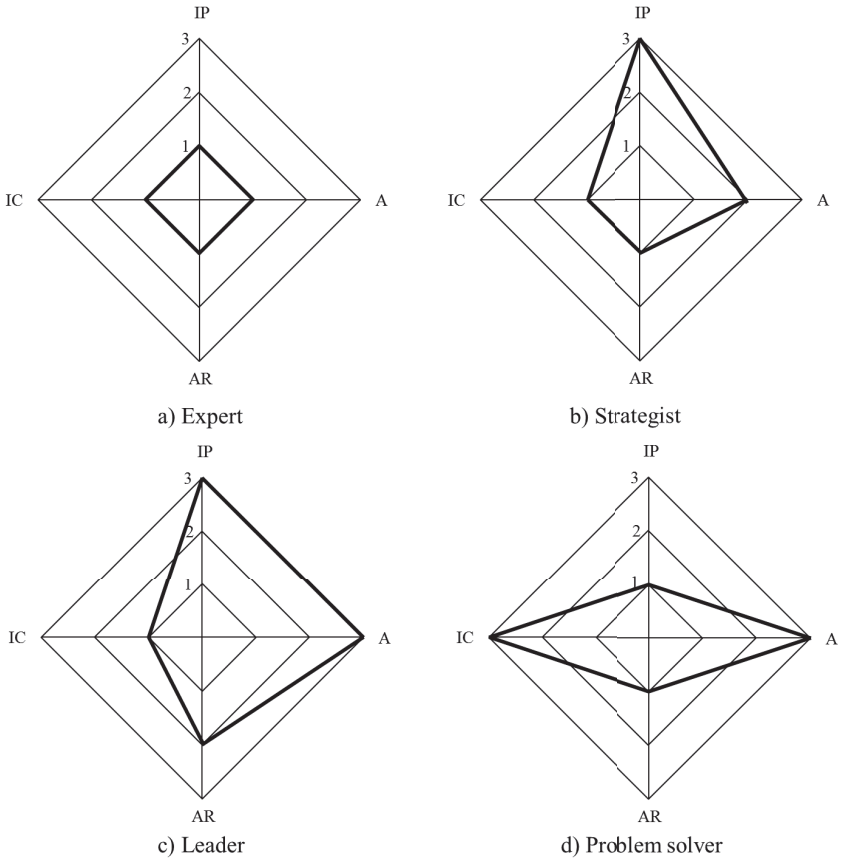

Figure 8. Observed profiles

The first profile, named *Expert* (Figure 8, a), has low levels of properties in all dimensions. The *Expert* is a person who has deep expertise in any area of business or development, but has little responsibility over product management activities. Good examples of this profile are junior product managers who come from specific fields such as engineering, marketing, or sales. Sometimes *Experts* represent the engineering side of product development, and other activities are built around these experts.

"*There is an informal product manager because we do not have this position in our company. He is a highly qualified expert who develops, tests, and supports our solutions. He understands these systems deeply at the technological level because neither I nor my colleagues have expertise in this area... Therefore, all technological ideas come from him. He acts as an undisputed guru. If he thinks that some features are really important for our product, then we build the business around them creating the right structure.*" – Sales Director, Company M.

The *Experts* hold a position in which the success of the product depends on their expertise and on understanding which features should be implemented. They act as product leaders even if they participate only in the implementation, avoiding other areas of responsibilities such as product analysis,

requirements elicitation, roadmapping, and strategy definition specific for the role of the product manager. This type of product manager was observed in Organization E. The company had not enough resources to hire many people, so cross-functional roles were common. Moreover, the company paid attention to its technological know-how, and therefore a technical leader became a product manager who paid attention to product development and positioning but, in reality, had no direct impact on the product. Only a few people in the organization knew the full picture of their business, and the role of the product manager was limited to some minor details. We called also this group of product managers *Experts* because of their high qualifications in what they do, even if they participate only in one of the many activities common for product managers.

The second profile, named *Strategist* (Figure 8, b) describes a product manager who actively participates in strategic and tactical planning of the product development and has enough power and authority to bring real impact to the strategy. This means that the roadmap and vision suggested by him or her are usually accepted by the higher management with minor changes.

"*I make decisions regarding the product: what it should look like, which features will be implemented and how it will be positioned in the market segments.*" – Product manager, Company C.

"*I make propositions of the vision and our strategy for the next year. Then, these documents are defended in the front of the top management board and necessary changes are introduced. After that, the strategy is ready for implementation.*" – Product manager, Company G.

The *Strategist* profile was observed in the large and medium sized companies (Table 2, Organizations C and G) that had a separate product management department. The responsibilities and hierarchy in the department depended on the maturity of the product management. In the simplest case, product management was represented by a small group of people who were responsible for communicating with customers, defining strategy and vision, and planning features for the next releases. In these companies product management was also tightly coupled with marketing. Therefore, a *Strategist* can be responsible for the product strategy as well as the marketing strategy. As the company grows, marketing is separated into another department. Then, a hierarchy in the product management department may appear along with the role of a vice president of product management. The organizational changes may be associated with an increased role of the product management department to product strategy and its implementation. The influence of the top management on the product may decrease because it is delegated to the product management.

The third profile, named *Leader* (Figure 8, c) can be characterized with a medium level of access to resources and with a high level of authority and influence on the product. The *Leader* profile is the next step in the evolution of the *Strategist.* When a strategist shows his or her influence on the success of the product by providing a strategic vision to the existing situation, his or her authority grows and he or she gains access to resources from the higher management. As a result, he or she becomes the leader of the product but is still controlled by the top management. This is a step towards becoming the product "mini-CEO."

"*I define the product strategy which is matched with our vision and customers' requirements. I am also the curator of resource allocation. I allocate resources to product development and to the implementation of the requirements for this product.*" – Product manager, Company C.

The *Leader* is balanced in his or her responsibilities because the *Leader* has a possibility to influence the product resources for the strategy implementation. Only the influence on collaboration is limited.

This implies that the *Leader* concentrates in his or her work without the involvement of other departments in product development.

The fourth observed profile we named the *Problem solver* (Figure 8, d). In general, the influence of this role to actual product management and development can be quite limited.

"*My task is to work as a lubricant for all the processes and departments involved in the product development so that these people know and understand the situation. I do not participate in the strategy definition because it is what comes from geeks and they do it*." – Product manager, Company A.

A product manager of the *Problem solver* type is a negotiator between many people who represent marketing, development, sales, support, and higher management. The problem solver acts as a manager who solves arising product-related issues while the top management does the product strategy and roadmapping. The main thing here is that the *Problem solver* has good communication skills and authority in problem areas, which leads to an ability to build effective collaboration between the product stakeholders.

6 DISCUSSION

The outcome of the study is the Software Product Management Roles Framework (SPMRF) for identification and description of software product manager's role in an organization. We illustrated the use of the framework in the studied organizations and identified four stereotypical role profiles of software product managers. The framework was developed empirically based on the in-depth interviews with the companies' representatives and investigation of the supporting documentation. The SPMRF assesses product managers along four dimensions with a three-level scale. In this section we discuss the two research questions formulated in the beginning of the study. Then, we compare post factum the developed framework with ten management roles of Mintzberg (1971) and discuss the orthogonality of the framework axes. After that, the implications of the study are described and followed by the discussion of generalizability of the study.

6.1 RQ: Which common roles do software product managers fulfil in organizations??

In the product management literature, for example (Dver, 2003; Gorchels, 2000; Murphy and Gorchels, 1996), product manager is often described as the product "mini-CEO". In the SPMRF, the "mini-CEO" profile looks like a profile with the highest levels in all four dimensions (Figure 9).

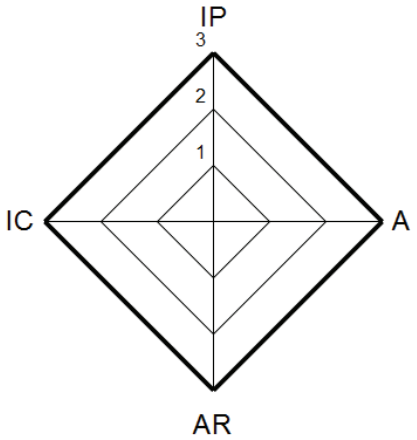

Figure 9. The "mini-CEO" profile

This profile would mean that a product manager has a possibility to make strategic and tactical decisions as well as implement tactical actions to create a successful product, has all resources in his or her hands to manage them in alliance with the product vision, has a power for making decisions related to the product, and collaborates with all other departments responsible for the product. In our data, none of the profiles had the highest value in all of the four dimensions: *influence on the product (IP), authority (A), access to resource (AR),* and *influence on collaboration (IC)*, which may be explained with the reluctance of the top management to delegate its own authority (Ugboro and Obeng, 2000). However, this profile may be easily extracted from the existing descriptions of the "mini-CEO" role in the literature.

Low levels in the dimensions are related to the cross-functional and multitasking nature of the role of the product manager, which leads to taking responsibility of many things at a time. The existing software product management frameworks (Ebert, 2007; Kittlaus and Clough, 2009; van de Weerd et al., 2006a) describe many product activities in which product manager is involved. In practice, these activities are not the responsibility of one product manager only but of several managers or even a separate product management department. Therefore, a typical product manager focuses on a limited set of functions defining his or her profile.

In our cases product managers had not started their career in product management but came to product management from adjacent disciplines. These disciplines varied from purely technical such as software development and system analysis to business related such as sales management and marketing management. When discussing about the first steps in the field of product management they all mentioned that they started as *Experts* in the field they were working before. Technical specialists started as *Experts* in the technologies, because they could explain and evaluate how the customers' needs can be satisfied with the existing codebase. Business related specialists started as specialists in elicitation of product requirements and selection of features. The marketing specialists also had previous experience of product marketing.

The stereotypical profile of *Strategist* fits well with the core product management activities in the Software Product Management Framework (Kittlaus and Clough, 2009). As a person who has an

impact on the developed product, his or her main responsibilities were related to positioning, roadmapping, requirements managing, and release planning. Since the impact on collaboration and access to resources for *Strategist* is limited, all the plans and propositions may be fully delegated to other departments such as research and development by the top management only. In this regard, *Strategist* has no people in direct subordination and reports to the higher management only.

The stereotypical profile of *Leader,* in comparison with *Strategist,* has access to resources and a high-level of authority to make all tactical and sometimes strategic decisions. Therefore, *Leader* is not only responsible for the product vision and strategy but also takes part in their implementation. *Leader* is involved in the same activities as *Strategist* but is also responsible for resource allocation. This allows *Leader* to be more flexible than *Strategist* in making decisions and planning the product features and releases.

In comparison with project managers who have resources for project implementation, we found that product managers often have a limited access to resources. Without resources, product managers cannot act as product leaders and their role may become restricted to giving recommendations to the higher management and project managers who have the necessary resources for development.

The stereotypical profile of *Problem Solver* is neither extension nor evolution of the previous profiles but another profile of a product manager in the company. *Problem Solver's* impact on the product is limited as well as access to resources. In this regard this profile is similar to *Expert* but the profile has the same level of authority as *Leader* in addition to the level of *impact on collaboration*, which was not observed in any other profile. Altogether, these two characteristics make a product manager a good *Problem Solver.* The product manager of this type is able to effectively organize and orchestrate all the departments involved in the product development. Even more important is that this type of product manager is able to resolve conflicts arising between the departments in order to make their collaboration more effective and reducing time-to-market. Kittlaus & Clough's framework (Kittlaus and Clough, 2009) makes a distinction between activities in which the product manager is involved and activities he or she orchestrates. The involvement of *Problem Solver* in any activity may be sporadic, but the orchestration is the main part of his or her work.

The product manager's responsibilities seem to depend on the particular organizational structure and the top management. They define whether a product management department exists and how it is organized. The organizational structure is a result of the company history and culture. It defines the values and conceptions of the top management, as well as their responsibilities and the decisions they are ready to delegate to product managers (Christensen and Overdorf, 2000).

Some of the studied companies had started as technological startups. In these companies product management may appear later and without a readily available understanding of its role in the organization. As the company grows, the top management may not able to solve all the daily product-related technical and business problems. To reduce their workload, the top management hires one or several persons who will be responsible for the activities related to product management and development. Unfortunately the top management may not yet be ready to delegate the strategic decisions. In these cases the product manager often acts as a *Problem Solver* or *Expert* without the power of making strategic or tactical decisions related to the product. However, we also observed companies that were established by two persons who separated business and technical parts from the beginning and acted as the Chief Executive Officer (CEO) and Chief Technology Officer (CTO), respectively. In these companies, product management existed from the beginning.

Overall, the product manager's work as well as other managers' work is dynamic rather than static (Haines, 2008). The identified four stereotypical profiles altogether with empirical observations of the differences in adoption of software product management practices in SMEs and large enterprises (Maglyas et al., 2012a) show how a product manager's role may evolve from *Expert* to *Strategist* or *Problem Solver* and from *Strategist* to *Leader* by extending product management responsibilities. The next steps in the evolution of a product manager's role might be the profile of *mini-CEO* but we have not observed it in practice yet. The profile of *mini-CEO* attracted our attention mainly because it is widely discussed and described in the product management literature.

In this study we have identified the roles of software product managers using the grounded theory as the research method. The research method allowed us to conduct the study inductively without any predetermined theories. The companies in our study produced software-intensive products and we observed that the knowledge of the software domain is embedded into the *Expert* profile. The other three profiles can be seen as evolution of the *Expert* profile and therefore the knowledge of the software deomain is also inherited by *Strategist, Problem Solver,* and *Leader.* However, we observed that the specific skills and knowledge are often acquired in advance before entering a job of a product manager. Therefore, the knowledge of the software domain is not specifically reflected on the framework, which may be suitable not only for the software domain but for other domains as well.

6.2 Management roles

We developed the SPMRF empirically and inductively using the grounded theory approach. This kind of an inductive approach requires that the analysis should not be based on any particular background theory. Therefore, we did not try to fit our theory to any existing frameworks, such as the ten managerial roles developed by Mintzberg (1971). As the framework was developed, we compared it with other frameworks post factum. Overall, our SPMRF differs significantly from Mintzberg's typology. First, Mintzberg (1971) assumed that power and authority is something that is embedded in the very nature of manager work. In our framework, we extracted authority only as one of the dimensions because we observed a lack of authority in some cases. In this regard, it is possible that a product manager has no people in subordination. Therefore, authority and leadership are not that important for all product managers as for managers that need to manage people. In total, Mintzberg (1990) identified three interpersonal and three information roles. Based on our data we could differentiate many roles, and thus the dimension *influence on collaboration (IC)* is a synthesis of six roles. It seems that product managers act as communicators and collectors of information without significant differences between the external and internal sources of information and the persons they communicate with. Product managers concentrate on the essence of their product and its improvement. The Mintzberg (1971) "resource allocator" role fits well with our dimension *access to resources (AR),* but we additionally established three levels of it. This role is described as a decisional role by Mintzberg (1971), but in SPMRF it is a separate dimension because some product managers had only a limited access to resources. The SPMRF dimension *impact on the product* has no counterpart in Mintzberg's roles. We may consider this dimension as a synthesis of three decisional roles, but it also includes some special properties, such as strategic, tactical and roadmapping issues which are not described by Mintzberg, who talks about improvements and changes only (Mintzberg, 1971). Overall, Mintzberg's roles can be seen in the dimensions of SPMRF. Our profiles describe the synthesis of roles performed by product managers. Mintzberg's roles lack this synthesis because he considered a real manager as a mix of the described ten roles, but did not present role profiles for managers (Mintzberg, 1990).

When comparing our stereotypical profiles with the typology of middle management involvement in strategy developed by Floyd and Wooldridge (1992), we found that the involvement in strategy at the corporate level is characteristic to two profiles only: *Strategist* and *Leader*. The other two profiles (*Expert* and *Problem solver)* do not participate in strategic management and, therefore, have low impact to the product strategy. Their role is described well by Balogun (2003). They act as change intermediaries who keep the business going by implementing the strategy and changes made by the higher management.

Our stereotypical profiles fit partially to Mintzberg's framework (1971) and to other product management frameworks (Ebert, 2009; Kittlaus and Clough, 2009; van de Weerd et al., 2006a) because these frameworks represent a synthesis of the activities of all managers. In practice, the activities of managers in general and product managers in particular are limited, due to political issues or available work time and other resources. In our study we observed that the product managers are so busy that they are not able to participate in all the activities they should according to the existing frameworks. Therefore, some of them concentrate on strategic activities while others are involved in solving everyday problems. This focus on some activities only is reflected in our profiles, which present how a particular product manager may focus, rather than what all product managers do.

6.3 Framework axes' orthogonality

An important question for applicability of the framework in practice is the orthogonality of its axes, or independence of score changes in one axis from other axes. The current study was an interpretive qualitative study with the goal to identify product manager profiles rather than create a statistically confirmed model for the framework. Therefore, we cannot fully determine if axes are orthogonal. However, even the four identified profiles can provide an insight on this topic. We analyzed variations between the axes by fixing one axis and observing how the values of other axes may vary. The results of this analysis are presented in Table 10.

Table 10. Variations in values of different axes if one axis is fixed

		SC1			SC2			SC3			SC4		
		1	2	3	1	2	3	1	2	3	1	2	3
SC1	1				X		X	X			X		X
	2												
	3					X	X	X	X		X		
SC2	1	X						X			X		
	2			X				X			X		
	3	X		X				X	X		X		X
SC3	1	X		X	X	X	X				X		X
	2			X			X				X		
	3												
SC4	1	X		X	X	X	X	X	X				
	2												
	3	X					X	X					

Rows in Table 10 present a fixed super category with particular score, columns show what scores correspond to the fixed score. For example, when the super category *Authority* (SC2) has the highest value three (3), other super categories can have different values, e.g. SC1 can be either 1 or 3, SC3 can be 1 or 2, and SC4 can be either 1 or 3. In this regard, we can consider the super category SC2 independent from other super categories. Similarly, when the super category *Access to resources* (SC3) has the lowest score 1, the super category *Authority* (SC2) can have any score from 1 to 3. However,

we do not have a complete value set for some super categories, e.g. SC1 with the score 2, SC3 with the score 3, and SC4 with the score 2. In addition, for some super categories, e.g. SC2 with the score 1, we have fixed scores in other axes. This may mean certain dependence between axes or it can also be explained by missing profiles that have not been observed in practice yet. In spite of these missing values Table 10 suggests that the axes are to some degree independent. Overall, the question about the orthogonality of the axes requires an additional quantitative study, where more precise scales are developed and tested.

6.4 Theoretical and practical implications

The main theoretical implication of the study is the framework for assessing and evaluating the tasks of software product managers. The framework decomposes the product manager role thoroughly described in the product management literature, the "mini-CEO", into four stereotypical product manager profiles, an *expert, strategist, leader,* and *problem solver.*

The results of this study have implications for top management, product managers, and researchers. The three-level scale for each dimension allows software product managers to assess their own positions in the company making their role more transparent and clarifying the nature of software product manager's work.

The four stereotypical profiles make it easier for the top management to assign responsibilities and control their execution according to the profile of a particular software product manager. The profiles may also be used to limit the number of activities in which the product manager is involved. In addition, the profiles may reduce overlapping activities between product managers and help to organize the product management department more effectively by separating the functions of many product managers. In case of a lack of a particular profile in a company, the developed profiles allow the human resources (HR) managers and top managers to identify the necessary skills required for the product manager depending on the role he or she has in the company.

Finally, the results have implications for product management education and further studies. The stereotypical profiles emphasize different activities in which product manager is involved. Therefore, a particular profile requires concentration on the set of skills that vary from one profile to another. Taking into account that different product management frameworks include up to 48 activities (ISPMA, 2012; Kittlaus and Clough, 2009; Pragmatic Marketing, 2010b), limiting the skill set necessary for a product manager of a particular type lowers the entry barrier to the position. From the research perspective, further investigation of other possible stereotypical profiles is necessary. Theoretically, the framework describes 81 product manager's profiles but we have observed only four of them so far. The three-level scale developed during the qualitative analysis is only indicative and therefore it should be a subject for further research. Finally, the present study does not exclude the existence of other profiles.

6.5 Generalizability of the results

The generalizability of the grounded theory in general and our research in particular is based on the increasing level of abstraction from open to axial coding, and then to selective coding. The more abstract the concepts, the wider the scope of the developed theory. At the same time, the theory is based on collected data, so it may not be fully applied in "not-quite-the-same situations" (Corbin and Strauss, 1990). In our study, the companies represent businesses in various domains from banking software to telecommunication solutions. Therefore, the identified profiles are independent of the

business domain. In this regard, the results and the profiles may be usable regardless of the business domain.

Our results have a territorial bias because we conducted the interviews in Russia only. However, all the studied companies are international. The headquarters of six companies are situated in the USA and Europe and the Russian branches included research and development offices. The other companies are originally Russian, but also their activities are international. The study shows that the company size plays an important role in how the software product manager role is established. This has an effect on the generalizability of our results because this factor cannot be avoided (Lee and Baskerville, 2003).

The interpretations of the collected data are a source of researcher's bias to the findings. This bias is common to all qualitative studies but we tried to tackle this bias by using triangulation of various sources of data such as interviews and supporting documentation to verify our theoretical understanding and draw the conclusions based on the solid evidence from the data. We conducted three more interviews to determine the saturation of our findings and no new categories emerged from these three additional interviews. We also developed our theoretical understanding based on the emerged categories as soon as possible after the interviews. This allowed us to verify our understanding and interpretations several times in the further interviews. Based on the set of saturated data, we developed the SPMRF. However, its verification and further development of scales require additional investigation.

Strauss and Corbin (2008) state that by using the grounded theory approach we create a theory, which is dynamic rather than static and can be extended by adding new data. Therefore, we could reveal more details by increasing the number of studied companies. It may happen that in the future we find new roles in addition to the identified four. Theoretically the number of roles is 81, but currently we have no evidence of other roles except the four described. The grounded theory tends to provide credible results, because it is based on the method of constant comparison in which categories and concepts emerge repeatedly and guide the continuous research (Glaser and Strauss, 1967), resulting in an inductive theory. In this regard, credibility is embedded in the grounded theory approach.

7 CONCLUSION

In this study we provided an empirical insight into the role of product managers in software business. Throughout the study we searched answers to the questions of what roles of software product managers exist and how these roles are interrelated with the organizational structure and each other. The role of a product manager is especially important in the competitive market of software products, where most features can be easily reproduced and improved by competitors (Christensen and Overdorf, 2000).

The SPMRF provides an instrument for profiling of product managers. It allows product managers and top management to understand the tasks held by product managers. It helps to avoid the situation where the top management and the product manager have a different understanding and expectations about the responsibilities of the product manager. Our four identified profiles fill this gap by providing descriptions of variations in the responsibilities and by giving a tool for assigning responsibilities for a particular product manager. The framework is useful for companies with a separate product management department because it shows how the roles can be separated within the department between many product managers, so that each of them has clear responsibilities for their own part of product management.

The "mini-CEO" concept has initially been described in the product management literature as the product manager role (Dver, 2003; Ebert, 2007). This may have biased practitioners' understanding of what product managers really do. In practice, product managers have sometimes difficulties to explain what they are responsible for. The explanations may include descriptions like "*he does everything the product needs to be successful"* (Maglyas et al., 2012b). This study revealed that the product manager role may vary from *Experts* to *"mini-CEOs"* creating a multitude of different roles a particular product manager can have within an organization. The developed framework and identified stereotypical profiles explain the variation in product manager's work. Moreover, the product manager's role has a tendency to evolve within a company. It is especially important for the companies that have a separate product management department where several product managers are responsible for one product. Taking into account four stereotypical profiles, their tasks may be easily shared. *Expert,* who may be known as technical product manager, provides the technical or marketing expertise to the developed product. *Strategist* is responsible for the vision and strategy of the developed product, whose main goal is to collect the necessary information to support the vision and the strategy with quantitative and qualitative data. *Strategist* works in close collaboration with *Leader* who is responsible for strategy and vision implementation altogether with marketing, sales, and engineering departments and has an impact to the strategy planning as well. *Problem solver* facilitates interactions between the departments and resolves the collaboration and communication problems arising between the departments.

According to Mintzberg "managerial work does vary, according to the needs of a particular job and the approach of its particular incumbent" (Mintzberg, 1994). Nevertheless, an understanding of which roles exist, how product manager perform these roles, and what relationships between the roles exist is critical for definition of organizational structure (Mintzberg, 1994). Moreover, "being labeled or treated as a product CEO can be a daunting situation, since it nearly always means operating without the authority and resources available to a corporate CEO" (Steinhardt, 2010). Therefore, this study provides practitioners and researchers with an understanding that product manager is not limited to a product "mini-CEO" but he or she may as well act as *Expert, Strategist, Leader,* or *Problem Solver*.

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Appendix A. The interview questions for the first round

General questions and company context

- General information about an interviewee (name, company, e-mail address, phone number, position, experience)
- General information about a company (name, number of people, number of IT people, work area, goals)
- Could you describe the management hierarchy of the company?
- Could you describe the responsibilities at the each level of hierarchy?

Software Product Management components

- How do you manage your products? Do you have a product management function?
- How do you do the following things (briefly)?
    1. If you do not do something, briefly describe why
    2. Who is responsible for each activity?
    3. What is the role of … for managing the product?
    - software configuration management
    - defect management
    - strategy definition
    - portfolio management
    - product marketing
    - product development
    - product requirements
    - release planning
    - project management
    - finance (pricing)

Is there anything else that is related to the managing of the product?

Software Product Management discussion and conclusion

- What, if anything, do you know about software product management?
- Could you briefly describe the established process of managing the product? Are you satisfied? In your opinion, what should be changed? Are you familiar with the term "SPM"?
- Is there anything else you think I should know to understand the company better?
- Is there anything you would like to ask me?

Appendix B. The interview questions for the second round

General questions about software product management

- Have you ever heard about software product management?

- Could you explain how you understand the term software product management?
- What experience do you have regarding the application of software product management methods?
- What is the role of software product management in your organization?
- How does your business orientation affect software product management?

Product manager's role

- How is your work related to software product management?
- What is the role of product manager in your organization?
- Do product managers in the organization have access to the resources? How do they manage these resources?
- Could you describe the decision-making process in your organization?
- Who in your organization defines the strategy? Business goals? In your opinion, how much do policies or management affect these decisions?

The main components of software product management

- Do you have a strategy department? If yes, what are they doing? If not, why?
- Do you practice portfolio management? If yes, how are you doing it? If not, why?
- Could you explain the connections between "business level departments" such as marketing, sales, analysts, and others who work with the market and customers?
- How does the customer participation affect software product management? Can the customer affect software product management processes or decide anything?
- Does the intended purpose of the end-product affect software product management? If yes, why and how?

Software product management improvement

- In which areas, in you experience, software product management should be improved?
- Name three most effective practices that help to create successful products? Why are they effective? Have you defined them in writing? If yes, what details do they include? If not, why?
- What kind of knowledge is most beneficial to create your products? How can this knowledge be obtained?
- Could you tell a story of running the product in your organization from the idea to the market?

The company context

- What are the current unmet customer/end user needs? In your opinion, why do you think they have not been met? How do you plan to fulfill them? Do your product managers pay attention to this?
- How do you measure and optimize the business performance in your organization? Is it effective? If yes, how? If not, do you have any improvement ideas?
- Could you describe several unique features of your organization? How do they affect your business and internal processes?
- Could you describe your competitive advantages? How do they help you to be successful in the market?
- In your opinion, what market trends will influence your business in the nearest time?

Other questions

- Is there something you would like to add to your answers or something regarding software product management that you think should be mentioned?
- Do you have any questions?

Appendix II: Questions for the semi-structured interviews

Appendix II: Questions for the semi-structured interviews

Appendix A. Interview questions for the first round

General questions and company context

- General information about the interviewee (name, company, e-mail address, phone number, position, experience)
- General information about the company (name, number of employees, number of IT people, work area, goals)
- Could you describe the management hierarchy of the company?
- Could you describe the responsibilities at each level of hierarchy?

Components of software product management

- How do you manage your products? Do you have a product management function?
- How do you do the following things (briefly)?
    1. If you do not do something, briefly describe why
    2. Who is responsible for each activity?
    3. What is the role of … for managing the product?
        - software configuration management
        - defect management
        - strategy definition
        - portfolio management
        - product marketing
        - product development
        - product requirements
        - release planning
        - project management
        - finance (pricing)

Is there anything else that is related to the managing of the product?

Discussion and conclusions of software product management

- What, if anything, do you know about software product management?
- Could you briefly describe the established process of managing the product? Are you satisfied with this? In your opinion, what should be changed? Are you familiar with the term "SPM"?
- Is there anything else you think I should know to understand the company better?
- Is there anything you would like to ask me?

Appendix B. Interview questions for the second round

General questions about software product management

- Have you ever heard about software product management?
- Could you explain how you understand the term software product management?
- What experience do you have regarding the application of software product management methods?
- What is the role of software product management in your organization?
- How does your business orientation affect software product management?

Product manager's role

- How is your work related to software product management?
- What is the role of a product manager in your organization?
- Do the product managers in the organization have access to the resources? How do they manage these resources?
- Could you describe the decision-making process in your organization?
- Who in your organization defines the strategy? Business goals? In your opinion, how much do policies or management affect these decisions?

The main components of software product management

- Do you have a strategy department? If yes, what do they do? If not, why?
- Do you practice portfolio management? If yes, how do you do it? If not, why?
- Could you explain the connections between "business level departments" such as marketing, sales, analysts, and others who work with the market and customers?
- How does customer participation affect software product management? Can the customer affect the software product management processes or decide anything?
- Does the intended purpose of the end-product affect software product management? If yes, why and how?

Improvement of software product management

- In which areas, in you experience, should software product management be improved?
- Name three of the most effective practices that help to create successful products. Why are they effective? Have you defined them in writing? If yes, what details do they include? If not, why?
- What kind of knowledge is most beneficial to create your products? How can this knowledge be obtained?

- Could you tell a story of running the product in your organization from the idea to the market?

The company context

- What are the current unmet customer/end user needs? In your opinion, why do you think they have not been met? How do you plan to fulfill them? Do your product managers pay attention to this?
- How do you measure and optimize the business performance in your organization? Is it effective? If yes, how? If not, do you have any improvement ideas?
- Could you describe several unique features of your organization? How do they affect your business and internal processes?
- Could you describe your competitive advantages? How do they help you to be successful in the market?
- In your opinion, what market trends will influence your business in the nearest future?

Other questions

- Is there something you would like to add to your answers or something regarding software product management that you think should be mentioned?
- Do you have any questions

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