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Data-Driven Software Product Management

What is the role of a modern software product manager and how data-driven are they in making decisions?

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Abstract

Software product management refers to the function of managing a software product by considering business, user, and technology requirements. This multidisciplinary function is fairly new field, and the little existing research focuses on the technical aspects. Meanwhile, in practice product management has rapidly evolved to be more focused on the business side and academic research has not yet reported on this change. Product managers are constantly pushed to make decisions about their product and academia reports that these decisions are mainly based on opinions, expertise, and intuition. However, data analytics has been proposed as a tool to overcome subjective decision making to produce more reliable decisions that are of higher quality. Still, the extent to which product managers are data-driven has not been studied and data analytics does not come without concerns.

The thesis aimed to solve the two issues of bridging the gap in understanding product management function between academia and practice, as well as the lesser studied area of decision making based on data analytics. A qualitative interview study was conducted to answer these concerns where 10 product managers from various companies of different fields and sizes were interviewed. The interviews were analysed based on the interview transcripts using thematic analysis.

The results of the thesis research confirm the gap between how academia and the field define product management. Contemporary literature seems to have been closer to the truth where the role is less technical and more focused on business goals and product discovery through understanding users, defining requirements, and managing a roadmap. Two emerging concepts arose during the study, both of which have been overlooked previously in product management research. These include the effect that constraints and limited resources have on the product manager, and the role of stakeholders and how negotiations mould and even limit the product manager's role but also their decisions. The decisions that product managers are able to make, are mostly based on user research but subjective grounds still play an important part. Data analytics, which has been proposed as a solution for better decision making, was seen as burdensome, time consuming and lacking in depth. Thus, to enable product managers to be more data-driven better tools for analysing and portraying data are required, as the study still indicated that investing in a data analyst for the product team already makes product managers less subjective decision makers.

Keywords software product management, product data, data analytics, user research, decision making

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Preface and acknowledgements

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Turku, 31 July 2024
Janina Paasila

1 Introduction

Software product management is a key function in companies offering or based on a software product, whether it be a mobile application, downloadable computer software, or a digital service on web. Existing literature discusses the function of software product management from a technology-heavy point of view. Generally, software product management consists of managing the product or part of a product so that it matches the technical requirements and provides value for both the business and its users. Multiple varying and somewhat contradicting academic definitions of software product management exist, while not many of them regard the role of a software product manager in an organisational context. The academic literature discussing software product management as a practice and a role are almost exclusively over a decade old. Meanwhile, the field is rapidly changing and becoming more crucial in both software product companies and traditional hardware and service companies creating software products to address the market more effectively. Additionally, commercial literature of the field defines the field and role of a software product manager differently to academic research. Thus, there is a need for a definition of what the role of a software product manager looks like in this day which motivates the first research question:

RQ1: How have the software product manager role and responsibilities evolved in the last decade compared to previous research?

In modern software development the decisions concerning the software have a major impact on the software's cost, schedule, and value (Boehm, 2006). Many companies claim to be data-driven and collect vast amounts of product data. Additionally, software product managers and user researchers conduct numerous studies on users to understand their needs, characteristics, and behaviour better and use it to guide product management decisions. The needs of users are becoming ever more diverse and personalised incentivising a focus on user-centricity (Quan et al., 2021). However, while data collection itself is on a good track in many companies, the use of the data for product management decision making does not translate well into practice and academia reports that analytics are rarely used effectively for guiding the decision making (Buse & Zimmermann, 2010; Buse & Zimmermann, 2012; Chen, 2018; Hilbert & Redmiles, 2001; Holmström Olsson & Bosch, 2013; Holmström Olsson & Bosch, 2014; Sauvola et al., 2015; Wagenblatt, 2019). The use of data, however, is important to steer product management away from opinions, subjectivity, and ambiguity, towards a holistic understanding of the users and their real behaviour. While software companies are often born user-centric, this is not as much the case with hardware companies that are now transitioning into software service business driven by the digital shift (Holmström Olsson & Bosch, 2013). Thus, methods to effectively use data to guide product management decision making in its different subfields are necessary, and addressing the current state of using data in software product management is necessary. This need motivates the second research question:

> **RQ2:** How data-driven are the software product managers of today in their decision making?

The market context into which the product is being developed has a significant impact on the product management. Usually in a business-to-business (B2B) context the client is a specific organisation with specified needs and expectations for the product. The people that the product manager communicates with have a certain amount of power over the product management decision making while not necessarily being the end user for the product. Thus, there is an increased risk that the requests of the customer are not representative of the actual needs of the users of the product (Fotrousi & Fricker, 2016).

In contrast, with business-to-consumer (B2C) focused products there is not necessarily an explicitly defined request for a certain kind of product or features. Needs of potential users are derived from the market by examination of existing products in the market. Product management in relation to market-driven development is all about balancing commercial and technical requirements with quality attributes, managing the relationship between market-pull and technology-push, and optimising cost-to-value ratio in relation to dependencies when selecting requirements (Dzamashvili Fogelström et al., 2009). Thus, the customers may affect the decision making less or at least only indirectly, as the product management is free to make product decisions that they see to be the best fit (Dzamashvili Fogelström et al., 2009). Consequently, the accurate understanding of the product's users is even more crucial and data analytics provides insights about the needs of the market. Hence, the thesis research focuses on the B2C-context.

The research in this thesis aims to gather existing literature on the role of a software product manager and its associated activities, on the ways of understanding product users with data and analytics, as well as on the decision making process in product management context. A qualitative study with semi-structured interviews will be conducted to answer the research questions proposed before. The results of the research are presented in detail and contrasted with existing research.

The thesis is structured as follows. Chapter 2 discusses the previous literature on product management, taking a look at both academic contribution and contemporary professional literature. Earlier research on product data and analytics as well as decision making theory relevant to data-driven product management are also presented. Chapter 3 introduces the research methodology used. Chapter 4 presents the results of the research in detail. Chapter 5 continues with a discussion on the results in relation to existing literature and proposes implications of the results. Finally, chapter 6 concludes the findings and shortly discusses the limitations of the study and opportunities for further research.

2 Literature review

This section presents existing literature on, firstly, software product management function, its activities, and various frameworks to portray how it is understood in both academic and contemporary literature, highlighting the discrepancies between researchers and practitioners. The second part of the literature showcases the previous research on understanding product users, namely by user research methods and data collection and analysis. Finally, previous literature on product management decision making will be presented, focusing on the usage of data in decision making and how subjective biases affect decision making.

2.1 Software Product Management as a Practice

Software product management (referred to later as just product management) is a function of managing the overall product. In the context of software products, product management involves the whole variety of business, technical, and design questions related to the product's life-cycle. The product's position in the life-cycle determines what questions are answered and how. Besides the short-term decisions related to market positioning, user experience, and release planning, product management is also responsible for long-term alignment with product and overall company strategies (Dzamashvili Fogelström et al., 2009). In academic literature, product management is also referred to as product planning (Maglyas et al., 2017) or software project management (Benestad & Hannay, 2011).

The role of a (software) product manager is usually positioned in the product team along with others such as service designers, user experience designers, data analysts, product owners, and software engineers. Although sometimes the product management tasks are (partly) the responsibility of the project manager in which case they are usually also the team lead (Buse & Zimmermann, 2010). In the working environment the title product manager is often used interchangeably with titles such as product owner, service manager, and service owner (Wagenblatt, 2019). However, especially in the context of agile software development methods, product owner title is usually a technical position different from product manager, managing feature development and backlog while overseeing the work of the software engineers. Additionally, a product manager usually does not have authority in their team (Cagan, 2018; Perri, 2019; van de Weerd et al., 2006a; Wagenblatt, 2019).

A product manager manages a product's value creation through understanding users and their needs; evaluating and selecting features to meet those needs; scoping the market to identify trends and opportunities to gain market share; and gaining more users through promotion and correct pricing

(Saketharaman, 2015). Van de Weerd et al. (2006a) define a product manager's role to focus on requirements engineering, release planning and product planning in the context of responding to various stakeholders' needs and constraints. However, both in academia and in the industry the description of a product manager's role and responsibilities vary (Maglyas et al., 2017; van de Weerd et al., 2006b). In the study by Barney et al. (2008), product managers primary roles were described as follows:

A. facilitating development and release of functionality to the product,
B. monitoring the market and competing products beyond functionality,
C. deriving the requirements that meet the real market needs.

The differences between product management processes between companies are explained mostly by customer characteristics, business sector, and product characteristics, especially application age and lifetime (Bekkers et al., 2008). Despite the discord in academic role definitions, the common denominator is acting as a link between business and technology concerns while interacting with stakeholders, especially users of the product (Maglyas et al., 2017).

2.1.1 Value-Based Software Engineering

The function of product management and the role of a product manager have both been established and popularised only in the past couple of decades. Value-Based Software Engineering i.e. VBSE (Biffl et al., 2006) has in many ways paved the way for product management practice and acted as a predecessor to it. In the early 2000s a VBSE agenda emerged to reshape software engineering practices and principles to accommodate value considerations (Boehm, 2006). It is a framework where the managerial and technical decisions regarding software development must relate to value propositions of the stakeholders i.e. decisions must result in actions that provide value to stakeholders (Berry & Aurum, 2006).

VBSE aims at aligning software development, stakeholder requirements, and business objectives (Wohlin & Aurum, 2006). Such involvement of customer needs while aligning business and technology attributes is characteristic of what is nowadays known as product management. In fact, Wohlin & Aurum in 2006 argued that software development, marketing, and product management are organisational units divided by conflicting goals, culture, and language, and that software development is not linked with business goals and design decisions creating a gap between technological capabilities and business objectives. Then, VBSE was proposed as the solution, but today such process that links these units and processes would be product management.

2.1.2 Different Views to Structuring Product Management

Fotrousi et al. (2013) structure product management based on the decision making level which are portfolio, roadmap and release level. Portfolio level decisions consist of deciding to create a new product, selecting the technology for a product, and terminating an old product. Roadmap level decisions relate to features and which features should be developed and when or whether a feature should be removed. Finally, release level decisions focus on the specific features and which requirements they consist of, how they should be prioritised and selected. Thus, in this top-down approach portfolio level decisions affect roadmap and release levels, and roadmap level affects the release level. In the study it was found that most decisions are made on the roadmap level and further measuring feature usage and technical faults such as downtime were most important factors. Fotrousi & Fricker (2016) expanded on the previous study by dividing product management into portfolio management, roadmapping, and release planning. Extending on portfolio level decision making, portfolio management additionally includes researching the market to find gaps, deciding on marketing of the product, and how to position the product all while considering constraints and resources. While portfolio management is high-level and focuses on the long-term, roadmapping plans ahead a few years or so and tackles how the mid-term strategy supports the portfolio by reacting to current trends and threaths. Release planning focuses on the practical feature development, which features are released and when on a short-term basis.

Similarly, van de Weerd et al. (2006a; 2006b) divide product management into portfolio management, that includes multiple products; product roadmapping, that includes the releases of the product; release planning, that includes the requirements for the releases; and requirements management, that includes the content of the requirements. They call this the artifact hierarchy (figure 1). Product portfolio may include under itself multiple products, those each having multiple releases, and those each having multiple requirements. Thus, the model has an additional level to the bottom compared to Fotrousi & Fricker (2016), and it hints that views on product management are not clear cut, e.g. Svahnberg et al. (2010) synonymise release planning and roadmapping. Van de Weerd et al. (2006a; 2006b) also emphasise the role of internal and external stakeholders and how the connection with them shapes the product management process. The artifact hierarchy combined with stakeholder interaction forms the reference framework for software product management (figure 2).

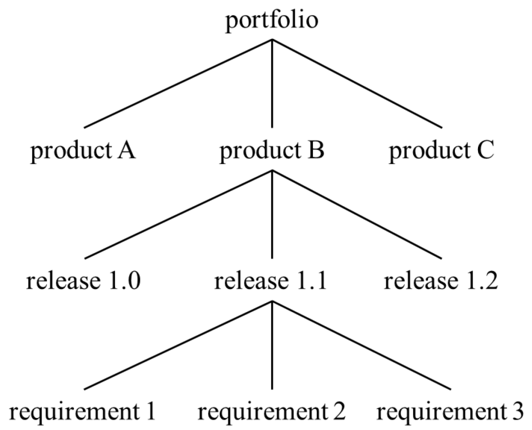

Figure 1. Product management artifact hierarchy (based on van de Weerd et al., 2006a; 2006b)

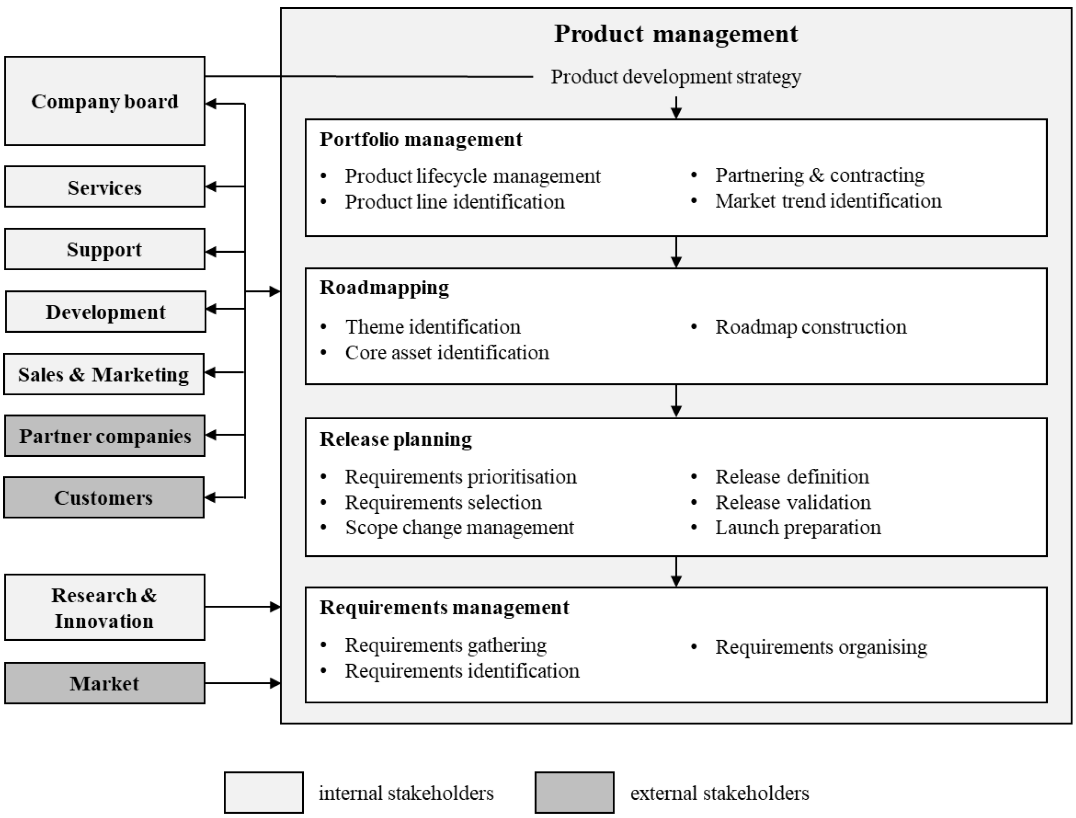

Figure 2. Reference framework for software product management (simplified from van de Weerd et al., 2006b)

The preceding artifact hierarchy and reference framework models by Fotrousi & Fricker (2016) are quite technical approaches to product management with their focus on releases and features. Saketharaman (2015) provides a more business-focused approach that is based on the product life-cycle, elaborating on traditional non-software products (figure 3). A product's life-cycle starts from development featuring prototypes and market analysis, followed by incubation by releasing the product to a select set of customers to receive feedback and estimate revenue prospects. Finally, a business plan is formed based on forecasted cash flow and return on investment. Next, the product enters enhance phase where it grows, and development focuses on broadening the functionality to reach wider audiences. A lot is invested in marketing and sales to ensure the growth and position in the competitive environment. Once the growth begins to stagnate the product moves to maturity stage. The product and its customer base stabilise, and quality of service becomes the key focus area. Returns are predictable while costs related to product and market growth diminish. Finally, the product enters decline as it becomes obsolete to its customers, whether it is due to outdated technology, cost, change to competitor product, or other. Here the product manager must decide whether the product will be discontinued before the decline results in the upkeep of the product becoming too expensive. An alternative option is to renew or reinvent the product to better suit the needs of customers and match competitors. By renewing or reinventing a product, it could start a new product life-cycle, however, it could be less risky and costly to develop an entirely new product. On the other hand, van de Weerd et al. (2006b) describe product life-cycle management to concern the planning and controlling of processes related to product information and knowledge, and state that it is one of the processes relevant in the portfolio management stage of the product management artifact hierarchy.

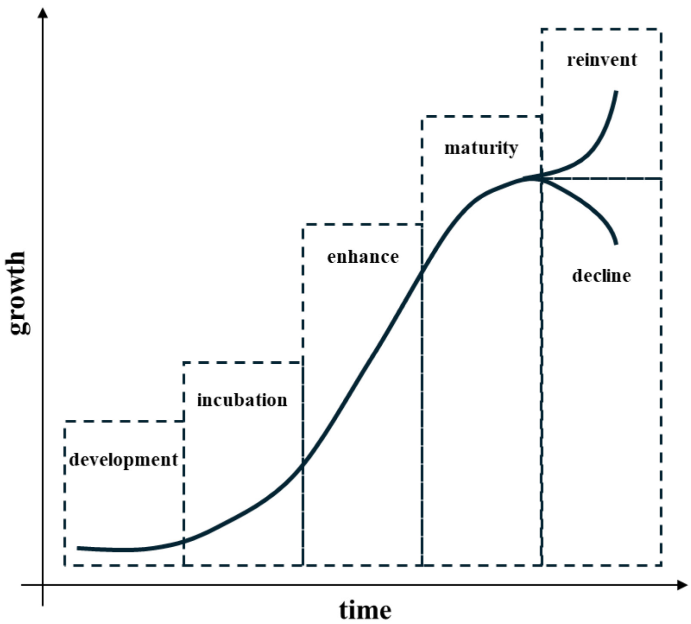

Figure 3. Software product life-cycle (based on Saketharaman, 2015)

More recently Maglyas et al. (2017) synthesised multiple studies and industry research to come up with core and supporting product management activities. The core activities are the main responsibilities of a product manager, and most product managers would be very familiar with them. Similar to earlier product management descriptions, Maglyas et al. (2017) found out that roadmapping, release planning, and requirements engineering constitute the core of the role, however, they also added product vision and life-cycle management as core activities. Portfolio management, on the other hand, was labelled as just supporting product management activity, along with strategic planning, product analysis launches, support, and development. The supporting activities are ones that are often a part of product management, but they receive less emphasis and not all of them are relevant to all product managers.

Finally, the International Software Product Management Association ISPMA proposes a framework for product management function based on which it educates and certifies product managers. According to ISPMA (n.d.) there is an array of activities and tasks related to the product, but product management is only responsible for some of them. They argue that the execution of product development, marketing, sales, and delivery is not product management responsibility, but rather product management only orchestrates these activities. Strategic management belongs in the group as well, however, out of the strategic management tasks product management is only responsible for market and product analysis, while participating in the other tasks. Finally, the core of product management comprises of tasks under product strategy, such as positioning, pricing and delivery modelling, and product planning, such as customer insights, roadmapping, and release planning. Some tasks considered to be a part of product management by other sources, such as UX design and requirements engineering, are not the responsibility of product management according to ISPMA.

2.1.3 Product Management Processes

Product management consists of a variety of, somewhat overlapping, processes related to the business, technical, and design aspects. These include e.g. requirements engineering, release planning, roadmapping, market research, product design, and user research. The overarching structure of product management has been explained in the previous section, but despite the multitude of models, academia is not clear cut on the terminology (e.g. mixing requirements selection and release planning on Barney et al., 2008; and Svahnberg et al., 2010). In terms of decision making, the research seems to be focused on release planning, while product portfolio management has received little attention overall (van de Weerd et al., 2006b).

Milne & Maiden (2012) define requirements engineering as a socio-technical field emphasising that it is the process of software engineering where considering human factors is most relevant. More specifically, van de Weerd et al. (2006b) define requirements management as the process of identifying and organising requests and needs from stakeholders while considering resources and constraints. Requirements are managed by eliciting, modelling, analysing, communicating, agreeing on, and evolving them (Nuseibeh & Easterbrook, 2000). Traditionally requirements were considered to exist as something to be found, and that different stakeholders would strive for mostly the same requirements (Bergman et al., 2002). However, this view has since changed to consider requirements as the problems of the stakeholders that they do not necessarily even realise having.

Factors affecting the selection of the requirements for a software product may be divided into technical and non-technical factors (Svahnberg et al., 2010). Technical factors relate to the tools, architecture, technologies, and quality requirements, such as performance, security, maintainability, and interdependencies. Most requirements do not exist independently (Maurice et al., 2006). Interdependencies may be divided into coupling related, i.e. requirements support or require each other and should be engineered into a feature at the same time, and precedence related, i.e. one requirement is a prerequisite to the other and must be engineered into features after one another (Ruhe & Saliu, 2005). Non-technical requirements include strategic goals and value propositions, stakeholder priorities, product maturity, as well as time and cost constraints (Svahnberg et al., 2010). Further, Barney et al. (2008) argue that overlooking the technical dependencies and interdependencies may lead to issues with the non-technical requirements. In VBSE, requirements engineering is described as deriving software objectives from the value propositions of critical stakeholders (Boehm, 2006). Furthermore, Wohlin & Aurum (2006) argue that product value is created by assigning the correct requirements to correct releases.

Release planning is the function of selecting which features are developed for and delivered in each release considering the risks and predominant technical, resource, and budget constraints (Du et al., 2006; Benestad & Hannay, 2011; Maurice et al., 2006; Ruhe & Saliu, 2005). Barney et al. (2008) note that the more there are customers and different requirements, the more requirements engineering and release planning are divided. The planning of each release is influenced by hard constraints, which restrict the implementability of features at a certain time and in a certain order, and soft factors, which concern unpredictable events such as risk (Svahnberg et al., 2010). Additionally, time-to-market, return on investment (ROI), and satisfying important stakeholders may affect the selection process (Ruhe & Saliu, 2005), however existing release planning models are poor at taking these soft factors into account (Svahnberg et al., 2010).

The practices in use for release planning may be formal models rooted in explicit analysis of alternative release plans, or judgment-based (also ad-hoc) where project members and informal negotiations influence the planning.

According to Benestad & Hannay (2011) and Ruhe & Saliu (2005) most organizations use the latter, even though formal models are shown to lead to release planning that is both more efficient and effective and satisfies stakeholders more. Yet, they point out that even formal release planning models require replanning and flexibility for practical use. Further, Ruhe & Saliu (2005) suggest that human intelligence should be integrated into the formal models since projects always include uncertain information that is difficult to handle computationally. They propose that computational models could suggest alternative release plans of which the product manager could make evaluations based on their judgement and intuition. Judgment-based release planning is highly influenced by the meetings between stakeholders, where the resulting plan is dependent on which stakeholders have attended and therefore may be more or less accurate (Du et al., 2006), which is especially the case with agile development (Ruhe & Saliu, 2005). However, Maurice et al. (2006) suggest that ad-hoc release plans may work for small projects where the project manager is the sole decision maker.

Roadmap is a short-term, usually 3-5 years, strategy that combines product planning for resources and releases and forecasting of technology and market trends (van de Weerd et al., 2006b). It is guided by decisions in the portfolio management level and constructs an actionable plan for the upcoming releases of the product and their requirements on a general level. Cagan (2018) defines roadmap as a list of features in order of priority that is used to track progress against business goals and time constraints.

While product marketing is usually not considered to be the responsibility of product management, it is crucial for the product manager to follow the trends and competitors in their respective market through market research. Based on van de Weerd et al. (2006b), the portfolio management process identifies market trends that are then used for product life-cycle management and further fed into the requirements, releases, and the roadmap. Active following of market trends improves competitiveness, as the product function can quickly adapt to changing needs and monitor competitors' successes. Additionally, researching the market may point out user needs that have not come up with the managed product.

Product design can be defined as the properties of a product related to its aesthetics and functionality (Kumar et al., 2015). According to Quan et al. (2021) product design processes vary by organisation, but a general design process consists of nine tasks "*product vision definition, market research, competitive research, user research, idea generation, feasibility analysis, sketching, prototyping, and scheme evaluation*" (pp. 3, 2021), of which product vision definition is done first and the rest follow unordered. Each task is (or could be) supported by different tools, methods, and data such as wireframing for sketching and interviewing for user research. Thus, product design is largely synonymous with product planning.

2.1.4 Product Management in Agile Development

In the early 2000s incremental software development, where development is executed in time segments including an optimal set of requirements, was overtaking the traditional waterfall model, where the software is developed in one iteration and deployed only when every requirement has been fulfilled (Wohlin & Aurum, 2006). More recently, the agile software development frameworks such as Scrum have become the de facto approach to software development.

In many ways, agile methods have made product management easier as time to market has decreased providing faster access to both feedback and data collection and reacting to feedback and defects is possible quicker than with traditional software development such as waterfall (Dzamashvili Fogelström et al., 2014). However, Dzamashvili Fogelström et al. (2009) argue that current agile practices are unable to effectively take into account the needs of product management, especially in the case of non-functional requirements. In their study it was found that agile methods emphasise commercial requirements that translate unambiguous value to the customer and/or company while overlooking technical requirements, such as information security, that are crucial in the long-term but difficult to translate into value propositions. Further, Sauvola et al. (2015) argue that agile practices should focus evermore on involving users in software development. Thus, product management in agile context requires vigilance in making sure that the long-term product management is effective and supported by the agile practices.

2.1.5 Contemporary Product Management

As the academic literature on product management is limited and largely not up to date, it is necessary to also look into commercial literature in the field. Marty Cagan and his book from 2018 is consistently claimed as being one of the top books in contemporary product management. The author is an experienced product manager and portrays his view of modern software product management. Cagan (2018) argues that the traditional process of coming with an idea and placing it into a roadmap including requirements that are then turned into designs, built, tested, and released is not an effective way to build products that answer to the needs of users. He argues that this model is reminiscent of the waterfall model in software development and lacks in supporting continuous innovation and iteration. He also claims that product management should focus on outcome rather than output, meaning that each thing that a product manager works on should be a solution to a problem and not a feature per se. Here he highlights that the underlying goal is business results that serve the user, which is quite far from the views of academia.

Cagan (2018) introduces his model of product management as Continuous Discovery and Delivery (figure 4). He sees these two activities to be the main activities of product management and more importantly that they are constantly ongoing in parallel. Discovery is described as understanding how and why the product should be built before implementing any coding. The goal of product discovery is to evaluate 4 questions: is user willing to use the product, is user able to use the product, is it possible to build the product, and will stakeholders support the product? Cagan argues that the output of discovery is a product backlog, which should not be confused with roadmap, as it does not include deadlines. Product discovery is the main objective of a product manager and is heavy on prototyping and other validation methods. Product delivery, on the other hand, is the process where the product is built under the technological capabilities. Often the output of product delivery is minimum viable feature (MVF) or minimum viable product (MVP), which is the smallest working feature or product that works for the users to gain feedback, data, and validation for the solution. Finally, product vision considers the long term of the product. It is a vague goal or direction for the product that aligns with the company vision and addresses the market as well. The vision should loosely guide the Continuous Discovery and Delivery. Cagan (2018) states the goal of the product manager to be evaluating and deciding what is delivered to users, and to do that successfully a product manager requires deep knowledge of the users, data, business, market and industry.

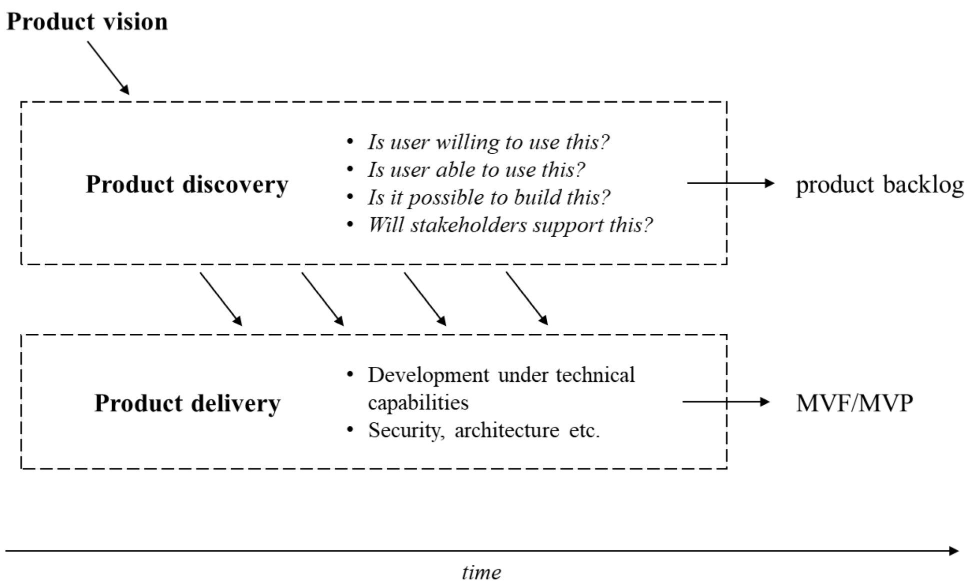

Figure 4. Continuous Discovery and Delivery (based on Cagan, 2018).

Melissa Perri is another top author of the field and in her 2019 book she introduces the Build Trap, wherein companies are stuck measuring the outputs of product development rather than outcomes. She argues that companies tend to measure success by quantifying output such as gained revenues, instead of measuring value, such as solving a user problem, because it is more difficult to measure qualitative value. According to her it is the responsibility of the product manager to focus on the value, on the why, by using data, feedback, market insights, and stakeholder communication to guide the value creation process. She highlights that product management is situated balancing the business and user goals. Compared to Cagan's (2018) view of product manager focusing on product discovery, Perri (2019) emphasises that product manager has a vital role in all three areas of product management including product vision, discovery, and delivery, and the stakeholders play into how the product manager operates in these three areas.

Finally, Wagenblatt (2019) outlines product management to concern six dimensions: product viability, development, marketing, demonstrations and training, market and customers, and organisational maturity. They argue that product management consists of coordination of any activity that is relevant for achieving product success with the ultimate goal of delivering business and customer value. Value is defined as the extent to which user problems are solved by the product. Thus, again the product manager's focus is not restricted to only discovery, as with Cagan's (2018) view. Further, Wagenblatt states that product manager is responsible for long-term strategy as well as innovation and roadmapping. Moreover, they too emphasise the role of communicating with stakeholders and that it is one of the product manager's main roles, as well as focusing on outcomes rather than outputs.

2.2 Understanding Users with Data

Understanding the needs, goals, and behaviours of users of a product is a crucial part of product management, ensuring the product's success (Fabijan et al., 2015; Sauvola et al., 2015), usefulness, and usability (Hilbert & Redmiles, 2001), as well as overall company success (Kabbedijk et al., 2009). Sauvola et al. (2015) argue that the product manager is responsible for building both implicit and explicit understanding of the users. Different user research methods for uncovering user insights are used such as ethnography, focus groups, interviewing, surveys, questionnaires, polling, product testing, usability testing A/B-testing, beta testing, lead user method, observing, prototyping, and taking user's role (Bosch Sijtsema & Bosch, 2015; Fabijan et al., 2015; Fruhling & de Vreede, 2006; Hilbert & Redmiles, 2001; Sauvola et al., 2015). These methods can be used both internally within the company and with real users (Fabijan et al., 2015), and they produce mostly qualitative data, which is useful in innovation and planning (Bosch Sijtsema & Bosch, 2015). These qualitative data provide descriptive insights into the experience and feelings of the user (Fabijan et al., 2015).

However, user research methods come with a plethora of limitations and issues. Overall, user research is not consistently and systematically exploited, and it is not unusual for product developers to not be directly in contact with their users (Sauvola et al., 2015). According to Sauvola et al. (2015), product development sees testing as a way to identify defects but not confirming or denying match between solution and user need. Their focus is being concerned with assessing the impact of the issue and effort of solving the issue instead of ideation (Hilbert & Redmiles, 2001). Usability testing, referring to a user's ability to effectively and efficiently complete tasks within the software, is often expensive and challenging to organise (Fruhling & de Vreede, 2006) being limited by available resources, location, size, and duration of testing (Hilbert & Redmiles, 2001). Beta testing can produce skewed data as mostly the obvious errors are reported, reports lack details of causation, and user qualities affect reporting frequency (Hilbert & Redmiles, 2001). In-person interaction takes a lot of time and effort, both from the user and researcher side (Fabijan et al., 2015). Generally, users can be unaware of what they need or even falsely think they want something (Bosch Sijtsema & Bosch, 2015). Fotrousi & Fricker (2016) identify that qualitative data, such as interviews with users, may also produce unreliable results as the user may not be representative of all users and a request for a certain product or feature may not correspond with a real need of the user base.

Due to these limitations, Kabbedijk et al. (2009) report that user insights are rarely used in product development. Software products by nature enable efficient collection of user feedback and observation of actual behaviour for reliable data-driven user research (Bosch Sijtsema & Bosch, 2015). Building user understanding through data is cost efficient and the amount of data is vast (Bosch Sijtsema & Bosch, 2015). Additionally, data provides product management crucial continuous and timely feedback, which is not feasible with user research methods (Fabijan et al., 2015; Sauvola et al., 2015).

While user research produces heaps of data both quantitative and qualitative, product data usually refers to the data, measures, and metrics from sources outside of user research that are the quantitative resource on which analytics builds upon (Fotrousi & Fricker, 2016). Big data, referring to the concept of using highly developed analytics technologies for large data quantities, could bring efficiency gains to product management analytics (Quan et al., 2021). The use of big data allows access to data that is extensive; of high quality; derived directly from users; timely; brings about new insight and understanding; and collected from various media. However, data collection does not necessarily translate into data analysis (Chen, 2018).

Based on a model for product management analytics by Fotrousi & Fricker "*product managers use analytics to interpret the product goals while the analytics are constrained by both product characteristics and product goals*" (pp. 21, 2016). Extensive data from users help product managers have a deeper understanding of user needs, behaviour, and preferences (Chen, 2018; Fotrousi et al., 2013; Fotrousi & Fricker, 2016). Quan et al (2021) argue that the effective use of big data is a crucial requirement for successful product design in this day. Product data has the potential to be effectively used in defining requirements, evaluating product quality and reliability, development in the product's growth stage, improving the product sales, and maintaining user loyalty (Fotrousi et al., 2013; Saketharaman, 2015). Analytics are also required to support product management in receiving continuous validation from users during development (Holmström Olsson & Bosch, 2013; Holmström Olsson & Bosch, 2014).

Visualising data and providing clear actionable insights supports the use of data in decision making (Chen, 2018). Zhang et al. (2011) emphasise that while insightful information provides useful understanding of the product or its user, actionable information is the kind that concrete solutions may be built on. However, producing such data requires specialised technologies and is difficult due to data quantity and complexity. Moreover, in most cases there is a gap between product managers' information needs and the information provided by existing analytical tools, which are challenging to design due to the complexity of a product manager's role (Buse & Zimmermann, 2010; Buse & Zimmermann, 2012). Buse & Zimmermann (2010) state that current tools produce information, answering the "what?", but not insights, answering the "how and why?". Product managers depend on these insights to act upon data. Yet producing them from raw data is burdensome and requires domain knowledge, explaining the low usage of analytics in product management. Besides the difference in information and insight, the timeliness of analytics is important. Buse & Zimmermann (2012) studied the analytics needs of software project managers to find that analytics questions related to past are more important to answer while questions related to future are harder to answer (Figure 5). Additionally, it is generally easier to answer information-related questions (what?) than insight-related (how and why?) except for when evaluating the future.

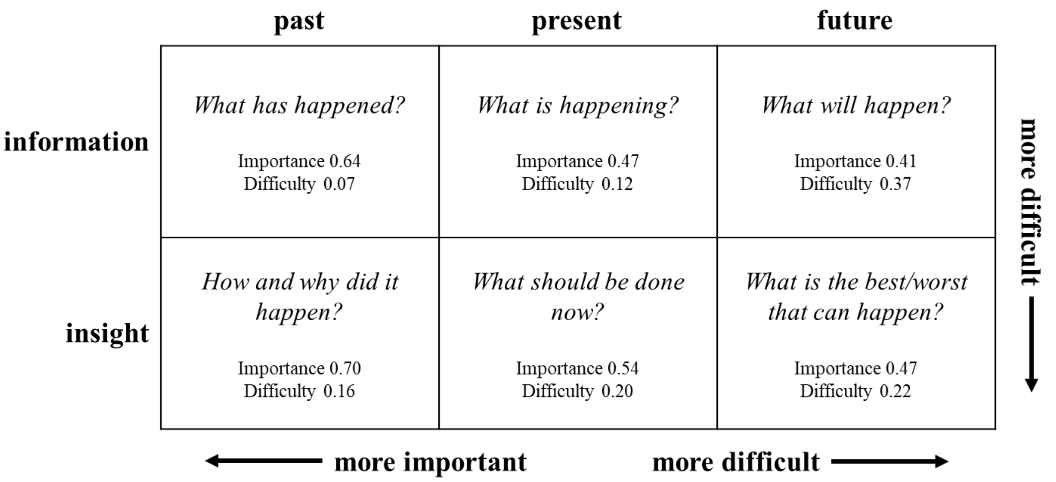

Figure 5. Analytics questions, their importance and difficulty to software project managers (based on Buse & Zimmermann, 2012)

2.2.1 Collecting and Analysing Data

Software projects can be measured in all stages from the initial specification to continuous maintenance (Buse & Zimmermann, 2010). Holmström Olsson & Bosch (2013) identify three main types of data collected from software products: operational, diagnostic, and feature usage data. Operational data explains how a system performs in real-time by providing insight into e.g. loading times, system uptime and product abandonment rate. Operational data is easy to collect but does not provide much explanation into causes. Diagnostic data supports troubleshooting and bug fixing and can provide reasons for poor operational data. Examples of diagnostic data include error codes and crash reports. Finally, feature usage data demonstrates how individual features are used and data collected may be e.g. use frequency and usefulness of a feature. Feature usage data plays an important role in understanding users but is also difficult to collect and correctly pinpoint poor data to correct reasons. Thus, collected product data can be categorised based on whether the data can explain itself (operational or not) and whether it concerns the product as a whole (diagnostic or feature usage).

While Fotrousi et al. (2013) found out that data analytics truly does decrease the impact of biases in product management decision making, it should be noted that in some cases collecting data is difficult or even impossible which is the case especially with new products and features (Chen, 2018). Thus, most of the little existing research is focused on the data collected from product use after release i.e. post-deployment data (Holmström Olsson & Bosch, 2013). Fabijan et al. (2015) confirm that often feature validation is done after deployment. Fotrousi et al. (2013) and Fotrousi & Fricker (2016) even argue that it is impossible to do product analytics for a product or feature that does not have a prototype or is not released. However, it is not unusual that customers are involved in the development phase to support in defining requirements and validating solutions, creating pre-deployment data (Holmström Olsson & Bosch, 2013).

Holmström Olsson & Bosch (2013) found out that the post-deployment data is rarely used by companies in guiding product decisions even though it has potential to improve and create efficiencies for feature validation and delivery frequency; requirements prioritisation; and product design as well as support in predicting prospective changes in user needs. Commonly it seems that post-deployment data is used for maintenance purposes such as identifying and evaluating technical issues. Thus, diagnostic data is used somewhat efficiently for product management, but operational and feature usage data are not, as the purpose of collecting those is often missing. The focus on post-deployment data makes requirement and feature prioritisation suboptimal leading to a gap between the product and user needs (Fabijan et al., 2015). Further, Holmström Olsson & Bosch (2013) identify as one of the major issues the difficulty to translate scattered data points into a meaningful story to be distributed to different stakeholders within the organisation.

As for evaluating the business case for a product with data, Denne & Cleland-Huang (2004) propose a financially driven approach to data-driven product management. In the Incremental Funding Method (IFM) the product is divided into chunks, and each is evaluated for net present value. These chunks are minimum marketable features (MMF), that are the smallest, complete features that bring customer value. The value of MMF may be measured quantitatively, e.g. revenue, or qualitatively, e.g. brand loyalty. Through the financial estimates, each MMF can aid in informed decision making about the related requirements. While the IFM was originally based on a plea for incremental software development and its financial reliability compared to traditional waterfall models, it was still proposed as one option for evaluating a product by Wagenblatt in 2019.

Perri (2019) discusses product metrics as the major tool for product managers to estimate product success. She emphasises that metrics should be formed in a way that they help make product decisions and they can be tied to business goals. According to her, data platforms with a variety of metrics supports in making informed decisions and all companies should have extensive analytical tools in their disposal. A challenge for tools is that adoption of them is dependent on whether managers consider them to give answers to the most important concerns and the relevant data can be collected with the tool (Benestad & Hannay, 2011). Van de Weerd et al. (2006b) proposed a prototype of a comprehensive software to support product managers called Product Management Workbench, that would include modules for requirements, release planning, roadmap, and portfolio. However, the software does not seem to exist – if it was ever developed. Overall, multiple tools have been developed but research shows lack in using them or getting benefit from them. The issue with most tools is that they only focus on certain activities forcing the product manager to switch between software and combine data. Based on the research by Benestad & Hannay (2011) existing release planning models focus on internal, technical, and strategic concerns while overlooking external, non-technical, and operational factors. Further, the release planning tools do not answer to the needs of companies (Svahnberg et al., 2010).

2.3 Product Management Decision Making

Via effective decision making, product management organisations are able to gain competitive advantage for their product (Wohlin & Aurum, 2006). Decision makers must consider stakeholder, business, and technology requirements which requires understanding of both technical and business considerations, while taking into account constraints such as budget. Product decisions based on analytics improve decision-making efficiency, help manage risks and forecast changes, as well as provide reliability and consistency when past decisions are under evaluation (Buse & Zimmermann, 2010). Data-driven decisions improve product management accuracy (Sauvola et al., 2015). According to a study of SaaS product managers, feedback from users leads to improved decision making (Fotrousi et al., 2013). The use of a decision support system (DSS) has been shown to increase confidence in the solution in the case of release planning (Du et al., 2006). Additionally, general supporting tools for decision making can be applied to software context, such as decision trees for evaluating net present value of a decision result (Erdogmus et al., 2006).

2.3.1 Decision Making Theory

The history of research on human decision making goes far back. Generally, humans are poor at making objective decisions when they include multiple criteria and factors, and the evaluation of decision alternatives is subjective. Decision making is a process of analysing alternative options with regard to their outcomes (Vetschera, 2006). Complexity and conflicting goals increase decision difficulty (Maurice et al., 2006), and make decisions more subject to social influence (Bergman et al., 2002).

Berry & Aurum (2006) present a behavioural decision making model called Image Theory (figure 6) introduced by Beach & Mitchell in 1990, that is descriptive of the decision making process in VBSE. Based on the theory a decision maker cognitively forms mental images of the things they want to make a decision on (what they label as object of interest), and these images are inaccessible to others. According to Berry & Aurum (2006), a decision maker has six complementary images of situation based on how things have been (experience), are (reality), and are expected to be (expectation), and how things should in their opinion be (beliefs and values), could be if they do something (desirable future), and would be if nothing is done (probable future). In the model of Image Theory, target of the decision stimulates a need for a decision. Experience, expectations, and beliefs and values influence understanding of the decision need, process called decision framing, which forms the image of reality, which later feeds into experience through a selective filter. Based on the reality, the decision maker can construct a probable future and identify a required action to achieve desirable future. However, if the image of reality is flawed, so will the decision process, which is then replicated in experience affecting future decisions as well. Made decisions affect the images with the goal of removing tension between differences in futures, beliefs and values, and expectations. The resolution is a state where the images align with each other.

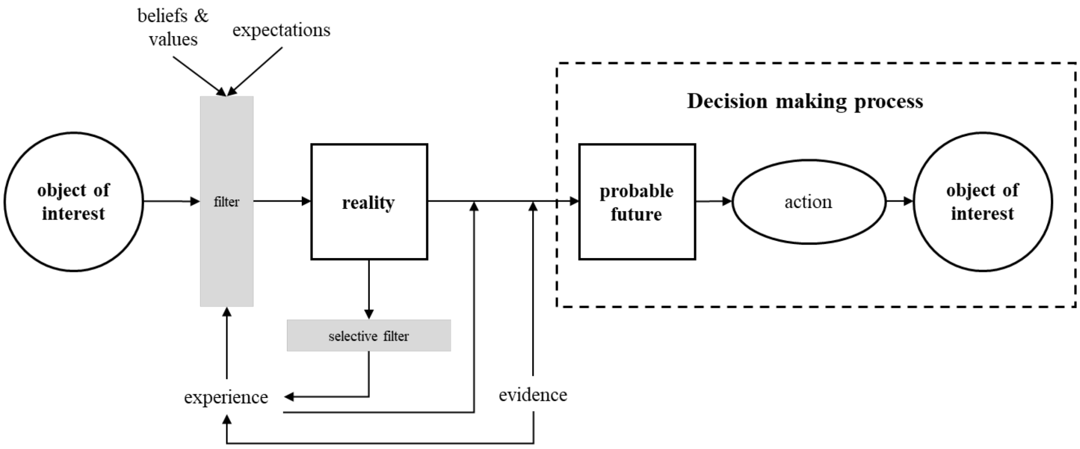

Figure 6. Decision process in Image Theory. Adapted from Berry & Aurum (2006).

2.3.2 Decision Making for Value Creation

As discussed previously, most product management frameworks focus on technical factors and hard constraints, overlooking the business-related factors. Meanwhile product managers are constantly making decisions that are affected by the non-technical and soft factors. Such misalignment of decisions is a key problem of product management (Barney et al., 2008). As globalisation creates rapidly changing and evolving customer needs, product managers must be able to react by adapting their product while maintaining the value proposition. By focusing on user needs and building close relationships with users, companies are able to provide value and become more profitable (Shah et al., 2006).

In economic theory, value is traditionally described as the ratio between perceived benefits and price, however, measuring value in the context of software is not as straightforward as with physical products (Wohlin & Aurum, 2006). The value creation decisions concern the business perspective i.e. sales, product perspective i.e. customer and market needs, and project perspective i.e. budget, time, and scope (Barney et al., 2008). Still, product managers tend to focus on the business perspective, while developers focus on the product perspective and project managers on the project perspective, possibly creating a misalignment in the decision making. The business perspective is also considered most important for value creation by product managers. Based on the study by Barney et al. (2008), companies do not formally plan their value creation decision making processes. Wohlin & Aurum (2006) identified customer value and resource constraints to be the most important criteria in release planning decision making. Additionally, the contemporary literature (Cagan, 2018; Perri, 2019; Wagenblatt, 2019) highlights the importance of value creation to build successful products. Thus, value should be an important consideration in decision making process.

2.3.3 Biases and Power in Product Management Decision Making

While complex decision making is highly subjective, Vetschera (2006) argues that decisions should not be made on pure intuition, but rather decision making requires support from logical methods that reduce decision complexity. Data-driven product management is important as usually product managers make decisions and prioritisation based on ambiguous past experiences, opinions, and intuition rather than data (Buse & Zimmermann, 2010; Buse & Zimmermann, 2012; Chen, 2018; Hilbert & Redmiles, 2001; Holmström Olsson & Bosch, 2013; Holmström Olsson & Bosch, 2014; Sauvola et al., 2015). Sauvola et al. (2015) report that feature prioritisation in software companies is based on product manager's assumptions and opinions. Wagenblatt's (2019) survey results show that majority of decisions are made based on experience and gut feeling, while less than a quarter of respondents stated following a structured decision process. These subjectively grounded decisions may be proven true or false only after the release and user feedback which can accrue unnecessary costs (Fabijan et al., 2015; Holmström Olsson & Bosch, 2013). Unvalidated decisions deviate the product further from real user needs and wants (Sauvola et al., 2015).

The subjectivity and biases do not concern only the product manager, but the stakeholders as well which can have a huge impact on how well the product decisions align with the reality and thus product analytics could solve the issue of stakeholder ambiguity as well (Fotrousi et al., 2013). Saketharaman (2015) even argues that with data analytics "*the 'subjectivity' elements and guess-works involved in Product management would completely be replaced by objective intelligence*" (pp. 2296). Others, however, see product analytics as a supporting tool to guide the product manager's expertise-based, intuitive decision making (Fotrousi & Fricker, 2016). This is because even research data may not always be reliable and fully representative due to both the innate imperfections of different research methods as well as the biased inputs from the users that are the target of the research, however, product data, such as feature use statistics, are seen as more representative (Fotrousi & Fricker, 2016). Moreover, Fotrousi et al. (2013) point out that even quantitative product data can be misleading if interpreted incorrectly, such as high use frequency of a feature interpreted as being liked versus being difficult.

In academia, analytics is considered to innately relate to actionability and decision making (Fotrousi & Fricker, 2016). Fabijan et al. (2015) report that there is often a weak link in between user data and decisions of product managers. Despite the importance of data and using it to guide decision-making, many end up in what Chen (2018) labels "analysis paralysis". The term means a situation where a lot of targets for data collection are identified and accompanied with numerous data points, but the separate targets fail to translate into an overall understanding of the situation. Hence data collection does not mean that the data is used in decision-making (Chen, 2018). Wagenblatt (2019) argues that analysis paralysis can even lead to delayed decision making. Others in academia seem to confirm the lack of using product data in decision making (Buse & Zimmermann, 2010; Buse & Zimmermann, 2012; Fotrousi et al., 2013).

Without data decisions become opinions that are easily influenced (Sauvola et al., 2015). Product management decisions may be affected by senior management's opinions and organisational culture related to hierarchy and risk aversion (Holmström Olsson & Bosch, 2014). Organisational culture can act both as a facilitator and impediment for decision making, and higher management plays a key role in signalling desired ways for making decisions (Shah et al., 2006). The larger the system and therefore more stakeholders there are, it is likely that decision makers disagree on the goals and decision making becomes politicised (Bergman et al., 2002). Mapping stakeholders and their needs is assumed to level the effect of politics and power which Bergman et al. (2002) argue to be untrue. Stakeholders approach decision making negotiations from a subjective perspective, and the product team mapping out the stakeholders does the same, which can lead to considering stakeholder needs to the product team's own favour. Despite the uncertainty, according to Bergman et al. (2002) decision making processes end up being politically loaded because future is hard to predict. Data analytics could, however, solve this to some extent.

According to Milne & Maiden (2012) the effects of power and politics on requirements selection are acknowledged but not seen as critical. Nevertheless, they highlight that understanding the influence of power and political influence can support rational decision making. Understanding these is especially crucial when stakeholders' opinions and motivations are conflicting, or the decision conditions are uncertain or complex. Further, Milne & Maiden (2012) point out that because requirements do not exist pre-defined but must be negotiated, the process is particularly susceptible to the influence of organisational power and politics. The results of these negotiations are affected by which stakeholders are present and to what extent they consciously or unconsciously apply their negotiating power (Du et al., 2006). In a negotiation setting decision makers are more likely to withhold information than exchange it, especially if information exchange does not align with the group norms (Berry & Aurum, 2006).

Decision making in a group setting is additionally affected by the individuals' differing, and sometimes conflicting incentives and information (Erdogmus et al., 2006). Bergman et al. (2002) argue that selection of requirements is a political decision process consisting of complex solution spaces. Developing shared understanding and expectations about product management and actively sharing information makes group decisions easier (Berry & Aurum, 2006). Incomplete information exchange may lead to poor decision making. Berry & Aurum (2006) argue that decisions made by groups are riskier than those made by individuals. As product management decisions are made under constraints to resources, an individual's risk attitude and uncertainty tolerance affect the decision making process (Erdogmus et al., 2006).

2.3.4 HYPEX Model

Holmström Olsson & Bosch (2013; 2014) have studied the use of data in product management and identified, what they call, an "open-loop problem" (2014), where the collected data from users fail to "loop back" to product management. This results into biased decision making based on opinions and lack of value delivery validation, as discussed earlier. Thus, Holmström Olsson & Bosch (2014) have created the HYPEX model (Hypothesis Experiment Data-Driven Development) to close the loop while also considering the subjectivity and the degree of unreliability of user input. The model consists of six practices that can be taken into use one at a time or all at once: feature backlog generation; feature selection and specification; implementation and instrumentation; gap analysis; hypothesis generation and selection; and alternative implementation. It should be noted that not every product feature goes through all six steps if the feature meets the user needs at first implementation.

The HYPEX model (figure 7) starts from generating feature ideas into the backlog based on the development team's understanding of the user and their needs as well as business goals. Next, the team figures out the priority order of the feature ideas in the backlog and selects a feature of highest priority to develop further. They define how the feature supports user and business value creation in detail, and further specify expected user behaviour with the feature. In the third stage, the feature is sliced until Minimal Viable Feature is identified. MVF is the first slice to be implemented, followed with continuous development of supporting feature slices. These slices are constantly set up for users to test and this data is collected to later validate the expected behaviour. Next, the crucial part of the HYPEX model, the development team analyses the expected behaviour and the captured behaviour and estimate the gap between these. If the gap is small, the feature is moved into full development and HYPEX model is done with its purpose. However, if the user does not achieve the expected behaviour, the team may discard the feature as unnecessary or continues to analyse the reasons behind the gap by creating hypotheses. The main question to solve with the hypothesising is whether the gap is large because the feature is not yet defined enough or whether the feature is unable to meet the expected behaviour in the first place. In the latter case the feature is discarded, but in the first case an alternative feature is designed and validated through A/B-testing, and the model moves back to gap analysis.

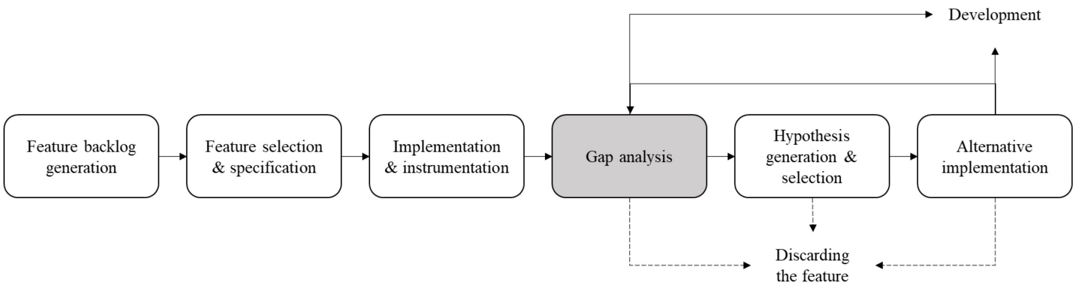

Figure 7. Visualisation of HYPEX model based on Holmström Olsson & Bosch, 2014

The HYPEX model has been shown good results and companies that have implemented it, have considered it a practice they wish to keep using (Holmström Olsson & Bosch, 2014). The accrued benefits include clarity of user needs and value creation, improved discussion on feature and product expectations and assumptions, as well as better understanding of stakeholders beyond users. Thus, the model is portrayed as one viable solution for closing the gap between collecting data and using it in practical product management.

3 Research Methodology

For the purpose of getting a deep understanding of product management role and responsibilities, as well as the usage of data in decision making, qualitative research and further interviewing was chosen as the research method (Gubrium & Holstein, 2001). Interviews were designed as semi-structured to preserve the opportunity of probing deeper into topics of interest that arise during the interview. Interviewees were selected with convenience sampling first based on their professional title and then confirming that they work in a product management role with a B2C focus. The limitation of the selected method and sampling include small sample size and sample being subject to the possibility that interviewees are not representative of the group “product managers” as a whole. A focus on B2C-product managers was chosen, because product managers are both more free to make decisions but more reliant on building understanding of the users in a B2C context (Dzamashvili Fogelström et al., 2009). The type of software product that the interviewee works with was not limited, as long as it can be considered a software product in the sense that it consists of features (Fotrousi & Fricker, 2016). Thus, simple web pages did not suffice as a product for the research.

Interviews were conducted remotely with a video call software to cater for distances between interviewer and interviewee locations. In the beginning of the interviews, interviewees were informed about the research content and ways of handling the research data. Interviewees were also confirmed to agree to be subjected to data collection, being recorded during the interviews, and that the results of the study would be anonymised.

The structure of the interview to be used as a basis consisted of first discussing the interviewee’s role and responsibilities, further what roles are in their team, who do they work with, and what are some of the tasks they complete regularly. Additionally, to get insights into the factors moulding their role, interviewees were questioned about their most important goals and biggest challenges regarding their role.

After discussing the role, the focus of the interview moved to decision making. The part about decision making started purposefully about general decision making processes as not to guide the interviewees to discuss decision making from the point of data-driven decision making. This is because during the design of the research a concern arose about how to ensure that interviewees describe their decision making accurately and realistically without emphasizing their usage of data. Additionally, due to this concern when interviewees were collected they were not informed about the focus on data, but rather that the research is about product management decision making in general. The general decision making questions focused on product discovery, product delivery, and product vision decisions, guided by the Continuous Discovery and Development framework by Cagan (2018). The division also assisted in understanding the responsibilities of the product manager and which areas they focus more or less on. Interviewees were also questioned about the ways of validating their decisions and how they build understanding of the users of their product. Finally, interviewees were asked about their data collection processes: what data is collected, who uses or accesses the data, and how is the data used in decision making. However, due to the semi-structured research method, many follow-up questions were included in the interviews, and based on the product managers' role descriptions they may not have been questioned about all three aspects of product management if those were not relevant for them.

For the analysis of the interviews, thematic analysis (Braun & Clarke, 2006) was chosen. Since the interview data is complex and unpredictable, thematic analysis provides a way of determining patterns in the data and analysing the connections between and meanings of the identified patterns. Themes in thematic analysis are data points that are interesting with regard to the research question, and to certain extent appear often or as important. As a part of the research is to understand the gap between previous academic research on product management role and current state of the field, the theme identification is a mix of inductive and theoretical thematic analysis. Thus, some themes are expected to emerge from the interviews, while the data will be simultaneously analysed against existing literature.

Iterativeness of data analysis is characteristic to thematic analysis. The interviews conducted for the study were transcribed and the transcriptions were the target of the analysis. As suggested by Braun & Clarke (2006), thematic analysis includes multiple readings through the data while simultaneously refining the formed themes. At first analysis, the transcriptions were highlighted based on codes that were considered to be important based on the initial interviewer notes. After the repeated readings and analyses, the codes were iterated into final themes and subthemes, and analysis concluded into insights and connections.

4 Results

For the study a total of 11 interviews were conducted. However, one of the interviews was omitted as during the interview it came up that their role could not be classified as a product manager role. Based on Maglyas et al.'s (2017) study on product management roles, interviewees started to repeat the same things at 14 interviews suggesting reaching of theoretical saturation. A similar theme emerged in this study, suggesting that 10 interviews is sufficient for representative results. Some of the interviewees worked with products targeted to both B2B and B2C customers (such as marketplaces where sellers can be companies or consumers). In these cases answers specifically about the B2B customers were redacted, as the focus of the study is B2C products.

The interviewees and their corresponding company details are shown in table 1. Included in the table are the interviewee label, the role of the interviewee, their company's size, number of employees, industry and whether the software product they manage is a core part of their operations. The table is ordered based on the company's number of employees. Interviewees are labelled with alphabets to address them in the results later.

The role of an interviewee is the current title they have disclosed on their LinkedIn page. However, it is noteworthy that in some cases the interviewees had different role titles mentioned in different parts of their profiles, indicating that the titles could be unclear and that they do not necessarily represent their role accurately. Five i.e. half of the interviewees worked with Product Manager title and the rest had unique titles of which two did not include the word "Product" in them. This showcases inconsistency with the role titles corresponding to a role in managing a software product, which is in line with the findings of Maglyas et al. (2017). The company size is based on number of employees and follows the categorisation of Maglyas et al. (2017). The company industry is determined from how the company itself labels it in their digital channels, LinkedIn and company website included.

Finally, the software product being a core part of operations is defined as either the software product is the main product of the company, or it is crucial in offering the main service of the company. The products that the interviewees worked with were either mobile applications or web-based digital services. Interestingly, company size seems to correlate with whether the product is a core offering or not and smaller companies tend to have the product as core offering. However, this also correlates with company age as for the companies where the product is not core offering the median age was 96 years and average age was 151 years. Whereas, in the companies where the product is core offering the median age was 17 years and average age was 60 years. The company ages are not disclosed in the table to ensure confidentiality.

Interviewee	Role	Company size	Number of employees	Industry	Software product core offering?
A	Product Owner	Extra Large	10 001+	Logistics	No
B	Product Manager	Extra Large	10 001+	Healthcare	No
C	Service Owner	Large-Extra Large	5 001-10 000	Chemical Manufacturing	No
D	Product Director	Large-Extra Large	5 001-10 000	Digital Services	Yes
E	Digital Development Manager	Large-Extra Large	5 001-10 000	Insurance	No
F	Product Team Lead	Large-Extra Large	5 001-10 000	Food and Grocery Delivery	Yes
G	Product Manager	Large	1 001-5 000	Mobility	Yes
H	Product Manager	Large	1 001-5 000	Media	Yes
I	Product Manager	Medium-Large	501-1 000	Parking	Yes
J	Product Manager	Small	11-50	Event Services	Yes

Table 1. Interviewees roles and company demographics.

4.1 Descriptions of Roles and Responsibilities

Many of the interviewees had similar responsibilities, but overall the roles varied significantly and especially in terms of the focus on technology, business, and users portrayed huge differences. However, these variations and focus differences were not related to the titles of the interviewees. As interviewee F pointed out, product manager is a role for them, not a title and the titles do not directly relate to what the people with these titles do. Interviewees A and B were team managers for their product or development team in addition to their product role. Interviewees C, E, G, and H worked within a product or development team without being a manager. Additionally, interviewees D and F had senior roles as managers to product managers, as their titles suggest. Interviewees A, B, and J were responsible for one whole product, interviewees C, E, and H were responsible for multiple products, and interviewees D, F, G, and I were responsible for a part of a product. The following short descriptions of the interviewees roles and responsibilities give insight into what their roles focus on.

Interviewee A *is a manager for a software development team of 15 with Scrum methodolody and mostly works with managing the roadmap and following its* *execution considering the resources. They are strongly both dependent and focused on "the business" and business goals, while trying to support user needs where possible. They are mostly working with the product delivery and somewhat involved with product discovery. However, product vision seems to come from upper business management and interviewee A is not able to affect those decisions.*

***Interviewee B** works in a heavily technical role managing "the development stream" by ensuring the technical operability and development. Their tasks usually come from internal or external stakeholders as orders that the development team delivers. A lot of their time goes into people management tasks and they state good people management to be their main goal. Their product management is influenced by business goals and decisions coming from the business owner, and they align the product delivery based on these and existing resources.*

***Interviewee C** manages one product entirely, one product partly from a business-focused perspective and describes their role to consist of a lot of communication with different stakeholders. Their product management has been heavily restricted by technical legacy issues and limited upkeep-only budget, but they are now working on a more user value-driven new version of one of the products. Their focus is mostly on product discovery while also doing product vision. It is noteworthy that interviewee C is the only one who reported that software developers come from a third party.*

***Interviewee D** works in a directory role managing a cluster of product features and the 5 product managers who are in charge of each feature area. Due to their managerial role, their time is spent on people management and mostly on product vision, supporting with product discovery. Their focus is on solving the user problems while considering the business goals. However, they also highlight their role as an enabler of the product managers' success, helping and supporting them where necessary.*

***Interviewee E** is in charge of a product portfolio that consists of multiple products in a mature stage and one new product, which their time is mostly spent on. Their focus is on supporting the needs and solving the problems of users and while balancing those with the business. Their role is characterised by high complexity as their products relate to all of their business operations throughout multiple countries. Their responsibilities mostly relate to product discovery and product vision.*

***Interviewee F** works in a business-orientated role while managing two product managers. They emphasise being a communicator between different stakeholders. Their responsibilities are focused on localising, local market, and customers. Their descriptions of product management work indicate a nature of project management. They almost exclusively work on product discovery. They were also the only interviewee to report that they do not and have not had any goals for their role in years.*

***Interviewee G** explains that their product teams are divided by user goals and they work with everything related to one user journey. They emphasize deep understanding of users' goals and answering to those with product management. A lot of their time is spent on researching users and finding and designing solutions for them. The focus is mostly on product discovery and vision, with limited product delivery.*

***Interviewee H** manages two products that relate to each other. Their responsibility is developing these products in a business-driven manner under limited resources and constraints. Some time is spent daily on scrum functions and tasks related to* *development. Thus, their focus seems to be balanced between product delivery and discovery, while they do not do any product vision work.*

Interviewee I *works on a part of their product where they drive business growth while aiming to consider user needs. Their time is also spent on managing the product team and communicating with various stakeholders. Their focus is on product discovery, however, they claim that their company's goal is to move product vision responsibility more to product managers in near future.*

Interviewee J *is in charge of the only product of the company and due to the company's small size their responsibilities exceed that of product management. They also manage the product team. They are heavily involved in product delivery, discovery, and vision. However, due to challenges in the industry over past years, they have had to focus almost entirely on product delivery. Due to the challenges their role is very business-driven and even restricted to focus on profitability, but they stress wanting to focus more on user concerns in the future.*

Based on the interview findings of the roles and responsibilities for the 10 product managers, we can plot each interviewee by estimating to what extent their role is user-, technology-, and business-driven, and how much they focus on product discovery, product delivery, and product vision. These two aspects can be visualised as triangles where each of three aspects is in one of the corners, as seen in figure 8. The interviewees are marked based on whether their product is the company's core offering, circles for those that are, and squares for those that are not (see table 1), to help showcase correlations. It should be noted that the positions in the triangles are estimated weights within a role and should be viewed in context of the whole three aspects. Thus, interviewees cannot be compared to each other within the visualisations.

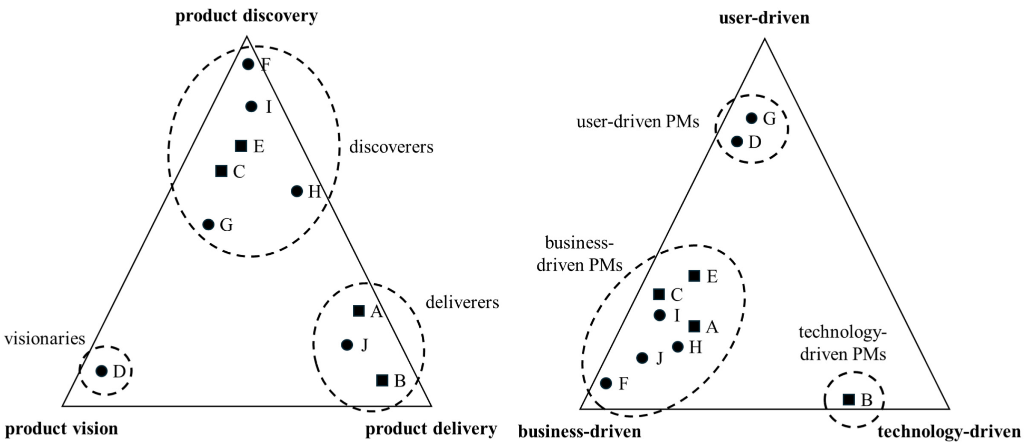

Figure 8. The dominant activity focus areas and drivers for product managers.

Further, based on the visualisations we can identify clusters, marked with the circles. By cross-referencing the circles between the two triangles, we can induce types of product managers: *user-driven discoverers*, represented by interviewee G; *user-driven visionaries*, represented by interviewee D; *technology-driven deliverers*, represented by interviewee B; *business-driven discoverers*, represented by interviewees C, E, F, and I; and *business-driven deliverers*, represented by interviewees A, H, and J. It is probable that other combinations could exist, however, as most interviewees fall into two categories, it may be assumed that the major roles and responsibilities of product managers are business-driven discoverers and business-driven deliverers.

An important factor in moulding the role of a product manager was the challenges they face in their work such as various constraints and requirements that limit the way they operate. The top challenge for the product managers was clearly complexity of the role which was related to e.g. complexity of the product itself, complexity in the product dependencies, complexity of user types, complexity (or uncertainty) of the field of business, and complexity of stakeholders.

The number of stakeholders and interaction with them was narrated as the second most relevant challenge for product managers. The general message was that there are numerous stakeholders both within the product team and as internal and external stakeholders. The internal stakeholders in many cases pressured priority for their interests, as interviewees A and F mentioned, and even pushed work for the product team unannounced with short time limit, as disclosed by interviewees B and F. Product teams are also dependent on the stakeholders to get work done, as claimed by interviewee E, and get permission to enter a market like interviewee G explained. Discussions with stakeholders take a lot of time, and requires constant negotiating and even being lenient with the needs of the product team, as proposed by interviewee H. The stakeholders constantly require information to be communicated and ask even impossible questions that the product manager has to be able to somehow answer, as claimed by interviewee J. Interviewee C reported unclarity in roles within the product team and across internal stakeholders contributing to issues in decision making: "*the drawing of a line on who does what and who decides on which things becomes* [hard]...*since our roles have not been written open like you decide that and I decide that but we have role descriptions that have some leeway*." Similarly, interviewee A stated that the role of product manager includes doing the things that do not clearly fall into any other role in the product team. Finally, interviewee G pointed out that in the case of external stakeholders it is difficult to push against their wishes in fear of negative impact for the product or the company.

Almost all interviewees reported challenges with not having enough time that affected different areas of their work, but the ones working in the biggest and smallest companies (interviewees A, B, I, and J) reported time as a constraint more often and more strongly, whereas product managers from middle-sized companies mentioned time as a part of limited resources. For some, the lack of time meant not being able to put as much effort into their daily tasks as they would hope to, such as interviewee A saying they do not have enough time to spend with users and interviewee I stating that they would like to have more time for innovation and ideation. For others, not having time meant not being able to do whole parts of their role, such as interviewee J reporting that they do not have time to think about the product's future at all even though it is their responsibility. Overall, the time horizons for planning varied between product managers from a month to 10 years, however, this was rarely about the company size but more about the role description and whether the product manager was responsible for decisions about product vision, and what was the situation in their product's respective market. Besides time, the lack in other resources was stated to restrict the product manager's work, such as limited budget, not enough workforce or limited skillsets.

Two constraints more specific to certain fields of business were claimed by a few interviewees. Legal implications were mentioned as a constraint by interviewees F and I. Both stated that changes in the legal environment in their field of business require prioritising development that adheres to legal requirements as top priority. Additionally, interviewee J reminded that legal limitations to collection of data have had an impact on product analytics as well, especially making it more difficult to get information about all users. Moreover, interviewees E and J stated language barriers to affect their product management especially in limiting user research and understanding users outside of their home country.

Finally, the role of a product manager was repeatedly described to demand a lot from the person in the role. Interviewee B described that their role as a product manager requires a wide skillset including deep technical understanding of the product and enough business knowledge to translate requirements between business unit and the development personnel while maintaining the overall image for themselves. Interviewee D took a stance on a wider scale on the industry, explaining that too often in product management business value goes over user value, and as often product managers come to the role from being software developers and product owners, product managers can be too focused on technical issues. Additionally, they claimed that the role of a product manager is very difficult while having high accountability and requires a lot of curiosity. Finally, interviewee J commented that a product manager's role is easy and hard at the same time, completely dependent on the day and task.

4.2 How Decisions Are Made

The product managers' decision making styles varied and the variation seemed to be mostly explained by differences in organisational practices. It looks like rarely do product managers have autonomy in decision making and that is especially the case with product vision, which explains why product managers' roles tend to focus on product discovery or product delivery, as suggested by figure 8. Similarly, the role focus affected decision autonomy, as the user-driven product managers tended to report a wider range of decisions compared to the business- and technology-driven product managers, who claimed decisions usually concern execution and are restricted by management imposed guidelines. Interviewees A and B explained that their goals for product development come from business management directly and they are left with implementing those decisions. Interviewee F even stated that the lack in decision autonomy adds extra work and poses risks, such as legal risks, as features are published without consulting the local team that would ensure legal compatibility.

One key factor affecting the product management decision making was the role of stakeholders, external, but especially internal. All interviewees reported spending a lot of their time both communicating (giving or receiving information) and negotiating (exchanging information to come to a decision) with stakeholders. Some interviewees proposed their stakeholder involvement to be more focused on communicating and apparent negotiating, interviewees B, E, and I describing that they give stakeholders only an impression of negotiation while in reality they have already made a decision and are just making sure that it is okay for the stakeholder. In contrast, interviewees A, B, and F revealed that they are involved in the conversations about the decisions with stakeholders, but rarely actually get to make the decisions. Evidently, some interviewees both use apparent negotiating and are the subject of it depending on the decision. Use of organisational power was relevant in many descriptions of decision making, such as interviewee A explaining that "*requirements and pressure come from somewhere else* [within the company]"; interviewee B stating that they are "*attending meetings daily but final decisions are made by business owner*" and that they need "*stamp of approval from business owner to move forward*"; interviewee C stating that "*different parts of the organisation have their goals and want to get their projects to completed…so it* [priorisation] *requires some discussion*"; and interviewee I pondering "*if we have differing opinions about the decision then I have to weigh that should I make the decision anyways, am I going to argue for it that it is my strong opinion and needs to be done…or is it that hey we will do it your way or something in between*". Decision making involving stakeholders seemed to become more relevant the bigger the decision was and most reported that bigger decisions require more people and negotiating. Overall, decision scope was mentioned as the major determinant in how decisions are made and who makes them.

In terms of product discovery, product managers seem to make decisions based on the focus of their role driven by business, technology, or user needs. As shown previously in figure 8, product managers differed in what their role is focused on. Strongly technology-driven interviewee B did not mention many decisions related to product discovery and only stated that the discovery decisions are based on the order from an internal or external stakeholder. Interviewee D also did not report doing much product discovery and mostly emphasised that it is important to build the right product before building the product right, meaning that product discovery should focus on the user need. Those who actively worked on product discovery narrated mostly making discovery decisions driven by a business need or goal. Interviewees A, C, F, and J clearly stated business as the driver for the decisions and talked about things such as building a business case, evaluating product investments, and increasing profitability in relation to product discovery decisions. Interviewees E, H, and I stated business and user needs to be equally important drivers for decisions, however, only interviewee E consistently brought up user needs in relation to discovery decisions during the interview suggesting that for interviewees H and I it is more of a goal or an ideal situation that both would be equal drivers. Only interviewee G stated user needs as the main driver for their product discovery decision making. Thus, it seems that business needs and goals are strong drivers for product discovery decisions. Moreover, the tendency to being business-driven could be linked with decision autonomy. Interviewees A and F stated that the discovery decisions come from higher business management but they can affect the decision process by providing their input on it. Similarly, interviewees H, I, and J explained that they make decisions by negotiating together with a few people. The actual decisions were reported to be influenced by user research (A,E,G,H,I), data (A,E,G,H,I), resources/capabilities (A,B,E,H), intuition/expertise (H,J), and feedback (A). Interviewees explained their decision making grounds saying that they start with gathering internal information first (interviewee J), if there is not enough information they try to get more with user research and analytics (interviewees G and I), they involve stakeholders to support in defining decision scope and alternative solutions (interviewees H and I), and final decisions are only made once they have enough information (interviewee A).

Product managers were far less involved in product delivery decisions. Interviewees D and F stated that they do not make delivery decisions, while interviewees C, E, G, H, I, and J told that they are only involved in the discussions. Commonly, delivery decisions were the responsibility of a product owner, tech lead, development lead or similar role, or done together with them or a designer. However, interviewees A and B claimed being the decision maker for product delivery. Interviewee A involves the designer and developer in these decisions that are based on feedback, intuition/experience, resources/capabilities, and pre-release testing. Interviewee B does the decisions on their own except for usability-related decisions where they involve the designer. The delivery decisions are based on the orders from stakeholders and affected by resources/capabilities with emphasis on optimising development. Thus, with product delivery it seems that decision making is not as much focused on one driver as with product discovery. However, the interviewees only involved in the decision making discussions reported that their input to the discussions is promoting the business perspective (C,E,J), the user perspective (G), or managing resources/capabilities (H,I).

As for product vision, it was much more common that the decisions came from higher management and product manager is only responsible for aligning the roadmap or similar shorter-term plan with the vision. Interviewees H and I reported that they follow a vision for the business unit that the product is a part of, while the rest reported that they have a product-specific vision in addition to other organisational visions. Interviewees A, B, F, H, and I reported that they are not involved in decisions about the product vision. The remaining interviewees stated that they make product vision decisions based primarily on business need (C,E,J) or user need (D,G). All mentioned the decision making process to heavily involve stakeholders, especially management, and product vision to be linked tightly to organisational vision. For example, interviewees C and E both explained the need for digitalising customer service to digital self-service to cut costs as a major driver for product vision decisions, which are also the only two companies where product manager makes product vision decisions but where the product is non-core service.

A large portion of decisions made by product managers relate to prioritising between options, and business needs and financial value seem to be strong optimisation determinants even for the product managers who are not business-driven. However, interviewees F and G still mentioned user value as a driver for prioritisation, and interviewee E stated to rely on data to prioritise. It does not seem to always be up to the product manager to make the prioritisation decisions. For example, interviewee A stated that "*if it is about money everyone knows that it will become a priority*" and most decisions are already prioritised by others, interviewee B explaining that prioritisation is done by the business owner outside the product team, interviewee F stating that management decides priorities, interviewee H saying that their business unit does the prioritisation already when planning the roadmap, and interviewee I claiming that the company roadmap imposes strict deadlines which determines prioritising. Interviewee C described that management pushes for their own priorities and their product team's manager is constantly pushing against that. Moreover, interviewee J described priorities arising naturally from business needs stating that "*often…it has been pretty obvious what is the thing that has to done…there has not really been any realistic options*". Legal requirements (F,I,J) and fixing operability related issues (B,F,I) seemed to automatically gain priority. Effort requirement also affects prioritising, as interviewees G, I, and J mentioned that small effort tasks can ride ahead of priority even on short notice. However, prioritising is not always simple and comparing options can be difficult, as claimed by interviewees C, D, I, and J, many idiomatically mentioning "*comparing apples to* *pears*". Interviewee C pointed out that balancing resources against stakeholder needs makes prioritising tricky. Overall, the constraints the product manager operates under seem to heavily influence priority decisions and even lead to postponing decisions, as interviewees A and B described that dependencies between features guide prioritising, and interviewee C explained that unclarity of roles and decision making responsibility slows decision making process. When discussing prioritising specifically it seemed to be more common to mention the use of intuition and experience as grounds for the decisions.

Moving from prioritisation to validating decisions, interviewee G said that validated decisions gain the highest priority, and separately stated that it is "*important to do* [validation] *as much as you can, because also some things they feel like a no-brainer*". Interviewees D and G, both being user-driven product managers, also highlighted the importance of constantly reviewing assumptions and hypotheses of customer needs. Interviewee G also described that validating decisions helps in validating similar future decisions, and that to support validation decision scope should be cut to minimal. Simultaneously the business- and technology-driven product managers described difficulties in validating decisions beforehand, such as interviewee C saying that future is hard to validate, and interviewee E stating that "*future shows whether the decision was correct or not*". Interviewees A, C, E, H, and J stated that most decisions and resulting features or changes are validated with time, in a follow-up nature. Validation was not considered to be important for small or easy decisions (A,C,E). Additionally, interviewee B did not seem to do any validation as when asked about validation they discussed other unrelated things. Product managers reported using user research (C,E,G,H) and data (A,C,E,F,G,H,I,J) more or less for validating their decisions. However, in many cases the financial gain and operability of the decision target seemed to be enough as validators.

As with prioritising, intuition and experience played a strong role in validating decisions as well, with the addition of stakeholders and the following power and politics. Interviewees A and B described gaining validation from product team members' feedback, and interviewees E, F, H and I stated validating their decisions with stakeholders in general. Additionally, interviewee A stated that their business unit does most of the validation beforehand and afterwards in terms of business goals. Validation of decisions seemed to be most influenced by intuition and experience, as interviewee E described about decision scope that "*a lot of decisions can be made just like that... that sure would not work that each decision would need a lot of information and have to be validated*", interviewee F explaining that "*I summarise my own strong opinion and based on that I am able to make mostly good decisions*", interviewee H stating that "*first you have to collect all the facts and then think what is the best way...*[afterwards] *you can assume if analytics tells that there is traffic that users are content*", interviewee I describing validating a solution by considering "*is there some really big issue and we know that the feature would solve it*", and finally interviewee J saying that sometimes they "*just have to choose one*".

4.3 Gaining and Using Insights: User Research and Data Analytics

All product managers reported using a mix of qualitative and quantitative data to understand users. Internal practices such as writing user stories and doing internal testing were also somewhat popular. In general, however, the emphasis seems to be on using mostly qualitative data as it is narrated to give a deeper understanding of the needs and problems as well as explaining the how and why. Quantitative data is expressed to be more about the what, requiring more effort to gain valuable insights. All interviewees except interviewee B mentioned user research and the importance of understanding users before being asked about it. When asked about whether they are ever actually dealing with users, they answered that they read feedback, implying that they might understand user research in a different way. All interviewees except interviewee B also mentioned data and most explained ways in which they use analytics before being asked about it. A possible explanation could be interviewee B's technology-driven product delivery focus.

Some of the ways in which product managers support their decisions of product discovery, delivery, and vision in regards to user input were presented in the previous part. In terms of user research most of the collected data was qualitative. Interviewees mentioned the use of following user research methods: A/B-testing (A,E,F,G,H,I,J), pilot group testing (C,G,J), prototype testing (D,G), usability testing (B,E), general surveys (B,D,F,G,H,I,J), satisfaction/NPS-surveys (A,C,E,H), touch point surveys (C), interviews (C,D,G,I), recordings (D,E), and observations (G). Other qualitative data included user feedback (A,B,D,E,G,H), internal feedback (A,B), social media comments (G), internal testing (B,G), and reports from customer service (E,G,H,I). Despite using the results of the user research, not all user research was done by the interviewees. In the cases of interviewees C, D, and G user research was carried out by the product manager alone or together with someone within the team. Interviewees A and I reported doing user research together with an internal stakeholder. Interviewees B, E, F, H, and J did not report doing any user research themselves but only being involved in planning it with stakeholders.

Understanding the users seemed to be important to product managers and interviewees E, G, and I even stated it to be the basis of decision making. The understanding was reported to be used for decisions about new features (B,C,H), decisions related to business goals (B), prioritising between options (A,F), creating hypotheses (G,I), and segmenting users (C). Based on the earlier listing product managers mainly use A/B-testing, surveys, and user feedback for building the understanding of their users. While A/B-testing and surveys were mentioned by more product managers, feedback was emphasised relatively more in the narratives of product managers. Feedback was reported to support in spotting bugs (A,E,H), identifying usability issues (E), and as a source for development ideas (A,E,H). Interviewee E further explained that "*when the feedback loop works it is possible to make repairing changes pretty quickly*". Feedback was also described to help in getting a deep understanding of the need or problem and what specific factors affect it, as suggested by interviewees E and I. Finally, interviewees E, G, and I also pointed out that they are active in doing more research or diving deeper into analytics if they feel like they do not have enough understanding of the users or of the need or problem, or they notice that something might be off.

Despite the multitude of user research methods and other sources of qualitative data, product managers' descriptions of decision making implied a certain weight on the use of intuition and experience too, with expressions such as "*I want to think for myself whether it is sensible to do*" by interviewee A, "[user research] *gives a really good starting hunch that in which direction we should take* [the solution] *and solve it*" by interviewee I, and "*I have quite a good feeling since we have been doing this for so long* [...] *that what are the* [user] *needs and perhaps pitfalls of our product*" by interviewee J. However, interviewee A also pointed out that they are aware of being biased, and interviewee J admitted that they have not been able to use understanding of the users as much as they wish due to the market situation their product is in.

Overall, during the interviews many product managers mentioned data in general, not being specific as to what data they refer to. When being asked about data, it became apparent that to some it meant specifically quantitative data gathered with an analytics software, while others mixed it with the qualitative data from user research and other sources. Interviewee A especially turned the discussion repeatedly to user research when asked about data analytics, suggesting that user research has a strong importance for them in understanding users and their needs and problems.

Out of the interviewed product managers A, C, E, and G told that they have a data analyst role within their product team, and interviewee I stated that they have a data analyst shared with a few product teams. The ones without a data analyst within the team narrated analytics being a mix of having another team within the company responsible for analytics, having a third party stakeholder for it, being responsible for data analytics themselves, or the responsibility varied or was not clear. Some of the (quantitative) data points that product managers stated to collect from their product include user journeys (A,B,E,F,G,I,J), click events (B,E,F,G,I), use counts (B,C,E,H,I), version/device data (B,E,H), transaction data (C,G,I,J), settings data (E), downloads (E), conversions (F), advertising/search engine data (H,J), responsiveness (J). Some interviewees also mentioned "*basic data*", "*feature data*", “*product data*”, “*technical data*”, “*user data*”, and “*behaviour data*” as more general concepts. Dashboards seemed to be a particularly popular way of presenting and analysing data as mentioned by interviewees C, D, E, I, and J. Interviewees I and D also further explained that dashboards are created to fit the needs of the product team or for a specific problem they are interested in. The product managers reported many tools for both data collection and analysis, but the most important trend was that while many stated having many tools they said to use mostly just one or two. Interviewee G explained that they tend to use the software with the most user-friendly interface, and visualisation seems to be key for the tool selection.

Interviewees A, B, F, G, H, and I reported a tendency to be business-driven when it comes to data analytics too. Interviewee A said that their business unit is data orientated using data for decisions, interviewee B stated that their business unit follows data analytics coming from a third party actively, and interviewee F explained that they have a business intelligence team that does data reports based on business needs. Additionally, interviewee G explained that data is used to quantify user needs into a business case. Technical data was reported to be collected by development or engineers and the narratives seemed to position it to be separate from product data and something only software developers are interested in, as explained by interviewees B, E, and G.

Data and analytics were reported to be used for identifying problems (B,C,F,I,J), understanding user behaviour (C,F,G,I), validating hypotheses (F,G,I), building a business case (G,I), creating ideas (A), prioritising development (B), evaluating quality (B), removal of features (C), and answering stakeholder questions (J). Also, more general statements e.g. using data “*in many ways depending on context*” and “*tracking what has happened*” were mentioned. It is noteworthy that interviewees B and J did not mention the use of data in decision making before being asked about it. The focus on data analytics seemed to also be on analysing features only after their release as mentioned by interviewees C, E, F, H, and J. However, interviewees H and I reported that the follow-up nature of data allows it to be also used as a motivating success metric. Some interviewees also reported a wish of being able to use data analytics more, such as interviewees C and F. Interviewee E claimed that use of data is more important the bigger the decision is. Interviewees F and I also stated that data is the basis for their decision making, however the interviewee F’s narratives during the interview do not seem to support such a claim, and interviewee I also earlier claimed user research to be the basis of their decision making. Interviewee I further described their discomfort with making decisions without data: “*I would feel bad to do something completely blind not knowing what is the impact of doing this... it would be awful to just publish some feature and close my eyes and not at all know what kind of an impact it has*”.

The use of data does not seem to come without restrictions and challenges. Interviewee C explained that data collection is difficult, because the legacy systems in their use are not equipped for collecting data. They also considered this to be an issue in all companies, stating that "*at ours or all companies it is still the getting of data and basing decisions on it is very hard since we are talking about legacy systems*". However, such issue was not reported by any other company. They also discussed an issue with not always knowing where data concerning a certain issue could be found within the company. Interviewee F claimed that since product data analytics is done elsewhere within the company the data is sometimes collected wrong and they are unable to affect that. Additionally, interviewee J pointed out the recent legal regulations on data collection and said that the restriction of having to have consent from their users for data and cookie collection has limited the amount of available data.

Interviewee E also described the issue of data requiring deeper analysis saying that "*it is not explicitly clear why something is the way it is*" and that user research tends to bring up things they would not have noticed from analytics, interviewee B agreeing that to be useful analytics requires qualitative data to understand the situation better, and interviewee J explaining that analytics by nature is hard to use as a tool for planning as it does not explicitly tell what should be done. The overwhelming amount of data was also reported by interviewee F commenting that "*I do not even know all the kinds of data we have*". Finally, interviewee D pointed out that it is possible to use too much data and too much time on diving deep into data, and thus product manager needs to identify the key data to focus on. Further, interviewee F explained that "*there is so much data I have to outline the use of it…I could use 50 hours in a day just reading data but that would not necessarily be the best use of time*" and that deeper analysis of data is relevant for them if there is a specific need for it, which was also mentioned by interviewee I.

Based on the previous presentation of what user research and data analytics methods are used and what kind of data product managers collect from their product, their orientation towards using user research data, analytics data, or subjection as a grounds for product management decisions can be evaluated and visualised in a triangle similarly as in part 4.1. Subjection refers to intuition, experience, and opinions that are not clearly grounded on any data point, or a lack of defining any reasoning for a decision. It should be noted that the evaluation is based on what is the basis of decision making for the interviewee, not the company as a whole. The visualisation (figure 9) is once again presented with regard to whether their product is the company's core offering, circles for those that are, and squares for those that are not.

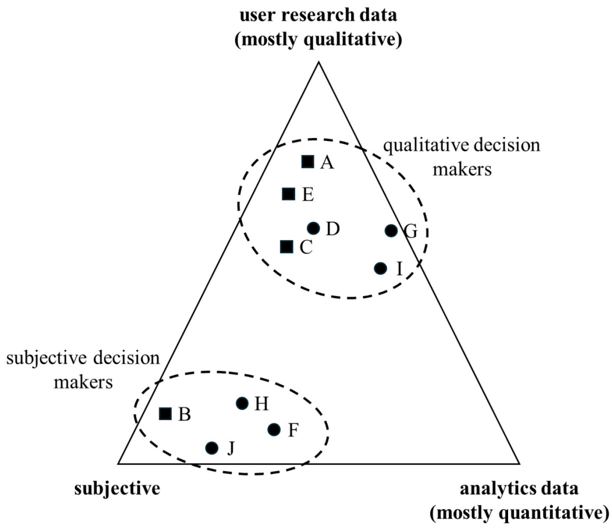

Figure 9. Product managers' decision making types.

Based on figure 9 it becomes clear that not a single product manager was particularly driven by quantitative data or analytics, or in other words "data-driven". Product managers' grounds for decision making seemed to be either heavily subjective or driven by qualitative data. However, considering the limits of quantitative data that have been acknowledged by both academia and the interviewees, it could be argued that the best ground for product management decisions would be balanced between qualitative and quantitative data, creating a third group of decision making style.

4.4 Thematic Map on Product Management

The results presented in the previous sections give insight into how product management of today operates. Based on the labelling categories developed in the beginning of analysis and later the analysed findings a thematic map (figure 10) can be created that shows the most important concepts and the relationship between them as well as how each influences the product manager's role. As shown by the map, the product manager is driven business, user, and/or technology goals and needs, that are interrelated to the role's focus. Delivery focus tends to pair with technology-driver, where as discovery and vision foci are related to both business- and user-drivers. The focus area determines what activities the product manager mainly spends their time on. When a product manager makes decision, they base these decisions mainly on data from user research, analytics, or on subjective grounds. The decision making basis is influenced by the main driver as well as the available resources and limitations. Product manager is constantly constrained by various things and lack in resources as well as influenced by stakeholders within the team, company, and externally. The stakeholders have an effect on the resources and limitations as well as the role focus too. If the management is adamant in making product decisions, the role focus moves away from vision and closer to delivery. Meanwhile, stakeholders, usually the organisation's management, are often in charge of determining resources such as the budget and timeline as well as often requirements for the product as well. External stakeholders can affect these too and they are especially relevant for language barriers and legal concerns.

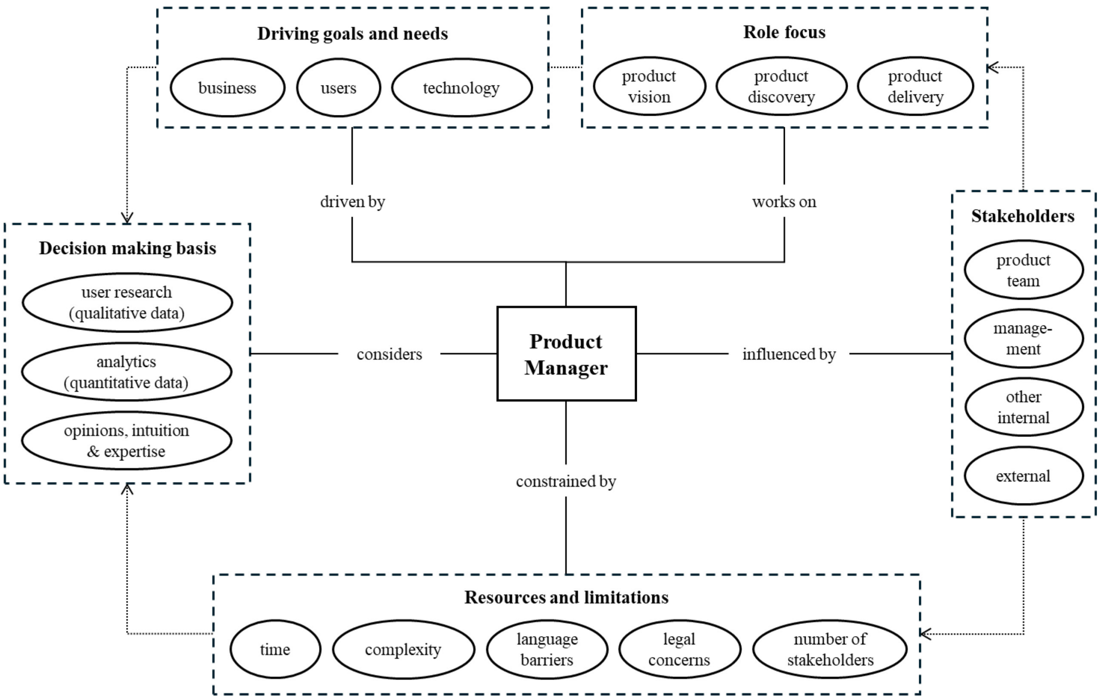

Figure 10. Thematic Map on Product Management.

5 Discussion

The results of the study indicate a wide gap between the academic view of product management (e.g. Fotrousi & Fricker, 2016; van de Weerd et al., 2006a; van de Weerd et al., 2006b) and the reality in the field. Even within the field product managers had varying understandings of what product management entails, where the focus should be, what the role of stakeholders is, and how users can be understood. Many details are somewhat attributable to the nature of the field in which the company operates as well as the characteristics of the product they manage and how it is built.

5.1 The Role and Responsibilities of a Product Manager

Based on the study an average product manager is driven by business needs and goals and focuses mainly on product discovery including e.g. managing a roadmap, defining requirements, understanding users, and designing the product. They make decisions driven by business implications supported with user implications and base the understanding of their users mostly on qualitative data and secondarily with subjective reasoning. Communicating and negotiating with stakeholders takes a lot of time and moulds the role of a product manager. All these responsibilities are to be done under constraints of limited resources and capabilities, while not having much authority over the product or decisions regarding it. These factors result in a complicated role requiring many skills and deep knowledge of the product and market.

Since academic literature mostly describes the function of product management instead of the role of a product manager, there are not many reference points for the role and responsibilities from an academic perspective. The best description of the product manager role in academia comes from Maglyas et al.'s (2017) meta-analysis, defining the five core software product management activities: requirements engineering, release planning, roadmapping, lifecycle management, and vision creation; and six supporting product management activities: product development, support, launches, analysis, portfolio management, and strategic planning. In the study conducted here out of the main activities only roadmapping seemed to be relevant for most product managers, while for most lifecycle management and vision creation were not relevant but rather came given from higher management. Despite the prevalence of roadmapping, interviewees defined roadmap in different ways in terms of how detailed it is and what the time scale is, varying from a couple of weeks up to 10 years. To some the roadmap was a detailed backlog for development while others described the roadmap more as a vague plan for near future that is constantly changing. Some product managers did mention requirements, if indirectly, but requirements engineering as the kind of a process it is in software development was not relevant for most interviewees. Additionally, while some product managers mentioned working with agile methodologies (Scrum) they did not discuss releases or release planning at all. This is an interesting finding as well due to the apparent focus on academic literature on release planning in product management.

Out of the supporting activities product support and product analysis were the most relevant for the interviewees. As described in the study, most product managers do extensive research and testing for their product and support the product via communication and collaboration with the team. Some product managers also described activities related to strategic planning of the product, and the product managers with multiple products narrated portfolio management tasks. Product development was especially relevant for the technology-driven product manager, but for a few others as well to some extent. Product launches, however, were not particularly relevant for anyone except for tracking downloads for those working with new products.

The results of the study and the misalignment with existing research suggest that the field of software product management has indeed evolved rapidly in the past decade. While the article by Maglyas et al. was published in 2017, the three studies as a basis for it were conducted in 2012, 2012 and 2014, making the results a decade old. The results on the role and responsibilities of a contemporary product manager found in this study are most in line with Cagan (2018), which could be partially attributed to research design as well. It seems that the focus of product management is much more business-driven than most previous literature suggests. This is also in line with Cagan's (2018) suggestion of focusing on business results. However, Cagan also emphasises that business results go hand in hand with serving for user needs. The study results suggest that for many product managers user goals are not very relevant and the descriptions of being strongly driven by financial goals, restricted by tight budgets, needing approval of business management, or even being wholly controlled by business management do not express the necessary balance between being business- and user-driven. Thus, organisations could focus more on user needs. As interviewee D pointed out "*if you have product managers* [...] *talking about the business requested this then you are putting the cart before the horse and* [...] *eventually what that means is that you are not innovating. You are just* [...] *a feature factory*". The strength of business as a driver for product management can also be noticed in the narratives of the interviewees who almost always talked about "*customers*" instead of "*users*", even though the interview questions used the word "*users*", suggesting that their role as a paying entity is more relevant than their experience itself of using the product.

Thus, regarding the first research question and part of the study, a product manager's role is usually heavily business-driven with a focus on product discovery or delivery. Being user- or technology-driven and focusing on product vision is much rarer. The main activities of a product manager include managing a roadmap for the product, managing resources and capabilities, communicating and negotiating with stakeholders, and building understanding of users. The way in which these activities are executed and how much weight each activity receives, is largely dependent on the role and the organisation it is positioned in as well as the individual in the role. While Cagan (2018) argues that the product manager should also be the product owner, this was often not the case, and in many product teams there was a separate product owner leading to the product manager being more or less distanced from the actual software development. However, the research shows that the titles are not descriptive of responsibilities and such variety leads to comparing titles between organisations not being applicable, as suggested by Wagenblatt (2019). The study could not prove that product being a core offering of the company or not would have an effect on how product management function works within the company.

5.2 Decision Making as a Product Manager

The tendency to be business-driven was replicated in how decisions are made and what drives them. In most cases the business case was the most important consideration, especially when prioritising between decisions. Thus, it seems that product management's value is considered to be best valued in business terms which is in line with previous research on decision making for value creation (Barney et al., 2008). However, a stronger focus on user needs could provide more long-term value, ensure user satisfaction, and provide competitive advantage. Value creation was mentioned by some interviewees as an important consideration in decision making, however, most did not mention value at all or only in terms of monetary gains. This indicates that valuating product management on something that does not provide returns is considered difficult or too effortful. As interviewee D described "*sometimes products have no direct path to cash, you know, but you should understand how do these products create value for your business model as a company*". Existing research on product management seemed to be lacking in defining value beyond financial value as well.

Product managers make decisions mostly based on qualitative data, whether gathered by user research or passively received from users or internal stakeholders, and secondly based on intuition, opinions, and expertise. Previous studies (Buse & Zimmermann, 2010; Buse & Zimmermann, 2012; Chen, 2018; Hilbert & Redmiles, 2001; Holmström Olsson & Bosch, 2013; Holmström Olsson & Bosch, 2014; Sauvola et al., 2015; Wagenblatt, 2019) have shown that product managers most often make decisions ambiguously, whereas the study conducted here supports a tendency to be more focused on user research data. Despite user research being highlighted in understanding users, half of the product managers reported not being in in-person contact with the end users themselves, as suggested by previous findings (Sauvola et al., 2015). Many stated to be involved in the planning and design of user research, however, as Cagan (2018) and Perri (2019) emphasise, it is crucial for the product manager to see users use the product and hear directly from them to gain a deep understanding of the needs and issues of the users. Some interviewees reported only using the results of user research executed by an internal stakeholder or third party. The lack of involvement in user research is concerning, as previous studies suggest that user insights are not used in product management (e.g. Kabbedijk et al., 2009). Thus, despite the numerous advantages of using data analytics and its improvement of decision making quality and reliability, the product managers tend to rely on other grounds. Product managers tended to be especially prone to subjective decision making when validating decisions and not all validated their decisions in the first place. In many cases validation was reduced to stating that if it operates and brings in money, it was a good decision. Thus, the validation mainly happens after deployment, as suggested by Fabijan et al. (2015). Validation pre-deployment and overall were described to be difficult, however, validating was documented to be much easier for the user-driven product managers who described multiple ways in which they validate pre-deployment.

Almost all interviewees explained to gather volumes of data of their product, even too much or unknown amounts. Still, data was described as a useful tool to point out issues and anomalies, but most product managers narrated turning to qualitative data and especially feedback to understand user needs and problems in more detail, as well as to understand the deeper root causes and sentiments related to those. The results on data are in line with previous research according to which the focus is on operational and diagnostic data, while feature usage data is not effectively used, and data is mainly post-deployment data (Holmström Olsson & Bosch, 2013). The data was considered to lack in providing this depth while having certain constraints regarding its collection and trustworthiness. Most product managers stated them and one or two people within their team or organisation to be actively involved in analysing the data. Only a couple interviewees reported the whole team to be active data analysts, suggesting that in general product teams are not very data-driven or do not have a strong data culture. Many product managers also reported on the focus of business in data as well and that their business unit or business management are more active in using data in their decision making. This hints that the company culture regarding data usage may have a particular importance in terms of business needs and goals. Further, if the company culture is such that data analytics is not the responsibility of a product manager it could lead to them not gaining a deep understanding of the data, such as interviewee B stating that "*I just gather all the data and value it in decision making*".

However, despite the lack of using data analytics to guide product management decisions an argument could be made for that not being a bad thing. Multiple interviewees pointed out that data offers limited benefit in building deep understanding and even if such deep understanding could be derived from quantitative data it would require effort not many product managers can afford, already being under time constraints and operating with limited resources. Thus, importance of having a specified data analyst for the needs of the team may be advocated. Interviewees with a data analyst within their team or shared with a few teams all were classified as qualitative decision makers, while the ones without a data analyst were all classified as subjective decision makers. This highlights the importance of contributing to data analytics and shows that it reduces subjective decision making. Having enough resources for focusing on data analytics enables product team to be proactive instead of reactive and overcome the "analysis paralysis" (Chen, 2018). The product managers with an analyst in their team described that they are able to spend time on finding points of interest and analyse data to find possible needs and issues. In contrast, many product managers without an analyst described that they follow data reactively, spotting anomalies and unexpected data when it arises, but due to limited resources are not able to dive deeper into the issues.

It seems that a major obstacle for becoming a data-driven product manager is the gap between collecting data and analysing it. Proper analysis gives insights, even ones that can be translated into qualitative implications, but it requires both effort and deep understanding of the product, its users, and environment. Thus, without a data analyst that focuses specifically on the product teams needs and goals it is unlikely that data can give the objectivity and reliability for product management decision making. Using an established framework for integrating the use of data within decision making, such as the HYPEX model (Holmström Olsson & Bosch, 2014) presented in 2.3.4., could support in the use of data in product management. An answer or explanation may also be in the tools available. Many product managers discussed an issue of data being used at face value without further analysis, and also the effect of visualising data was documented both with the popularity of dashboards as well as the increased likelihood of using an analytics tool if it visualises data. This along with the constant proclamation for getting deeper insights about the data suggests that there is an urgent need for smarter and visualised analytics tools. Many interviewees echoed having a variety of data tools but using mostly just one or two, while none of the tools seemed to support in all data needs. Thus, product managers need actionable information (Zhang et al., 2011) that answers their needs to support decision making (Buse & Zimmermann, 2010; Buse & Zimmermann, 2012) and can be efficiently turned into action points to be shared with stakeholders (Holmström Olsson & Bosch, 2013). Especially in terms of the deeper insights the recent developments in artificial intelligence could provide useful in assisting resource-limited product managers in getting the most out of vast amounts of data they collect. Thus, as for the second research question and part of the study, it may be concluded that in general product managers are not very data-driven, and even the ones that are more prone to using data in decision making tend to prefer qualitative data instead of analytics, despite all the benefits suggested by previous academic research on data-driven decision making.

5.3 Emerging Concepts: Constraints and Stakeholder Negotiations

Finally, the study highlighted two important concepts that affect product management dramatically: operating under constraints and limited resources, and negotiating with stakeholders. Previous research has only brushed on these topics and many product management articles have not highlighted how strong of a role these have beyond e.g. mentioning that stakeholders play into product management activities (Perri, 2019). While both factors could be coined to be a part of any role involving project management, the amount of mentions and the variety in descriptions related to the two factors seems overwhelming in the study results. During the interviews the product managers consistently mentioned a variety of constraints they deal with that related to both the role and decision making. The most common constraints included complexity of the role, number of and interacting with stakeholders, and not having enough time. Complexity seems to be characteristic of product management which is shown by the large variety in defining product management and its frameworks as well. As a multidisciplinary field combining different functions within an organisation the complexity translates to stakeholders as well. Being in contact with the various stakeholders within the team, the business unit, the organisation, and externally was consistently claimed to take much time and be complicated with multiple different and often contradicting opinions and requests. Some product managers even said that most of their work hours goes into the communicating part. Overall, there was a consensus that a product manager never has enough time to do their job as well as they could, and days were often reported to be long. Restricted time was reported to be the biggest issue in the biggest and smallest companies. A possible explanation could be that in the biggest organisations the product also was not the core offering which could result in the organisation not investing enough resources in the product function. In these large organisations the product manager was solely responsible for the whole product while the size of the organisation also meant that the product had a lot of functionality and therefore a lot of stakeholders. Vice versa in the smallest organisations as there are overall not that many employees, more work is given to the product manager and their responsibilities are more widespread.

The effect of power and politics in negotiating with stakeholders was also consistently mentioned and seemed to mould the role and decision making significantly, as suggested by previous research (Bergman et al., 2002; Berry & Aurum, 2006; Du et al., 2006; Holmström Olsson & Bosch, 2014; Milne & Maiden, 2012; Sauvola et al., 2015; Shah et al., 2006). Product managers described negotiating with both internal and external stakeholders and in these negotiations being pushed to prioritise the stakeholders' needs, which in many cases was the management, business unit manager, or product team lead. However, an interesting concept of apparent negotiating, where the product manager proposes decisions as negotiable in stakeholder communication but has in reality made a decision, came up. Many interviewees reported that some decisions are made and prioritised outside their control or "higher up" and pushed to the product team. In many cases the management was described to push for business results and the product manager then tried to translate the features into financial figures. Thus, in negotiations the focus on business needs and goals was apparent. However, interviewees D, G, and I explained working in a more lenient model termed as empowered teams or servant leadership. Cagan (2018) describes the model as giving the product team a business problem to solve and allowing freedom to come to the solution themselves, while Wagenblatt (2019) emphasises that teams produce best results when given a shared goal as product vision and letting the team produce the best product with autonomy and accountability. However, in the case of most organisations product management was more or less controlled or guided top-up by the management e.g. the management deciding the roadmap or prioritising requirements. Some interviewees reported that they are often not the decision maker or do not have full autonomy in decision making, which clearly affects being data-driven in it, and was reported to even impose risks to product management. The user-driven product managers described to be freer with their decision making, compared to the business- and technology-driven product managers. Decision autonomy was also hindered in the larger decisions where the role and power of stakeholders outgrew that of the product managers.

5.4 Theoretical Contributions

This thesis has extended on previous older studies on product management, defining what contemporary product management focuses on and what activities are relevant. The results highlight that there indeed is a gap between the academic and practical view of product management. The study indicates that product managers are more business-driven than previous research implies. The role of constraints and stakeholders were shown to have not received enough attention in previous research as well. In terms of decision making, the study shows that product managers base their decisions on user research and subjective grounds, however, the results show less emphasis on subjective decision making that previous research suggests. The constraints and stakeholders are important for decision making too, as they restrict how and what decisions product managers make and decision autonomy could affect product managers' data-drivenness. The study also indicated that making decisions on decisions i.e. prioritisation and validation of decisions falls under a slightly different decision making process. Prioritising is more prone to being influenced by power, politics, and negotiating, and validation is more influenced by intuition, experience, and opinions, as compared to general decision making.

5.5 Managerial Implications

The existing academic research on product management poses it as a heavily technical field while in practice product management is largely driven by business goals. Commercial expert literature suggests that it is important to focus on both business and user needs, but currently it seems that most product managers are heavily business-driven, as shown by this thesis study. Value of products and product features was considered to only be measurable in terms of financial numbers according to most. Focusing more on user needs could provide long-term value and competitive advantage. The study here also showed that user-driven product managers are better at validating their decisions which could support in making better quality decisions. Most product managers make decisions mainly based on results of user research, however, a large minority base their decisions on opinions, experience, and intuition. Vast academic research has shown that subjective decision making comes with various risks and drawbacks, while data-driven decisions would be more reliable, more optimal, and better withstand later scrutinity.

However, the limitations and struggles of using analytics to support product management decisions are apparent. The key here is that while all product managers reported collecting tons of data, analysing and using the data is not as common. Thus, product managers require better tools to gain actionable data in a tool that easily turns data into understandable deep insights and is easy to use. The study showed that product teams that have a data analyst within the team or shared with a few teams were all basing their decisions less on subjective grounds than those without an analyst. Thus, investing in data analytics is crucial for making better product decisions. Finally, product managers struggle with being constrained by mainly role complexity and limited time, while being often in difficult positions with negotiating with stakeholders. Many product managers reported that they do not have enough autonomy over the decisions on their product and often it is the management of the organisation or business unit that pushes and restricts their work. Here once again, the product managers driven by user needs had more autonomy over the product and decisions regarding, potentially leading to better decision making and ultimately better product.

5.6 Limitations

The research design imposes some limitations to the reliability of the results. As the study consisted of long interviews, the results are based on what the product managers self-reported and what and how they chose to disclose about their role and decision making. Thus, the narratives of their product management may be more or less an accurate representation of the reality and the descriptions are most likely more or less affected by the interviewees' biases. The interviewees could have also forgot to mention some important points, or the interview questions may not have induced a desired response in the interviewee. The sample size of 10 could also lead to results that are not perfectly accurate or representative of the whole group of product managers. Finally, while the literature and existing research presented here discusses what academia and the field consider the correct way to build a product management function and what many strengths of being data-driven in decision making there are, the study conducted here does prove that a certain way of doing product management or making decisions about products is better than the other. Thus, the research is representative of what product managers spend their time on and what they base their decisions on, not how well these practices and approaches work in reality.

5.7 Future Research

Extensive academic research on product management practices, frameworks, and function is required to bridge the gap between the current studies that are over a decade old and how the rapidly changing field looks like currently. The study presented here shows that the previous articles are not representative of product management of 2020s. In terms of product management decision making, product management analytics, and combining the two more research is required as the number of existing studies is limited. Finally, as discussed in the section about the limitations, studying the effects of different role drivers (business, user, technology), focus areas (discovery, delivery, vision), and decision basis (user research, analytics, subjective) on the results and success of a product is needed.

6 Conclusion

The research presented here took a look in the existing product management literature, both academic and commercial, and the existing literature on the use of data in decision making within product management. A study with a double focus on the role of the product manager and the role of data in their decision making processes was conducted as a qualitative interview research. The results indicate that there exists a major gap between the academic portrayal of software product management function, which is very technology-focused and based on software development frameworks, and the reality of contemporary software product management, which is largely business-driven and dependent on company and product context while trying to take users into account whenever possible. Use of data in decision making for product management is seen as burdensome and not providing as much detail and insight as user research, despite the plethora of benefits proposed by academia. Thus, tools for analysing data efficiently and portraying insights in an easy-to-understand format are required. The software product management terminology is not clear cut in academia nor in the field, calling for an establishment of clear but easily adaptable frameworks driven by the industry, not the academia. Founding a common language between the academia and the practical field would serve to support both academic research and effective development of product management practice.

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