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The selection of IT project management methodologies

An investigation of project management methodologies and their selection process in integrated product development

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ABSTRACT:
Integrated product development combines multiple disciplines (mechanics, engineering, informatics) in the development of complex products in corporations. In today's economy, the development environment could be considered volatile, uncertain, complex and ambiguous, which prompts for experimentation, incremental product design and continuous engagement with the customer or end user. Literature suggests the importance of selecting the right way of working in delivering these product-projects. The thesis investigates how these market-driven requirements are supported by the current mainstream project management methodologies and what are the main considerations when applying a certain methodology in a variety of industries. These considerations are titled factors in this work, and they are clustered along main dimensions. To gain rich feedback and navigate ambiguity, the thesis chose qualitative interviews in performing the investigation. Results indicate stable dimensions across industries. However, factors show deviation in different business environments. This deviation is not only due to the different nature of hardware and software development, but a multitude of project, process, people, and organization related factors. Further finding is that there is no one project management methodology that would fit all industries, therefore methodology tailoring, and the careful assessment of the relevant factors is warranted.

List of abbreviations

ACS	Access Control Solution (in Axis)
APM	Applied Project Management
CEO	Chief Executive Officer
CoE	Center of Excellence
CRM	Customer Relationship Management
ECV	Expected Commercial Value
ERV	Estimated Recovery Value
EMC	Electromagnetic Compatibility
E2E	End-to-End project
FMCG	Fast-moving Consumer Goods
HPDP	Hardware Project Development Process (in Axis)
HW	Hardware
IPD	Integrated Product Development
IS	Information Systems
IT	Information Technologies
KPIs	Key Performance Indicators
LED	Light Emitting Diode
MVP	Minimum Viable Product
NB	New Business Department (in Axis)
NPD	New Product Development
OKR	Objectives and Key Results
PCB(A)	Printed Circuit Board (Assembly)
PMI	Project Management Institute
PMM	Project Management Methodology
PMO	Project Management Office
PRS	Product Requirement Specification
P&T	Product Maintenance Organization (in Axis)
QA	Quality Assurance

R&D	Research and Development
SAFe	Scaled Agile Framework
SLR	Systematic Literature Review
SMART	Specific, Measurable, Achievable, Realistic, Timely
SPDP	Sourced Program Development Process
SW	Software
TPM	Total Productive Maintenance
UI	User Interface
UX	User Experience
VUCA	Volatility, Uncertainty, Complexity and Ambiguity
XP	Extreme Programming

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1 Introduction

1.1 Background

Project management in the field of information technology (IT) is an organic source of literature on information systems (IS) and a constant topic of scientific journals in this field. Akin to IS, IT project management is related to business, people, and technology (Špundak, 2014). Moreover, the problem of choosing a methodology is associated with all three of these aspects. The literature today emphasizes the need to create further a theory on this issue: steps towards a unified view of project management since methodological pluralism burdens the exchange of knowledge (Niknazar & Bourgault, 2017). This contrasts with the development of new technologies that require new practices that lead to an even greater variety of methodologies, even if they are only combinations of existing models (Cooper, 2009).

With the development of the IS area, the choice of project management methodology in companies involved in IT project management becomes an increasingly complex task (Sirkin, Keenan, & Jackson, 2005), as new methodologies and approaches appear, and market requirements often undergo changes, therefore, the frequency of necessary changes increases. Agile methodologies have become the leading approach for software project management, in view of the competitive advantages and flexibility of application (Abrahamsson, Salo, Ronkainen, & Warsta, 2017). Hardware development projects, by contrast, do not often adopt agile software development practices because of their increased complexity and higher requirements for the quality of the products (Ronkainen & Abrahamsson, 2003). Thus, hardware and embedded software development are carried out according to more traditional methodologies, for example Waterfall, where the time of project development cycles is incredibly long for the market requirements (several years for complex systems) (Cooper & Sommer, 2016).

The task of choosing a methodology for the successful implementation of a project is often the responsibility of the project manager (Špundak, 2014); however, development teams and management departments strive for a comprehensive structure that defines the necessary guidelines, procedures and controls, as well as how projects should be implemented (Abrahamsson et al., 2017). The approach should take into account many factors of influence, stakeholders, and the basic principles of the company, which encourages companies to invent practices that are unique to each particular case (Cooper, 2009). Such methods are called hybrid as they combine the approaches of standard methodologies (agile and traditional) along with private practices of the organization; the topic of hybrid methodologies has been actively discussed in the academic community in recent years (Kuhrmann et al., 2017).

Companies that specialize in the production of complex hardware and software ecosystems have combined projects in which both hardware and software are being developed in parallel in order to reduce the time it takes for the product to enter the market (Wnuk, Runeson, Lantz, & Weijden, 2014). The unique characteristics of these types of projects require the adaptation of traditional hardware principles to more flexible software development approaches (Cooper

& Sommer, 2016). As a result, it becomes necessary to choose the methodology of managing integrated product development (the terms "integrated product development" and "combined development" are used analogously throughout this study), which will reduce time to market without sacrificing quality (Hornstein, 2015).

We gained access to perform interviews with associates in the New Business department at Axis Communications, which is located at Lund, Sweden, as the company is a supplier of hardware and software ecosystems for Swedish and global markets (Axis Communications, 2019). The department carries out new product development and a wide range of IT projects: software, hardware, combined, and ongoing programs. The purpose of taking the interviews is to enrich the empirical findings of the thesis. Numerous other interviews were also conducted to with experts from companies of different industries and background.

1.2 Problem area

Although the literature on hybrid IT project management methodologies has been actively developed in recent years (Edivandro C Conforto & Amaral, 2016; Garzaniti, Fortin, & Golkar, 2019; Rahmanian, 2014), the topic of adaptation of methodologies in combined projects is lacking holistic view and recommendations. Besides, there are many challenges for the joint development of software and hardware. In most cases, the software can be delivered quite quickly, having flexible and iterative development and testing, while the hardware may need three to six months before a minimally working device is provided (Edivandro C Conforto & Amaral, 2016). Thus, project managers are encountering difficult task of optimizing and setting up a process, in particular, choosing a management methodology that suits project needs. Moreover, market requirements such as product quality, high-frequency releases and customer satisfaction should be adhered (Papke-Shields, Beise, & Quan, 2010). Since new projects are continuously launched, several projects can be carried out in parallel, and some of them may be interdependent (Staudenmayer, 1997). The company also needs to develop a single integrated approach to operational management, decision-making and control procedures (Cooper, 2009).

Despite the fact that companies use different approaches, many organizations still struggle to effectively select and apply methodologies that meet the unique requirements of the company and therefore suffer losses (Geambaşu, Jianu, Jianu, & Gavrilă, 2011). Organizations are constantly faced with the need to develop integrated products in a short time to get ahead of competitors. Nothing more useful than project management has been invented to solve the problem (Brhel, Meth, Maedche, & Werder, 2015). The IS literature emphasizes the need and effectiveness of choosing the right project management methodology to achieve competitive advantage (Špundak, 2014; Tiwana, 2010). The consistent development and implementation of project management systems in organizations, including information systems, allows various teams and structures of the organization to work together to determine plans and implement projects to bring products to the market, synchronizing their schedules, coordinating resources and efforts to implement the organization's strategy (Papke-Shields et al., 2010).

Moreover, the literature on how to leverage methodologies in integrated product development projects has remained mostly unexamined in academic IS research (Edivandro C Conforto & Amaral, 2016; Imani, Nakano, & Anantatmula, 2017), compared to more practical articles, what signals a lack of scientific research regarding the choice of methodology in combined projects. The gap indicates that it is necessary to conduct a study regarding current design methodologies

and the process of their selection to achieve the required performance of the organization, and furthermore, what factors influence decision making regarding the suitable approach in project management.

1.3 Research question

In order to fill the gap on the lack of research regarding the selection of the methodology that fulfils requirements for managing combined projects, the research provides an answer to the following research question:

"What are the factors influencing the selection of the project management methodology in integrated product development?"

The research question is analyzed by addressing the following aspects: (1) the project management methodologies (PMM) and their application areas; (2) the selection of PMM in different application areas; (3) the factors that contribute to PMM selection in the projects of integrated product development. The aspects are selected for investigation as of giving the full perspective on the research question and furthermore, maintain the guideline of the research.

1.4 Research purpose

The purpose of the thesis is to explore why certain PMM is being used in different industries (in particular, the ones that manage integrated product development), and what are the building blocks of selecting the way of working. As the different factors cascade into wider concepts, such as project and team mechanics, they add up to whether agile could be used or not. The thesis also explores to what extent these factors could be generalized. However, it is worth specifying that the research does not target the agile transformation, but rather the methods to incorporate continuous engagement and adaptability in the development process. This is done by consolidating existing knowledge, comparing and contrasting literature and correlating them with practice in a dynamically changing environment. Conducting such research results in knowledge contribution and brings value to the academic literature, due to the fact that there is a lack of research and a scarcity of empirical findings regarding the application of certain methodologies in combined projects; thus, this study bridges the gap that separates theory and practice. Moreover, we believe that for the academic and practical environment, a deep understanding of the topic under study and the consequences of decisions made are important, as it will enable companies to achieve success in managing current and future projects, as well as provide long-term competitive advantages.

1.5 Delimitation

Since selection of PMM covers a wide range of research practices and opportunities, the study is delimited to the organizational and managerial aspects of project management; the research will not consider the production procedures of product development. The study is limited to influencing factors of PMM selection and decision-making processes behind, as well as the characteristics of the project and organization to obtain a holistic picture and a comprehensive solution. Moreover, targeted PMM of the study are limited to Waterfall and Agile (traditional and flexible) methodologies, as they are used in the development of privileged majority of IT projects (Cooper & Sommer, 2016; Schmidt et al., 2019; Wankhede, 2016).

2 Theoretical background

The following chapter represents the main theoretical construct of the thesis. Literature review summarises the main characteristics of project management methodologies and their selection in different application areas. Methodologies' section examines the evolution of PMM, current trends and key attributes of the methodologies. The following section addresses the main considerations of application areas in practice and theory. The final section of the chapter provides the framework for the research, which is built on the theoretical background.

2.1 Methodologies

Project management is a methodology for planning and organizing, as well as coordinating people, financial and material and technical resources using modern methods, techniques and management technologies (Špundak, 2014; Waldrop, 1984), aimed at achieving certain results in terms of the composition and volume of work, cost, time and quality (Hornstein, 2015; Killen, Jugdev, Drouin, & Petit, 2012).

When evaluating the effectiveness of managing a traditional project, the concept of the project management triangle is practiced, that is, evaluations in three parameters - quality, time and cost (Charvat, 2003; Waldrop, 1984). Also, when implementing a project, it is necessary to take into account its organizational structure, since each structure offers its own approaches to team building (Hornstein, 2015). And, although the basic standards and methodologies have now been formed, there is a fairly extensive experience of best practices and standardization, as part of the implementation of specific projects, managers have to adapt and modify methodologies, which leads to the creation of new methods and practices for using various methodologies (Charvat, 2003; Hornstein, 2015).

It is worth noting that in the context of global competition and an overall increase in the end-user requirements for the quality of goods or services, organizations have to regularly make changes to their products and services, which means that the importance of project management becomes even more significant (Charvat, 2003; Hornstein, 2015; Killen et al., 2012). Project management is applied in all areas of activities and business processes, including enterprises with a process-oriented production system (Killen et al., 2012; Špundak, 2014).

However, the number of failed projects is still significant (Charvat, 2003). Among the implemented projects, there are still often excesses of time limits and the approved budget, as well as failure to achieve other goals set within the project (Hornstein, 2015; Sirkin et al., 2005). Next, we consider the most common methodologies in which projects are managed, as well as their areas of application.

2.1.1 Agile methodologies

Agile methodologies are a family of development processes, and not the only approach to software development (Mnkandla, 2008). The values and principles of the agile methodology are

conceptualized in the Agile Manifesto (Manifesto, 2001). Agile does not include specific practices but defines the values and principles that guide successful teams (Diebold & Dahlem, 2014). Agile Manifesto was developed and adopted in 2001, the manifesto was signed by representatives of the following methodologies: Extreme programming, Scrum, Dynamic Systems Development Method, Adaptive Software Development, Crystal Clear, Feature-Driven Development, Pragmatic Programming (Manifesto, 2001). Agile methodologies are also similar to the iterative or incremental development models (Mitchell & Seaman, 2009).

Most flexible methodologies aim to minimize risks by reducing development to a series of short cycles called iterations (Hossain, Babar, & Verner, 2009). Each iteration by itself looks like a software project in miniature and includes all the tasks necessary to produce a Minimum viable product (MVP) in functionality: planning, requirements analysis, design, coding, testing and documentation (Williams, 2010). Although it is understood that a single iteration is usually not sufficient to release a new version of a product. At the end of each iteration, the team re-evaluates the development priorities (Papadopoulos, 2015); and in addition, if necessary to make changes, it is possible to do without significant additional costs and adjustments to the remaining components of the project (Stoica, Mircea, & Ghilic-Micu, 2013).

The main goal of improving the organization's project management based on the Agile is to reduce the number of project participants and the number of communications between them (Kumar & Bhatia, 2012; Mahadevan, Kettinger, & Meservy, 2015; Nishijima & Dos Santos, 2013). Thus, it is supposed to accelerate the time of the project, reduce the cost of services, ensure a more coordinated work of the levels of the organizational structure, increase the motivation of the team, improve the order of work with the client (Livermore, 2008).

When using the traditional approach to project management, managers spend a lot of time identifying and eliminating deviations from the planned progress of the project, redoing part of the work performed (Špundak, 2014). In the decision-making process based on Agile technologies, priority is always given to newer and more valuable development for the business, which allows timely fulfilment of the established project indicators (Drury, Conboy, & Power, 2012; Zannier & Maurer, 2006). Therefore, Agile methodologies will be most effective in areas where innovative products are being developed, as well as in those projects where a large number of improvements are needed due to frequent changes in customer requirements (Cooper & Sommer, 2016).

The development prospects of agile methodologies are confirmed by the choice of the enterprises themselves. Today Agile is common even in industries not related to the development and implementation of IT-technologies (Serrador & Pinto, 2015). The data of the State of Agile study, which is conducted by VersionOne for 11 times among companies around the world to study the distribution and application of Agile methodologies (Moniruzzaman & Hossain, 2013), can speak about the alleged effectiveness of implementing flexible methodologies in the organization under study.

The advantage of agile methodologies for project customers is the ability to quickly change project requirements (Williams, 2010). A survey of investors and sponsors on the main advantages of Agile for business (Kisielnicki & Misiak, 2017) showed that the greatest benefit for this type of interested parties is to ensure that customer needs are satisfied, as well as reduce the time it takes to bring the result to the market and reduce project costs. Agile technologies have a positive effect on the employees of the organization. The staff receives a friendly and

open-for-discussion environment (Kumar & Bhatia, 2012), in which the employees of the company are not simple executors, but also responsible persons and planners. Independent decision-making and a high level of responsibility are the main criteria for increasing satisfaction from the work of the project team (Matthies & Hesse, 2019).

Agile flexible methodology provides significant benefits to all stakeholders of the project, significantly improves the parameters of the project itself and can be considered as an effective tool to increase the effectiveness of project management in the organization. Nevertheless, as any other methodology, Agile has several drawbacks: (1) in the absence of a clear goal, difficulties can cause a measurement of progress and efficiency; (2) long-term development of project products can be quite problematic, since it is difficult to accurately predict the cost, as well as the time and resources needed at the beginning of the project; (3) team members and customers must constantly interact, which make organisation dependent on customer feedback and cause difficulties for large-scale implementations (Farokhad, Pinilla, Toledo, Gandarias, & Olaso, 2019; Stoica et al., 2013; Wankhede, 2016).

To conclude, it can be argued that in order to apply a flexible approach, it is necessary to evaluate the features of the organization and the project being implemented for compliance with certain criteria, as well as be prepared for the occurrence of common problem situations. In addition, the implementation of approaches based on the agile methodology is accompanied by risks associated with the organization of production, its planning, personnel and production directly. They must be considered when selecting a managerial approach to the project activities of the organization.

2.1.2 Traditional methodologies

The traditional project management approach uses a plan-driven (or stage-gate) methodology (Boehm & Turner, 2003). The cascade model and some of its modifications were first proposed about 40 years ago by Royce (1987). And although author considered only IT projects, the principles laid by him in the basis of the approach are also applicable to projects in other subject areas. The main characteristic of the traditional methodology is that the transition to the next stage of the project is carried out only after the complete completion of the previous one (Baird & Riggins, 2012). The plan-driven model relies on the formalization of project management, which in the case of a traditional type of project is very significant (Shinde, Tangde, & Kulkarni, 2015). Most well-known traditional project management methodologies (e.g. V-model, Waterfall) come from cascading project management principles, where the attributes are: strict decomposition of works; fixing the so-called basic project plan, formally completing the planning stage; analysis of the progress of the project by assessing deviations from the baseline or using the utilized volume method (Moniruzzaman & Hossain, 2013; Nishijima & Dos Santos, 2013; Papadopoulos, 2015; Špundak, 2014).

The traditional methodology is best suited for those projects in which there is no uncertainty (Y. Kwak & Stoddard, 2004); that is, the final product is known, its consumers and stakeholders are defined, the risks are not too high. The main advantage of the methodology is that it is universal (Niknazar & Bourgault, 2017); it can be used in any industry no matter what the company size or revenue is (Thomas & Fernández, 2008). The cascade approach, with all its obvious advantages for management purposes, has several limitations and creates some problems. The main disadvantage is the obsolescence of the product - planning can take up to 40% of the entire project (Baird & Riggins, 2012), but by the time the finished product is released,

no one may need it. Therefore, this methodology is not suitable for creating innovative products. Moreover, some of the shortcomings are associated with the correctness of the formulation of the initial data of the project, the accuracy and timeliness of management, which however can be solved within the framework of the waterfall model itself (Tiwana, 2010). But some problems, in principle, cannot be solved by a "cascade". The most significant problem areas: (1) accumulation of errors made at the early stages of the project, and the sharp complication of the project (in terms of content, costs, deadlines) associated with it, if the accumulated error leads to the need to return to the previous stages of the project; (2) the inability to adapt the project to changes, the approach does not take into account the external conditions that occur during the period of the transformation, which can significantly change the requirements for the necessary system parameters; (3) critical dependence on the accuracy of the formulation of requirements for the product of the project (Mahadevan et al., 2015; Nishijima & Dos Santos, 2013; Papadopoulos, 2015; Špundak, 2014; Stoica et al., 2013). Moreover, there are gaps in discussions of the following topics in the literature: (1) conditions on how to deliver timely; (2) adoption of methods for quick solutions for a small project (Jabar, Ali, Jusoh, Abdullah, & Mohanarajah, 2019; Papadopoulos, 2015).

2.1.3 Hybrid methods

The definition beyond the term hybrid methodology is a combination of practices of different approaches (agile and traditional) or a system to create a better approach (Kuhrmann et al., 2017). Although flexible methods have been used in industries with traditional project management methods since the 90's (Wankhede, 2016), the conceptualization of combining the Agile and waterfall methodologies (Fitzgerald & Stol, 2014; Karlstrom & Runeson, 2005; Vinekar, Slinkman, & Nerur, 2006), as well as the review of prospects for combined (hybrid) use of approaches in specific environment (Boehm & Turner, 2003; Highsmith & Cockburn, 2001; Nerur, Mahapatra, & Mangalaraj, 2005) were carried out in the 2000's. In recent decades, companies need to develop new technologies and markets quickly, the demand for high-quality solutions is growing, so with the advent of Manifesto for Agile Software Development (Papadakis & Tsironis, 2018), more and more industries are introducing agile practices into traditional approaches, thereby contributing to the development of hybrid methodologies (Papadakis & Tsironis, 2018). Additionally, hybrid methods are applied both in IT and non-IT projects (Imani et al., 2017).

West, Gilpin, Grant, and Anderson (2011) argue that the "Water-Scrum-Fall" approach will become a reality for most companies, while a study (Kuhrmann et al., 2017) confirms this. Kuhrmann et al. (2017) also find that hybrid approaches have become leading and are being used in various companies regardless of company size or industry. Hybrid methodologies are considered to bring the most "value" to the organizations and produce strategic or tactical advantage (Papadakis & Tsironis, 2018; Vinekar et al., 2006), and may lead to the most innovative outcomes (Cunha & Gomes, 2003), despite the fact that choosing the right approach is accompanied by a huge variety of influencing factors (Kuhrmann et al., 2017). Nevertheless, it is worth noting that if professionals are not able to make the right and balanced decision regarding the principles of separation of processes into Agile and Stage-gate, then the advantages of Agile are unlikely to be achieved (West et al., 2011).

Stage-gate methods fill the gaps that are present in agile methodologies (Baird & Riggins, 2012; Hassani, El Bouzekri El Idrissi, & Abouabdellah, 2018), although West (2011) argues that Agile is limited to the development-level mostly, while business management follows a traditional

approach in hybrid methods. However, in the future, hybrid approaches could be seen as the right set of practices suitable for a particular problem, as West (2011) phrases, and will also relate not only to development, but also to operations concerns and business change. The author also points out the necessary practices: (1) the documentation should not be redundant and should contain "just enough" information to ensure high-level development and planning; (2) teams should have clear measures to work efficiently; also (3) the production should aim for frequent releases. Hybrid approaches are also considered to contribute more because they focus on business value and higher product quality (Hass, 2007; Beckett, 2008). Other benefits of the hybrid approach in the non-software context relate to customer interaction and involvement, teamwork, productivity, and flexibility (Papadakis & Tsironis, 2018). Communication and transparency are one of the key components taken from agile method to traditional approach (Schmitz, Mahapatra, & Nerur, 2018). However, at first, a company culture should be adopted to agile practices in order to implement and take advantage of a flexible approach (Wankhede, 2016).

Figure 2.1: A hybrid project management model for software development
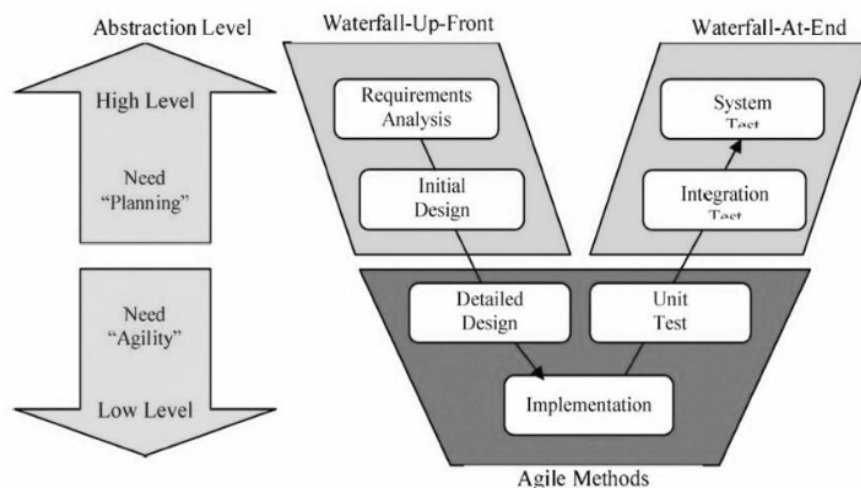
Source: Hayata and Han (2011)

Different models are proposed for a hybrid methodology; however, all early models agree on some flexibility in the middle of the project, and a straightforward process at the beginning and at the end. For example, the Hayata and Han (2011) model, involves a combination of Waterfall and Scrum models as shown in Figure 2.1, by dividing the processes into high and low levels. The same is for the Farokhad et al. (2019) model, which is the combination of Scrumban (mix of Scrum and Kanban methodologies) and classical project management; or Agile-Stage-Gate model of (Cooper & Sommer, 2016). Modern models offer a more comprehensive hybrid approach to development and require a versioned process to develop new product in small iterations providing the MVP in each version. An example is the model by Hassani et al. (2018) shown in Figure 2.2, by dividing the processes into high and low levels.

Figure 2.2: Hybrid methodology model
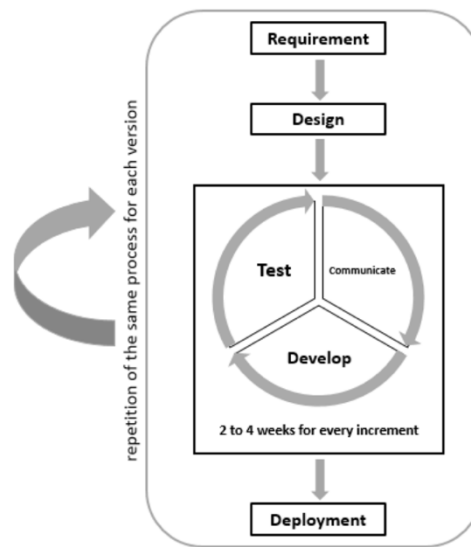
Source: Hassani et al. (2018)

The authors emphasize the effectiveness of the hybrid approach for both small teams (Vijayasarathy & Butler, 2015) and large-scale projects (Imani & Nakano, 2018). The effectiveness and success of the approach chosen must be constantly measured; moreover, metrics and processes, in turn, must be constantly finetuned (Pradhan & Nanniyur, 2019). The study of Vijayasarathy and Butler (2015) shows that Hybrid methodologies are used for projects with high criticality and a different budget, which satisfy the requirements for most of the projects. Despite the advantages of hybrid approaches, authors also highlight the drawbacks: (1) lack of flexibility in the decisions made in early stages; (2) lack of coordination may occur because of asynchronous development in different teams; (3) challenges in reconciling incremental minimum viable products (Garzaniti et al., 2019; Imani & Nakano, 2018; Kuhrmann et al., 2017). Other than that, several gaps are noted in the literature regarding hybrid project management models: (1) project models for medium and large projects are not discussed in a systematic way; (2) corporate management review is limited; (3) models do not propose different methodologies combination; (4) benefits, and measures used are not well managed (Edivandro C Conforto, Salum, Amaral, Da Silva, & De Almeida, 2014; Cooper & Sommer, 2016; Jabar et al., 2019; Kuhrmann et al., 2017; Rahmanian, 2014).

2.2 Methodology selection in different environments

Based on our literature review, we divided the areas of use of project methodologies into two segments: software development and integrated product development. The experience in software development is considered as a starting point for iterative hardware development (Gerber, Goevert, Schweigert-Recksiek, & Lindemann, 2019), and as adaptability in the development process is relevant for the research, therefore it was decided to review practices of the software development area to ensure the validity of the research. While software resides mostly in informatics, integrated product development is an intersection of electronic, mechanical and informatics domains. Software and hardware development are complex process of specification, design, creation and programming, documentation and testing associated with the creation and

maintenance of the final product. Moreover, the characteristics and requirements for software and hardware vary due to the physical nature of mechanical and electrical parts.

2.2.1 Software development

Software development is an integral part of companies developing products in the field of information technology. Commercial software can be in the form of programs, web services, desktop or mobile applications, as well as embedded software for managing custom products. Moreover, the software development process may include research, prototyping, re-engineering and other activities that lead to the creation of software products (Matthies & Hesse, 2019).

Projects that involve software development often have many interactions and dependencies, as well as several stakeholders whose priorities may vary (Staudenmayer, 1997). Many projects are characterized by a high level of uncertainty (Dingsøyr, Moe, Fægri, & Seim, 2018; Vijayasarathy & Butler, 2015), as the project scope adapts to market requirements and customer reviews, as well as project resources (budget, human resources), can change (Y. Kwak & Stoddard, 2004). It should be noted that some projects may have external dependencies and use additional resources, for example, individual teams or projects involved in continuous development (Dingsøyr et al., 2018; Y. Kwak & Stoddard, 2004).

In today's world, when the market is constantly changing under the influence of globalization, new technologies and competitors, time-to-market is the most important factor in the development of commercial products (Y. Kwak & Stoddard, 2004). In addition, software requirements include price, market compliance, quality, and usability and performance (Tiwana, 2010). Research identifies various risks that lead to unsatisfying project requirements, such as exceeding the budget or not fulfilling the necessary tasks (Y. Kwak & Stoddard, 2004). Y. Kwak and Stoddard (2004) also highlight that from 15 to 35% of projects are canceled, while the rest have problems with deadlines, project costs and goals, the study shows. Moreover, another research specifies that 45% of all reasons for postponing projects are organizational problems (Van Genuchten, 1991).

Software development methodologies are divided into traditional and agile, although a review of the literature indicates that agile methodologies are used with the preferred majority (Abrahamsson et al., 2017; Choudhary & Rakesh, 2016). As noted above, the essence of agile methodologies is communication and ability to quickly and adequately respond to changes in the project, which is a priority for a complex and rapidly changing environment. The authors argue that at least in cases where customer requirements are constantly changing in accordance with the changing needs of users, the choice should fall precisely on Agile (Abrahamsson et al., 2017; Choudhary & Rakesh, 2016). Scrum and Kanban are considered the most popular approaches of agile software development; according to the survey results, more than 70% use Scrum (Choudhary & Rakesh, 2016). Although flexible methodologies are considered more suitable for small and closely spaced teams, the success of small scales has inspired large projects to implement agile approaches using frameworks such as SAFe (Dingsøyr et al., 2018).

The success and effectiveness of software development teams is a widely discussed topic. According to the authors, most of the projects fail not for technical reasons, but because of improper management. Practices such as (1) a consistent definition of success, (2) measuring data, and (3) the use of results and data, are factors in the success of IT projects (Thomas & Fernández, 2008). Thus, more and more companies rely on data to make decisions. In modern

software projects data is collected with the use of many tools and it essential source for efficient communication and collaboration. However, studies show that team members rely more on their development experience (Zannier & Maurer, 2006) than on informed data-driven decisions, which are highly beneficial to agile software development.

2.2.2 Integrated product development

Extending the domain of pure software development to the physical domain, a similar evolutionary process could be observed for developing new products. Physical products in many industries involve mechanical, electrical and software processes in their design and assembly. Furthermore, many physical products have electronic, firmware and software components; often being referred to as embedded systems, ecosystems, cyber-physical systems, or simply hardware in the literature (Atzberger et al., 2019; Böhmer, Hugger, & Lindemann, 2017; Edivandro C Conforto & Amaral, 2016; Kaisti et al., 2013; Sommer, Hedegaard, Dukovska-Popovska, & Steger-Jensen, 2015). According to the authors, the development of such product requires the knowledge and coordination of multiple domains. Using Ovesen's definition, "…Integrated Product Development (IPD) is used as a term, that – in contrast to software development – spans a wide areas of elements such as mechanical development, construction, firmware, hardware, interface design and styling, but often also software" (Ovesen, 2012, p. 5.).

Figure 2.3: Illustration of the classical product development process
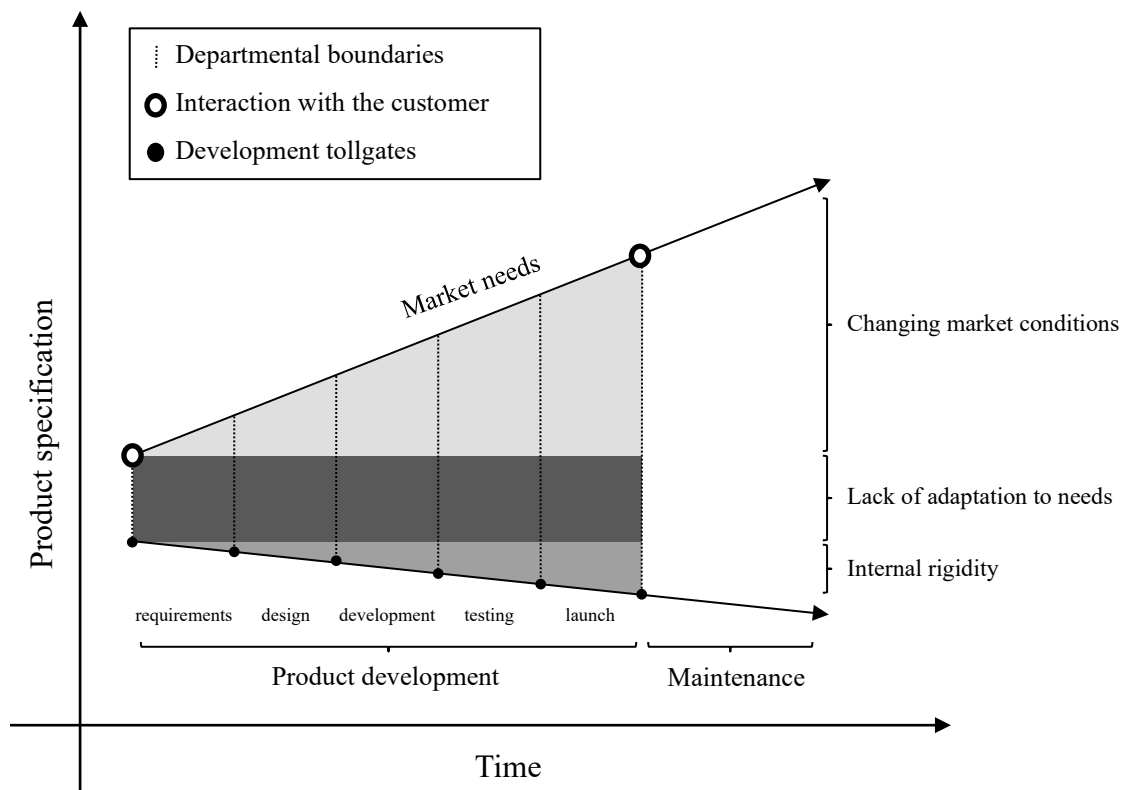
Source: Authors' contribution inspired by Ovesen (2012) and Kaisti et al. (2013)

With respect to the development environment, Atzberger et al. (2019) describes it as volatile, uncertain, complex and ambiguous (VUCA), due to the constantly changing market conditions. Trott (2017) explains the importance of new product development as it is the means of long-

term value creation. Digital disruption and globalization changed the competitive environment for companies and challenged the existing management frameworks of product development that was of traditional stage-gate or waterfall nature (Edivandro C Conforto & Amaral, 2016). This phenomenon is illustrated in Figure 2.3. Market needs are constantly changing, meaning that the ideal product that fulfils customer needs will probably have different specifications by the end of a lengthy development process. Without continuous customer interactions, the development teams responsible will not realize the increasing gap between the product in making versus market needs, that is a specification bringing maximum utility for the customer and profits for the company. Changing market conditions aside, the company needs to accommodate the desired specifications in its internal processes and adapt to customer needs. Lastly, in an organization, where there is no cross-functional development team, and responsibilities are being passed on through from one team to another after each tollgate closes, the end product may dilate from its conceptual plan. According to Ovesen (2012), this may result in a failing product that has no demand.

The need for a paradigm shift in product development has been under the magnifying glass of scholars and practitioners alike, and their arguments have been progressing in the last two decades. Multiple authors contributed by reviewing the existing literature on the topic, their observations are concluded in Table A.1. All of these authors performed keyword searches and snowball sampling techniques to build up their collection of articles further to be analysed. Shen, Yang, Rong, and Shao (2012), Kaisti et al. (2013) and Dikert, Paasivaara, and Lassenius (2016) researched the emergence of agile methods in embedded software and systems with a software focus, while Sharafi, Wolfenstetter, Wolf, and Krcmar (2010) and Ciric, Lalic, Gracanin, Palcic, and Zivlak (2018) focused on the adoption of agile techniques outside the software domain.

The main areas of applying APM in a non-SW environment are R&D, construction and real estate, education and the service sector (Ciric et al., 2018). The fact, that Sharafi et al. (2010) could not find PMM models that cover the entire development process and Ciric et al. (2018) discusses organization-wide inter-coordinated adoption of APM shows the rapid emergence of PMM in NPD in the last decade. A critique however, that literature reviews address is that most of the reviewed studies are merely experience reports without empirical justification of increased production following an agile shift. Literature also developed applicability criteria of Agile, by isolating factors based on the industry reports' critical success factors and key challenges (Ciric et al., 2018; Dikert et al., 2016). These factors concern project (scope, resources, requirement), organizational (fitting corporate environment, alignment, management buy-in, coaching, knowledge management, experimentation, change management, scaling), employee (project team composition, employee and customer engagement) and processes (iterative, complex project plans, self-governance). Furthermore, as both Dikert et al. (2016) and Ciric et al. (2018) state, the key to using PMM is to adapting it to the right task. Following this reasoning, which is also a key statement of this thesis, Ciric et al. (2018) adds, that APM could be thought of as an extension of traditional, stage-gate methodologies, consequently, PMM is a modular concept and its elements are meant to be combined to align corporate efforts.

In our literature review process, four further case studies were identified, their main findings can be seen in Table 2.1. Recent studies, therefore, confirm the previous literature reviews in many aspects that are related to the selection and successful implementation of new PMM approaches. All studies mention the requirement of shifting the power from central decision makers to dedicated, cross-functional teams. The entire organization needs to be made ready for the change, coaching and training might be necessary. Furthermore, a scaling framework, common

guidelines and alignment needs to be in place in between the inter-connected teams. Goal setting and the measurement and reward system needs to be realigned, while product concepts need to be rethought to allow for experimentation and continuous delivery.

Table 2.1: Recent case studies in NPD

Authors	PMM	Industry	Success factors
Cooper and Sommer (2018)	Agile-Stage-Gate Hybrid	Manufacturing (6 firms)	• Management buy-in • Dedicated teams • Fluid product concepts • Integrated governance and execution
Paasivaara, Behm, Lassenius, and Hallikainen (2018)	Large-scale Agile transformation	Telco.	• Change management • Scaling framework • Common concept and directions • Dedicated teams • Alignment
Durisic and Berényi (2019)	SAFe	Manufacturing (system architecture)	• Decentralized decision making • Common platform • Dedicated roles and supporting team
Sommer (2019)	Large-scale Agile transformation	Manufacturing	• Empowered teams • Product-oriented org. structures • Continuous resource allocation • Redefined measurement • Continuous delivery

Klein and Reinhart (2014) illustrates, that the development of a cyber-physical product today borders three main disciplines: mechanics, electronics, and informatics. As the authors state, mechatronics, the new paradigm emerged as an interdisciplinary field, as a combination of electronics and mechanics, focusing on creating efficiently designed mass-produced products. They further put, that as software solutions were gaining share in product value, mechatronics needed to shift to enable customizability by software, which implied that the development also changed to include the aspects of iterative, customer-focused development. Klein and Reinhart (2014) envisions that design processes of the future will be dominantly driven by software.

2.3 Framework

In summary, the research related to integrated product development PMM selection is seen as mostly consisting of case studies and experience reports without industry-wide empirical underpinnings, because the novelty and complexity of the area (Schmidt et al., 2019). However, the traditional and Agile methodologies are well discussed areas, what brings a background for implementation of hybrid approaches to the integrated products development. According to Kvale (2008); Miles and Huberman (1984), there is a great importance in the thematizing and framework that sets the expectations and guidelines for the further investigations. Therefore, we constructed the research framework based on the literature review in order to guide the research process. The framework presented in Table 2.1 outlines the main dimensions for PMM selection identified in the literature to be studied to answer the research question.

The overarching framework articulates the key factors influencing the selection of PMM, which are synthesized from the various academic contributions and key considerations distinguished by prominent authors in the field as discussed above. Even though Y. H. Kwak and Anbari (2009) claim that PMM is a subjective field, the factors selected are highlighted by multiple researchers and cannot be simplified to a single area. The factors identified are grouped under four dimensions: people and processes, projects, organizational development, and perceptions. These dimensions are based on similarities of the factors (to which area they relate) and are in line with the studies presented in the academic literature (Almeida Ferreira, Vieira Neto, & da Silveira Batista, 2019; Bergmann & Karwowski, 2018; Ovesen, 2012; Totten, 2017). Each dimension and factors are further discussed in the below sections. The framework gives a structure to the empirical investigation presented in Chapters 4 and 5. The framework itself, indirectly, through the revision of the preliminary interview guide (further explained in section 3.3) was refined, following the pilot interview sessions and subsequent literature revision, as more specific factors were recognized. Additional factors, such as communication and processes, project scope and requirements, resources, maturity, culture and change, and planning and risks were added.

2.3.1 People and processes

First dimension represents the human and operational conditions that need to be taken into consideration when exploring the PMM applied in different contexts. In particular, we distinguish the following factors: (1) roles, experience, and responsibilities; (2) teams and interdependencies between parties participating in the project; (3) communication and processes between stakeholders. The topics are rarely discussed in detail; however, people are the foundation of all processes in a company, therefore they should not be underestimated (Charvat, 2003; Špundak, 2014). The first factor explains the roles of people involved in the PMM, which is important to consider in the company hierarchy and decision-making process (Abrahamsson et al., 2017). The second factor is elucidating the role of a team in the PMM and highlights the importance of a team size and structure, as well as dependencies between different parties (Dingsøyr et al., 2018; Serrador & Pinto, 2015). Moreover, the selection of the methodology is largely dependent on the team's knowledge and experience with a particular methodology (Geambaşu et al., 2011; Yusof, Shukur, & Abdullah, 2011). The communication, in turn, especially with customers is an acknowledged factor influencing the processes of the product development (Totten, 2017); whereas processes set the background for the methodology operations and guide formal communication (Baird & Riggins, 2012; Špundak, 2014). It is worth mentioning that nevertheless several studies examined the process factor as a separate dimension (Almeida Ferreira et al., 2019; Totten, 2017), people and processes dimension was constructed as a unified component as we aimed for a more holistic focus, which is still retaining other researchers' opinion (Hossain et al., 2009; Kumar & Bhatia, 2012).

2.3.2 Projects

Factors relating to the projects dimension represent the main premise for the PMM selection and examines the conditions of the project defined as: (1) scope, which can relate, for example, to software, integrated or new product development; (2) project requirements as factors that determine the level of criticality and complexity, and involve the initial state of the project; (3) measurements and success factors that guide the product development and assist in the decision-

making process; (4) resources such as people, budget, and time; as well as (5) methodologies applied corporate-wide, their guidelines and processes. Project scope is the most deterministic factor discussed in the academic literature as software and hardware are diverse in nature (Charvat, 2003; Joslin & Müller, 2016; Vijayasarathy & Butler, 2015). The second factor provokes more agile methods across industries as requirements reflect fast changing market needs and complexity, and therefore is distinguished in the literature (Baird & Riggins, 2012; Imani & Nakano, 2018; Niknazar & Bourgault, 2017). Measurement are seen as necessary pointers for the product and project development, as success being a subjective parameter defines the deliverables of the development process (Edivandro Carlos Conforto, Amaral, da Silva, Di Felippo, & Kamikawachi, 2016; Joslin & Müller, 2016; Killen et al., 2012; Serrador & Pinto, 2015). The fourth factor defined as resources is represented as a deterministic measure for the PMM selection as companies possess different capacity and, moreover, different methodologies are privileged in diverse environments (Charvat, 2003; Serrador & Pinto, 2015). The last factor in the projects' dimension is discussing methodologies environment in the company and is considering corporate guidelines about methodology selection (Geambaşu et al., 2011; Hornstein, 2015).

2.3.3 Organizational development

The third dimension is related to the overall organizational processes and development. The literature review reveals the next factors, which are significant organization-wise in the methodology processes: (1) decision-making process of the methodology selection; (2) maturity of organization and processes, culture and change; (3) planning and risk management, which includes short- and long-term goals; (4) existence of the documentation, processes of knowledge managements, as well as lessons learnt. These topics are essential as PMM is often selected based on the problem area, along with the organizational settings (Yusof et al., 2011). Moreover, decision are always made based on the previous experience, therefore defined dimension is crucial for the research purpose (Orłowski, Deręgowski, Kurzawski, & Ziółkowski, 2017). Drury et al. (2012); Hornstein (2015); Stoica et al. (2013) highlights the complexity of the first factor (decision-making process) and its impact on the operational processes as well as on quality, consistency and agility of decisions. The second factor consists of multiple components and is necessary for the change introduction and acceptance (Cooper & Sommer, 2016; Papadakis & Tsironis, 2018), as well defines what methodology will be more effective (Imani et al., 2017). Planning and risk management are important to consider especially in the beginning of the project (Baird & Riggins, 2012; Totten, 2017; Wysocki & Orłowski, 2019), and being parts of organizational processes the factor represents the guidelines for the methodology selection (Y. H. Kwak & Anbari, 2009). Finally, knowledge management (including documentation and knowledge creation processes) results in more efficient capability of project development and plays a significant role in project execution, therefore it is regarded as significant factor for PMM selection (Edivandro C Conforto et al., 2014; Niknazar & Bourgault, 2017; Papadakis & Tsironis, 2018; Serrador & Pinto, 2015; Totten, 2017).

2.3.4 Perceptions

Project management field is seen as subjective and opinionated (Y. H. Kwak & Anbari, 2009). The existence of perceptions is prevalent in the literature, therefore we added extra interdimensional component to the research framework in order to gain unique, industry and organization specific insights from experts. We divided perceptions into factors that relate to either people or processes, or projects, or organizational dimensions: (1) best practices (Baird & Riggins, 2012; Papadakis & Tsironis, 2018); (2) opportunities (Edivandro C Conforto et al., 2014; Killen et al., 2012; Stoica et al., 2013) as a representation of processes or challenges, that have potentially known options for improvement; and (3) challenges and bottlenecks (Orłowski et al., 2017; West et al., 2011) that companies face in the operating activities, but do not know how to solve. The literature is scarce covering these topics, however perceptions are important to take into account for the purpose of the study. Furthermore, PMM is often adjusted based on the project challenges and best practices (Baird & Riggins, 2012; Orłowski et al., 2017). It needs highlighting, that perceptions dimension served as an interdimensional category and is aiming to bring more details and broader perspective to the research due to the opinion- and experience- dependent nature of the research approach (interviews).

Table 2.2: Research framework

Dimensions	Factors	Reference
People and processes	Roles, experience and responsibilities	Abrahamsson et al. (2017); Charvat (2003); Špundak (2014)
	Teams and interdependencies	Dingsøyr et al. (2018); Geambaşu et al. (2011); Serrador and Pinto (2015)
	Communication and processes	Baird and Riggins (2012); Špundak (2014); Totten (2017)
Projects	Scope	Charvat (2003); Joslin and Müller (2016); Vijayasarathy and Butler (2015)
	Requirements	Baird and Riggins (2012); Imani and Nakano (2018); Niknazar and Bourgault (2017)
	Measurements and success	Edivandro Carlos Conforto et al. (2016); Joslin and Müller (2016); Killen et al. (2012); Serrador and Pinto (2015)
	Resources	Charvat (2003); Serrador and Pinto (2015)
	Methodologies	Geambaşu et al. (2011); Hornstein (2015)
Organizational development	Decision-making process	Drury et al. (2012); Hornstein (2015); Orłowski et al. (2017); Stoica et al. (2013)
	Maturity, culture, change	Cooper and Sommer (2016); Imani and Nakano (2018); Papadakis and Tsironis (2018)

	Planning and risks	Joslin and Müller (2016); Y. H. Kwak and Anbari (2009); Totten (2017); Wysocki and Orłowski (2019)
	Knowledge management, lessons learnt and documentation	Edivandro C Conforto et al. (2014); Niknazar and Bourgault (2017); Serrador and Pinto (2015); Papadakis and Tsironis (2018); Totten (2017)
Perceptions	Best practices	Baird and Riggins (2012); Papadakis and Tsironis (2018)
	Opportunities	Edivandro C Conforto and Amaral (2016); Killen et al. (2012); Stoica et al. (2013)
	Challenges and bottlenecks	Orłowski et al. (2017); West et al. (2011)

3 Research method

The purpose of this chapter is to describe the strategy that was chosen to conduct the literature selection and research introduced in this work. The first section discusses the choice of literature. The following sections entail the explanation for the data collection and analysis, structure of both pilot and subsequent semi-structured interviews as well as the additional secondary research. Finally, this chapter covers the steps taken to ensure research quality and ethical considerations.

3.1 Literature selection

The selected literature was a result of a systematic review process. The process aimed to provide a comprehensive and unbiased set of relevant publications that cover the research problem (Bryman, 2016). The purpose of the literature review was to assess the dominant approaches within software and hardware development and how these two processes relate to each other in organizations. Since, the research area could be considered multidisciplinary, the review process also served to integrate different strands of literature, building bridges between the related topics and identify the central issues, as explained by Creswell (2014). Furthermore, the search was put in a context of the choice of PMM. Hence, a variety of keywords needed to be included in the search that was conducted on multiple online databases: Scopus, LUB Search. This also relates to the fact, that after conducting preliminary keyword searches, it was found that for example the same concepts are explored in findings relating to "cyber-physical systems" and "combined development", "co-development", or "integrated product development", in relation to the clash and collaboration of different subject matter expert teams during the development of a feature or function of a complex product. To better analyze the different strands of literature, (1) Project Management Methodologies and (2) their application areas were assessed separately. This was done, because while (1) discusses the general connotations of PM, the framework, the organizational controls, whereas (2) entails the practical applications and investigations of the adaptability of new approaches in different industries.

Preliminary search generated 90 172 (in Scopus) and 85 802 (LUB Search); and 2 169 (in Scopus) and 19 234 (LUB Search) hits respectively for each topic. Because the search resulted in numerous irrelevant articles and duplicates, we limited our choice to the most relevant and cited articles (filtered with the help of search engines). Then, firstly the titles, secondly the abstracts were carefully investigated before further processing. Duplicates, publications that were not specifically written about the selection and application of specific methodologies, based on the abstracts, were discarded. Following that, to find possible new insights, using a snowball sampling method, the newest citations of the most impactful articles (most cited relative to their publication date) were included in the analysis. Finally, we selected 76 articles for the PMM section (1) and 73 articles for the application areas section (2). In addition, while conducting

the research, it was identified that the topics addressed gained popularity after 2001 in multiple disciplines (Engineering, Computer Science, Business and Management, Social Sciences); and the main source of academic knowledge comes from scientific articles and conference papers (almost 60% to 40% respectively).

For the methodologies part (1) the following string keyword were included in the search:

"TITLE-ABS-KEY (((management) OR (management methodologies)) AND ((project) OR ((hybrid OR combined OR mixed)) OR (hardware OR software) OR (traditional OR plan-driven OR stage-gate) OR (agile OR agility) OR (selection))) AND (LIMIT-TO (EXACTKEYWORD , "Project Management"))"

Regarding the application area (2), the purpose was to find out about the recent developments in practice in the academic literature. Therefore, the search was narrowed down to publications that are after 2010. Multiple iterations were performed because new keywords were found during the research. This also marks the complexity of terminology applied especially in product development. Below is the final search string that included all the terms:

"TITLE-ABS-KEY ((hardware OR software OR systems OR product) OR (new OR integr- OR innov-) AND (development OR co-design) OR (embedded AND (systems OR software)) OR (cyber-physical) AND ((agile OR waterfall OR traditional OR hybrid) OR methodology) OR (selection) AND (project management)) AND (PUBYEAR > 2010) AND (LIMIT-TO (EXACTKEYWORD , "Project Management"))"

3.2 Research strategy

Ultimately, the purpose of this study is to explore the different factors that motivate why a certain PMM is adopted. In our preliminary literature review and discussions with multiple experts within Axis Communications, it was discovered that not only the scientific landscape is fragmented, PMM differs by processes, teams, organizations and industries. Exploring this phenomenon and understanding the underlying context, especially considering the different aspects of PMM are difficult to quantify and there is no one optimal strategy, we sided with a pragmatic worldview, as explained by Johnson and Onwuegbuzie (2004) and Creswell (2014). The PM research is also a central topic in the seminal work of Söderlund (2004), calling for a the investigation of projects and project organizations with multiple lens. Given the complexity of the research topic, which requires researchers to understand both human behavior and organizational processes on a theoretical and practical level, a qualitative approach is taken as of being the most appropriate for the study (Bhattacherjee, 2012). Interviews deemed to be the best way of collecting rich qualitative data that could be further analyzed, having the consequent exploratory nature of our research approach (Bhattacherjee, 2012). Likewise, we used semi-structured interviews as a guide for the data collection as it conforms to the interpretative strategy and inductive approach discussed above (Myers & Newman, 2007). This way allowed us to get a clarification and better understanding of the subjects accessed due to more conversational rather than instructive manner of the semi-structured interviews (Recker, 2012).

3.3 Data collection

The work started with pilot interviews, that helped put the preliminary findings in the literature in context, help locate areas for further dive-in and mark potential differences across different industries that further helped phrase the subsequent interview questions. The interpretive approach enables to investigate the phenomenon of PM in context, supported by the explanation of relevant experts of the subject matter, uncovering rich data and hidden connections (Bhattacherjee, 2012; Bryman, 2016; Creswell, 2014; Kvale, 2008; Myers & Newman, 2007; Patton, 2014; Schultze & Avital, 2011). As Walsham (2006) points out, interpretive methods do not necessarily mean relying only on qualitative data and findings could be supplemented by other ways of data collection. Semi-structured interviews were scheduled with participants in other companies (in the medical, FMCG, software-development, communications and consumer electronics sectors), where increasing complexity and size require systems that integrate both hardware and software, and methodologies shift from traditional project management approaches (Akeela & Dezfouli, 2018). The research method leads to the contextualization of the research problem and help understand the phenomenon in depth. In this socio-technical setting, technology, infrastructure, management approaches, beliefs and behaviors are under the lens of our research.

3.3.1 Pilot interviews

The pilot interviews were conducted with associates of Axis Communications of varying roles within PM. Hence the literature itself cannot provide a solid ground to understand the specificities of applied project management within a concrete organizational context, an additional inductive approach was warranted, assessing the most important stakeholders and decision-making process in the New Business department. After consulting the preliminary literature and a brief introduction to the department, a standard set of questions were designed to steer the conversation but provide room for detailed answers. The questions were centered around the dimensions listed in the table below.

Table 3.1: Interview guide for the pilot interviews

Dimensions and factors	Questions
Roles • **Titles, experience, responsibilities** • **Teams and interdependencies**	• What are your areas of expertise within the company? • What does your position involve?
Projects • **Methodologies used** • **Decision-making process**	• What kind of projects are you working on? • What are the methodologies used? • What is the decision-making process when it comes to selecting the ways of working? • What factors need to be considered when making decisions (i.e.: developers, teams, processes, etc.)?
Organizational development • **Measurement of success** • **Lessons learnt** • **Existence of documentation**	• What are the success factors of a project and how do you measure them? • How do you document projects? • Are there any lessons learnt from previous projects?
Perceptions • **Best practices** • **Opportunities, bottlenecks**	• What challenges and opportunities do you perceive in the current ways of working? • What are the bottlenecks in the process?

In total, five interviews were conducted in order to perceive the holistic view on the product development. The participants were chosen to represent the full outlook of the organizational processes; and are referred to as *Int1* to *Int5*. *Int1* is responsible for the PM coordination of the entire New Business project portfolio. *Int2* and *Int3* are managers of specific processes and teams, the first relating to software, the second to hardware. *Int4* is a product manager, having closer ties to sales and product development, responsible for cascading the specifications that development needs to fulfil. Finally, *Int5* is a combined large-scale hardware-software project manager with various intra-departmental responsibilities. These interviews could be considered semi-structured, according to Kvale (2008), however their use is exploring the problem, and they help set the stage for the consequent semi-structured interviews that are intended for a broader audience. The questions were open-ended and linked back to the dimensions of our preliminary theoretical investigations. The interviews were recorded via a voice recorder, transcribed, and, finally, coded with the use of the NVivo software, a process suggested by Bryman (2016) and Creswell (2014).

Table 3.2: Scheduled pilot interviews

Informant	Position	Organization	Date	Medium	Length
Int1	Head of PMO	Axis	11.03.2020	Face-to-face	1 h
Int2	Engineering manager (SW)	Axis	23.03.2020	Videoconference	45 min
Int3	Engineering manager (HW)	Axis	24.03.2020	Videoconference	45 min
Int4	Product manager	Axis	31.03.2020	Videoconference	45 min
Int5	Project manager	Axis	1.04.2020	Videoconference	45 min

3.3.2 Subsequent interviews with experts from different industries

When selecting our informants for the next round, our aim was twofold. Firstly, to gain insight in other industries, that deliver complex multidisciplinary projects, therefore we sought out informants from the medical, telecommunications, FMCG and consumer electronics industries. Secondly, for a richer and more saturated picture, the secondary aim was to include a variety of roles and responsibilities. Here, the experience and skills sought after were roles in co-development, command of a variety of project methodologies, exposure to VUCA environments, and experience in team coordination. According to Miles, Huberman, and Saldana (2014), random sampling is what guarantees the least biased outcome. However, this research is focused on a unique context and has limitations to participant access, therefore the chosen method is convenience sampling, which is another acceptable form of selecting participants as pointed out by the authors. The process of designing the interview guide followed the recommendation of Bryman (2016), who recommends starting from a broad research problem and narrowing it down to tentative questions, that are reviewed, revised by member-validating the pilot results and contrasting them to the literature. The refined guide could be seen in Table 3.3, highlighted the additional elements (with dashed underline) that are further explained in section 3.4, also reflected in the final framework seen in Table 2.2.

Table 3.3: Final interview guide

Dimensions and factors	Questions
People and processes • **Roles, experience, responsibilities** • **Teams and interdependencies** • **Communication and processes**	• What are your areas of expertise within the company? • How are the organizational units interrelated around product development?
Projects • **Scope** • **Requirements** • **Measurements and success** • **Resources** • **Methodologies**	• What kind of projects are you working on? • What are the methodologies used? • Which factors need to be considered? • How do you prioritize the backlog? • What are the key factors that indicate project success? • Is it important to measure the development process?
Organizational development • **Decision-making process** • **Maturity, culture, change** • **Planning and risks** • **Knowledge management, lessons learnt and documentation**	• Do you have fixed guidelines and methodologies? • How do you select the ways of working? • How do you link internal and external feedback back to the development process for further refinement? • How do you introduce changes in the process? • Top-down or bottom-up is the dominant source of change? • How would you describe company culture? • What are your views on project documentation? • How often did the development process change in the recent years?
Perceptions • **Best practices** • **Opportunities** • **Challenges and bottlenecks**	• What challenges and opportunities do you perceive in the current ways of working? • What are the bottlenecks in the process? • What are your future expectations of methodologies and integrated product development?

Table 3.4 lists the interview participants, who, for confidentiality reasons will be referred to as *Int6* to *Int13*. Regarding their occupations, *Int6* is a people and project leader, responsible for any digital project that is on the agenda for an international homeware retail company. *Int7* is accountable for tracking and budgeting portfolios of projects, coordinating the effort of IT finance and project management and product development, as one of the senior managers of the PMO office in a big pharmaceutical company. *Int8*'s area of expertise is setting global guidelines for IT strategy and governance in a top line pharmaceutical company. *Int9*'s area of expertise lies in innovation and new product development management, as well as leading strategy and change management initiatives, transforming the way of working in an international FMCG firm. *Int10* is a developer in a software company that is in its way of changing from waterfall to agile methodologies. *Int11* in his career has worked with high profile projects, experienced in both line management and PMMs in a major telecommunications company. *Int12-13* participants are members of the PMO office in an international consumer electronics corporation. Above interviewees represent a great variety of industries, roles and experience in the researching area, what benefits the relevance of the study (Bhattacherjee, 2012).

Table 3.4: Scheduled interviews from other companies and industries

Informant	Position	Organization	Date	Medium	Length
Int6	Project manager	HomewareRetail	20.04.2020	Videoconference	45 min
Int7	Supply-demand manager	BigPharma	22.04.2020	Videoconference	45 min
Int8	IT strategy & governance	BigPharma	23.04.2020	Videoconference	45 min
Int9	Strategy & Innovation mgr.	FMCG	30.04.2020	Videoconference	45 min
Int10	Developer	Software	17.04.2020	Videoconference	45 min
Int11	Project manager	Telco	30.04.2020	Videoconference	45 min
Int12,13	PMO representatives	ConsumerElectro	14.05.2020	Videoconference	60 min

The standard engagement procedure with the participants was to first shortly introduce the topic of the study, the research question and main purpose and ask for a short interview that is executed online. Following a positive response, the schedule was set, tailored to the participant's availability. When setting the time, the interview guide was also sent, informing the participant about a request to record the session and their rights to withdraw from participating or deny answering any questions. The videoconferencing tool was the participant's choice, Microsoft Teams, Skype, Google Hangouts and Zoom applications were used for the different interviews. Each session started with a reiteration of the topic of the thesis, the structure of the interview, the rights of the participant and the announcement that the recording will commence. Each participant was also informed, that the recording will not be used in the thesis and the interview transcripts were only going to be published once we received their consent, therefore they were given an opportunity to review the document. This was also beneficial for clarification purposes and asking additional questions over e-mail. During most interviews, both researchers were present, one leading the interaction, while the other one mediated and asked additional questions, when there were misalignments compared to the interview guide. Multiple researcher participation also helped in the following transcription and coding process. Probing technics for interviews were also used in order to unsure more thoughtful responses such as the silent probe of pausing before the following question, and encouragement by phrases as "I see", "okay" as suggested by Bhattacherjee (2012). Moreover, in the closing phase of the interview, the participants were thanked for their time and engagement (Kvale, 2006).

3.4 Data analysis

The overall approach uses the Flow Model of Miles and Huberman (1984), further elaborated in Miles et al. (2014). Segmented into data collection, data reduction, data display and verification in an iterative manner, building on constant revision, triangulation and member validation. After preprocessing the data, that is recording and transcribing the interviews, the interviews were being analyzed firstly through a descriptive coding process, where the unit of analysis are the words of the conversations, which process is in line with the literature (Bryman, 2016; Creswell, 2014; Miles et al., 2014). In a consequent coding cycle, the codes were clustered, according to the framework of the thesis. Patterns not fitting the preliminary framework initiated the literature review for refinement.

As Kvale (2008) explains, abstractions and loss of context are the inevitable shortcomings of transforming an oral conversation to written texts, that is the transcription process of interviews. The author states, that there is no dominant practice that is considered superior to others, but there are techniques to preserve reliability and validity of the information. Reliability may be improved by ensuring quality recordings and a clear structure of transcription. This work mainly

focuses on the analysis (coding) of written data; therefore, abstractions and omission were made compared to the oral conversation to guarantee a consistent, and stand-alone comprehensible interview transcript. In terms of validity, the interview transcripts were audited by both researchers, before having reviewed by the interviewee, where privacy-induced omissions, clarifications indicated further adjustments in the text.

While coding the transcripts, we followed Bryman (2016) and once the nodes were ready, we defined a general approach on fragmentation levels and assignation. Coding certain passages in a free-flow text or answer brings contextual loss, therefore, we sized the fragments to be one total interviewee answer (without interruptions). As the themes (dimensions), and nodes, but especially questions, due to the complexity of the topic, are not mutually exclusive, also, the interviewee may decide to include additional information, the fragments were assigned to multiple nodes if needed. Multi-assigned answer level fragments made the coding process fast, convenient and consistent, therefore also easily comparable across both coders.

Table 3.5: Coding schema for pilot interviews

Thematic code description	Node
Titles, experience and responsibilities	R-TER
Teams and interdependencies	R-TI
Methodologies used	PJ-M
Decision-making process	PJ-DMP
Measurements of success	OD-MS
Lessons learnt	OD-LL
Existence of documentation	OD-DE
Best practices	P-BP
Opportunities and bottlenecks	P-OB

As per the framework, nodes were created for the factors of PMM and each answer was paired to the appropriate nodes. During the coding of the pilot interviews, it became obvious, that certain passages relating to communication, culture or risk management, for example play an important role in methodology selection. In the initial coding phase, these fragments were assigned purely on the parent nodes (presented by dimensions of the framework). The assessment of these fragments, later, supported the revision of the accessed literature, with the purpose of finding theoretical backing for the identified new patterns. Refined and new nodes are highlighted (with dashed underline) in Table 3.6. The subsequent interviews were coded according to the refined coding schema, as well as pilot interviews were recoded to match the empirical findings.

Table 3.6: Refined coding schema

Thematic code description	Base node
Roles, experience and responsibilities	PP-RER
Teams and interdependencies	PP-TI
Communication and processes	PP-CP
Scope	PJ-S
Requirements	PJ-RQ
Measurements and success	PJ-MS
Resources	PJ-R
Methodologies	PJ-M
Decision-making process	OD-DMP
Maturity, culture, change	OD-MCC
Planning and risks	OD-PR
Knowledge management, lessons learnt and documentation	OD-KMD
Best practices	P-BP
Opportunities	P-O
Challenges and bottlenecks	P-CB

3.5 Quality

The quality of the interview has a decisive effect on the quality of the subsequent analysis and therefore the outcome of this work, however there are no strict rules what constitutes a good interview (Kvale, 2008). As the author puts, general criteria concern the richness of the answers provided to the interviews, length of the answers and clarifications on the interviewee statements. This work tended to these criteria by a set of guiding, open-ended questions, that are carefully administered to the proposed 45-minute duration of interviews. Making first contact with the respondents started with sharing the interview guide and providing clarification on the author's identity and purpose, furthermore, as mentioned, in the beginning of each interview, the purpose and structure of the questionnaire was reiterated. Further clarifications mid-conversation, follow-up e-mail conversations and having the final transcript approved by the interviewees helped develop a mutual understanding (Appendix B). Int6, Int10 and Int11 had remarks on certain sections of their answers to be changed or removed due to privacy reasons, which are not presented in the appendix.

Regarding the entire qualitative process, literature poses validity and reliability criteria to ensure the quality of the interview (Bhattacherjee, 2012; Bryman, 2016; Creswell, 2014; Kvale, 2008; Patton, 2014; Recker, 2012). As Bryman (2016) and Creswell (2014) phrase, this criteria can be further split into external and internal validity and reliability, which corresponds to trustworthiness in qualitative research. Trustworthiness consists of credibility (internal validity), transferability (external validity), dependability (reliability) and confirmability (objectivity). Credibility, which relates to the connection between the observations and theory, throughout this work, is ensured by respondent validation and triangulation. Transferability, that refers to the generalizability of this study is considered by using thick descriptions and broad concepts that could apply for multiple settings in general. Dependability means reliability, which aims

to ensure that multiple approaches would result in the same outcome. Taking advantage of having multiple authors for this document, each of the authors code the interviews and match results. Furthermore, the university grants a pre-submission peer review event which is also beneficial in securing dependability. Confirmability refers to the absence of personal values and theoretical affiliations in the work, which is tested by the peer reviews and the iterations between observation and theory. An important addition in qualitative research is authenticity, which, stated by Bryman (2016) concerns the impact of the research. Referring to our affiliation with Axis, as stated before, our involvement, relating this thesis, was concluded by having access to their associates to perform interviews. Therefore, the outcome of this work was not influenced by the company.

As mentioned above, in order to ensure the quality of the research findings, the interviews were coded separately by each author and then examined on the reliability. The intercoder reliability was calculated by a built-in function of NVivo (Nvivo, n.d.), that checks similarities in coding based on character count. Measuring intercoder reliability is considered to be a commonly used quality technique in social science (Miles & Huberman, 1984).

The first round of coding was conducted with pilot interviews and resulted in average intercoder reliability rate of 85%; moreover, only those segments that matched parent nodes were identified. Therefore, the comparison of the results facilitated further discussion reflecting authors' opinion on the empirical data. The approach made coding inconsistencies noticeable and revealed the possibility of using different interpretations and new nodes. Consequently, the discussion regarding identified conflicts was done to consider if codes assigned have to be revised. The intent of the discussion was to reduce personal bias and strengthen the research framework, therefore the refined framework was constructed. Thereby, this led to the refined coding schema, which was used for the second round of coding with both pilot and subsequent interviews. The results for pilot interviews (both rounds) and subsequent interviews are presented in tables (Appendix C). Second round of coding resulted in the average intercoder reliability rate of 94% for pilot interviews and 89% for subsequent interviews, which is considered as a high level of reliability (Miles & Huberman, 1984) and supports the quality of the research and coherence of the interview guide. The inconsistencies distinguished in the second round were also discussed by authors aiming for conflicts revision, and unbiased and reasoned conclusion of the coding process.

3.6 Ethical considerations and limitations

As our research is mostly built on qualitative interviews, the interviewer interviewee relations needed to be handled delicately, and attention needed to be given to ethical considerations (Kvale, 2008). According to Creswell (2014), the interviewee rights and needs can be adhered if the researcher shares their objectives and purpose, obtains permission from the interviewee to record and process their answers, informing about all data collection methods and devices. Moreover, the interview results, transcripts and interpretations are shared with the participants for final agreement. Finally, the right to anonymity is handled with the first priority when it comes to reporting of the results.

In all of our interviews, participants were informed about their rights not to participate, giving them the option to withdraw at any moment. The purpose of the report and the proposed interview questions were shared in advance, so they could carefully consider whether the subject

matter is within their area of expertise and borders no confidentiality problems. Their consent to proceed was given to us following that. Our industry participants prompted for anonymity regarding their descriptive title, name and company, hence we described them as i.e.: Big-Pharma IT strategy and governance responsible. The communication channel for both prior and during the interviews were chosen by the interviewees due to security and privacy reasons.

Regarding the role of the interviewer in their interaction with the interviewees Seale, Gobo, Gubrium, and Silverman (2004) mentions two ideal qualities: rapport and neutrality. Rapport refers to building trust and a comfortable environment for the interview participant to open up about the topic and establish a relaxed and encouraging relationship in the discussion. Neutrality means the interviewer will not bias the respondent by assuming a certain stance toward the topic. For the purpose of the research, which was prompting answers in a complex, ambiguous and many times (organization-wide) underdefined matter required the consideration of both qualities. Rapport was built by ensuring a professional, relaxed and well-paced structure, nudging, or clarifying answers if needed. Neutrality was pursued by the selection of questions and the mediation of both researchers.

For this study, twelve interviews were conducted, what is considered enough for qualitative research (Kvale, 2008). Whilst we would have preferred to have a couple more interviews, we faced difficulty in finding the contact with experts from specific companies that seemed relevant for the purpose of the study. Nevertheless, fewer interviews resulted in more thorough preparation and analysis of the findings (Kvale, 2008).

4 Empirical findings

The following chapter represents the findings and analysis of the research obtained according to the research methodology described in chapter 3. The structure of the section is based on the research framework. Direct quotations are cited from the interviews' transcripts and are following notation: Int1 (13) or (Int1:13) refers to Interviewee (respondent) 1, line 13.

4.1 People and processes

Respondents participating in the interviews to distinguish the importance of human collaboration and communication in any methodology. Depending on the position people have different requirements to the PMM, as well as the methodology selected affects all company employees, therefore, people and their communication are one of the most significant factors.

4.1.1 Roles, experience, and responsibilities

Companies have different level of hierarchy and various organizational structure, however, employees with the same roles have relatively similar responsibilities. Consequently, as understood from interviews, the position is what defines the role of a person in the methodology process. Int1(26), Int9(3) and Int7(16) highlighted that team members or management personnel initiate the transformation of the way of working. However, the project managers are the ones who have a final word on how to work (Int1:28; Int6:35; Int7:16; Int9:3; Int11:22; Int12:10). Developer's acceptance is another factor that have a great effect on the change management and should be considered (Int1:28; Int5:8; Int6:23; Int7:10; Int10:16; Int11:6; Int13:38), even though developers are not focused on the methodology as such (Int6:35). When selecting methodologies, interviewees disagree on whether experience and methodology tailoring are related: Int6(9) shared that the more experience the project manager has, the easier it becomes to tailor the methodology to the task at hand, while Int13(5) highlighted that best practice is as close to the textbook solution as possible.

"Historically the way of working has been led by project managers, with obvious inputs from line managers and team members."
  - Int1 (28)

4.1.2 Teams and interdependencies

Product development activities relate to many different teams in the organization from transforming customer requirements into codes and features, developing those features, productizing, marketing and maintaining them. This leads, especially in the context of integrated product

development, to many interdependencies between teams (Int1:2; Int3:6; Int5:4; Int6:17,19,21; Int7:0,2; Int8:8, Int12:6) and with third parties if they are linked to the value creation process, as suppliers of materials for example (Int3:8; Int4:8; Int6:3, Int8:10). Development-related responsibilities, tasks are split across teams, and it may be spread across different geographical areas. Int1(16), Int3(16), Int4(18), Int5(4), Int6(29), Int7(4), Int10(4) and Int11(4) agreed that collaboration is a challenge for an organization. Teams of different sizes and compositions of responsibilities, tasks, among other factors, affect the decision of what methodology to select (Int1:4; Int5:4; Int6:3; Int7:16; Int9:2). Some respondents related to creating process or project excellence, delegating decision making around project execution to teams, in a form of empowered, cross-functional autonomous teams (Int7:16; Int9:2). However, to guarantee the ability to scale, a framework, or scaling mechanism should be in place (like SAFe) (Int6:39; Int7:6), moreover, this approach comes with a loss of control over project execution (Int9:2).

"Also, performance should less be on an individual basis and more to be judged on a team basis."
-   Int7 (16)

4.1.3 Communication and processes

Finding the balance between transparency, plannability and autonomy is a key question that is answered differently across industries, further highlighting the importance of the interaction between employees, either in a formalized way (processes), or informally (communication) (Int7:0; Int9:2; Int11:10,14; Int12:25). Both communication and processes aim to synchronize organizational efforts and are part of the way of working (Int4:22; Int6:23; Int7:4,6). Respondents agree that communication is a key in the product development: Int6(23) expressed, that good communication, and facilitation is an internal tool to keep the project on track, while Int4(20,22) highlighted that this tool is important both externally, to align the deliverables with the customers, but also to coordinate the different departments. Especially in iterative development, communication in coordination efforts and access to customers is an enabler to successful projects (Int6:23; Int7:4).

The firms of our respondents chose different ways to address internal adherence and coordination, matching the various stakeholders, team sizes and project scope among other factors. Int9(2,4) and Int12(6,29) agree, that organizational communication should have a guiding function, nudging efforts towards the corporate vision. They do not see adherence or formality as a priority, but they require alignment on a corporate value level. Int1(8) sees communication as an initiator of change, where, depending on the rigidity of the overarching company processes, deltas (small changes to the process) can be made when necessary, these new initiatives tend to spread like viruses in the organization. The virus metaphor was also mentioned by Int7 and Int11 in relation to the informal spread of new ideas and working ways. Int2(14,24) stressed, that processes and consequently the necessary coordination is different in software and hardware projects. Int3(6,10) also made a distinction between processes relying on active decision making and straight-forward workflows that are defined by constraints such as the hardware procurement process, that is largely dependent on external providers. In this regard, iterative, multi-stakeholder processes, as Int4(8), Int5(8), Int6(21,35), Int7(4,6,8,16) all concurred, require communication to play an important, facilitative role, to secure common understanding and alignment. Int7(16) however, underlined a role of developing a common framework of communication, should the iterative approach require scaling within the organization. The need for transparency and the role of communication in it is also mentioned by Int10(16), as a

necessity that comes with the ever more interrelated and complex processes. Int7 compares project related communication to languages, where a dictionary is needed to bring isolated, departmental knowledge to project related expertise. A dictionary is needed to decipher and make communication project-relevant. This loosely follows the reasoning of Int11(4,8,10,12) who shared, that after a new working way shows benefits, communication itself, and the informal spread of new ideas must be formalized in form of processes. These processes could be put in place by the competent organizational bodies (process experts), and they are also a mandate to follow. Int8(8,10,16) believed, that especially in large organizations, many projects are launched that do not require any iterative work, leading to poorer performance. To avoid that, the corporate definition of projects needs to be changed, and a tighter control would be required over investments, shifting towards standardized processes, where straightforward workflows could be implemented.

Another aspect of communication is to ensure the connection between the organization and its external stakeholders. According to Int1(5), Int3(12), Int4(6,20,26), Int7(2,10), Int10(4), Int11(16,18) the perceived quality and utility of products or features, and the overall market success lies within having access to customer needs. The importance of communication and feedback starts with requirements setting and continues with an iterative, co-creation process throughout the project, which is based on live feedback. The term "continuous engagement" refers to being continuously connected to the customers and get direct feedback in order to better understand users' needs (Int7:6; Int11:18). Int9(10) emphasizes the need for market segmentation and building customer feedback and delivery on a representative set of customers. Companies use a different strategy in how many proxies are used in collecting the feedback, how many connection points does the information need to go through until it is received by the developer, who is working on the user stories. Noted, that proxies between developers and business may lead to the information ambiguity (Int12:33) and decrease developers' understanding of the value brought in with the project, especially in agile methodologies (Int6:29). On the other hand, as Int7(8) and Int8(6) explained, proxies might be ethical or regulatory environment, for instance in the pharmaceutical industry, when developers need to design a feature around confidential information. The ability to talk to customers and give a streamlined customer experience might also necessitate the creation of proxies between end-users and developers, as mentioned by Int11(18) and Int12(31). They further describe that developers might not be able to process requests and translate them into actionable steps, and the customer service centers, and product owners relay the information to them.

"Not too many proxies, not directly. You as a developer are most often not trained how to handle customers and things can easily backfire if you are too direct."
   - Int11 (18)

"(Being innovative) is really all about information sharing, being connected to the outside world, the ability to experiment, and ensuring psychological safety in the team."
   - Int7 (6)

Finally, as Int7 (4,6) believes, innovation is about combining coordination and external feedback in the development process, using the right communicational tools, providing psychological safety for experimentation. The process of brainstorming is always led by a group of internal project stakeholders, who facilitate the discussion for project members during their meetings, which discussion includes developer teams and representation on the business side (Int1:14; Int3:14; Int5:10; Int6:17; Int7:4; Int8:10; Int11:18). The aim is to connect various sources with different area of expertise and mindset (Int6:19,21; Int7:4; Int8:20).

4.2 Projects

Factors relating to project specifics provide the main background for the PMM selection. Project scope is viewed as one of the determinative factors for the methodology selection; furthermore, with the increasing complexity and rapidly changing market conditions, so do project requirements in recent years, provoking more agile approaches across industries. Besides, a great variety of projects and approaches exists; and it is agreed that there is no single way to deliver requirements. As there is a plethora of applied PMMs, some following the direct, textbook examples of popular methodologies, such as Scrum or Kanban, many development teams have the freedom to tailor tools and techniques to their specific need. With tailoring and the complexity of processes, so will the problem arise, if project progress and deliverables should be measured, and how a project could be considered successful.

4.2.1 Scope

In integrated product development, the development processes are split based on the technology they are working with, the first distinction separating software from hardware on a macro level (Int1:2; Int2:8; Int3:6; Int4:4; Int5:4; Int6:3; Int11:14; Int12:6). The main difference is highlighted by Int13 (40), that hardware is built in blocks in a waterfall manner, but software is a lot more fluid and many aspects of it can be changed. Moreover, hardware, by its nature is dependent on physical parts, for which procurement processes and supplier dependency leads to more costly and time-consuming changes or refinements as the development progresses (Int3:6,12; Int4:30; Int6:5; Int12:6). Apart the main distinction, if the complexity of the product requires, more functional boundaries may be created, such as between software and hardware. According to Int11(22), the development assembly of an integrated product may involve significantly more functions (including testing, firmware, security for instance), each function working on sub-modules or features of a product, each responsible for only their own scope within the entire product. These sub-project teams are manned by people of different domain expertise. As a countermeasure against the compartmentalization of development teams Int7(0) explained the creation of product teams that incorporate the entire product scope within themselves.

"I think the hardware development will be more and more like software development."
-   Int6 (49)

"I think the challenge is about understanding that there are large differences between planning and executing development in hardware-related aspects and comparing them with software. It is fundamentally different. Hardware is basically like blocks you put on each other and you can a waterfall plan work. In software, if you add something you can (still) change everything. You don't build software by adding one block on the top of another."
-   Int13 (40)

As Int6(49) and Int8(10) indicated, development of products and features may require less and less hardware elements, as solutions become cloud-based and will be simulated in order to be designed and tested. Another important factor in decision on what methodology to use is level of uncertainty (Int6:13; Int11:8). If a project has high level of uncertainty - agile principles are the best to choose; but if requirements are certain - Waterfall could be a preferred way (Int6:13). Therefore, in integrated product development experts emphasize using hybrid model that include Planning and Design phases on a high level for the whole project, while having milestones

to connect software and hardware delivery (Int6:13). Moreover, Int13(8) identified that some work is done in direction of iterative hardware development.

4.2.2 Requirements

Other than the main aspects of the project (or product), user needs are translated into actionable steps, requirements that may have an impact for each function that is supporting the project. Requirements therefore need to be introduced by the customer (Int4:24), however, depending on the project scope, additional industry regulations may apply (Int8:6). Int2 (14), Int3(10) and Int6(5) explained that requirements related to certain project components (especially those related to hardware development) need to be locked-in early on in the project as changes are resource intensive. As Int6(5,11) phrased, the requirements need to be agreed upon by all relevant functions and need to be concrete enough to allow for a high-level design. From a developer perspective, these requirements need to be communicated from a single source to avoid overlapping priorities (Int10:4). In this phase, the collaboration of functions (hardware and software) is of critical importance. The amount, complexity and flexibility of requirements therefore dictates the form of collaboration (Int6:13).

"…a typical kind of IT type project, which also is very much seen as IT doing it in isolation, (it is) based on a set of requirements that we don't even remember."
   - Int7 (4)

4.2.3 Measurements and success

Respondent attitudes towards measurements and success showed the greatest variance across all factors investigated. This also shows the ambiguity of value, success, which points to an inconsistent practice in measurement across industries. According to Int9 (2), Int1(19) and Int12 (47) organizations are built on values and principles and corporate efforts need to target company vision. This reasoning is consistent with the approach of Int7(2), who stated that projects should aim value creation and are only justified to exist while they still create value. Successful projects and project management is therefore value creating. Depending on the role or responsibility of the respondent, further understanding of success was perceived differently. Int1(17) implied that project success is more of a mutual, subjective understanding of project managers on good performance. This is because if company values are followed, then there is a clear understanding on what criteria needs to be satisfied to conclude a project successfully. Int2(18), Int3(24) and Int11(16) added, that meeting quality and timeline expectations aside project team satisfaction is required for success, which could be considered more practical, project management execution related criteria. These considerations came from project managers. Int4(14) highlighted that project development perspective and product perspectives differ. According to that statement, while the project related success is about time and quality, from a product perspective, marketability needs to be considered. Int8(14,18), Int6(19), Int4(8) attributed success to fulfilling project and product goals which is meeting customer and business needs. Int12(23) recognized two different definition of success: on a small scale, the project team should be satisfied with the work that was done and knowledge was generated in the process for the organization, but in broader terms, customers need to find utility in the project result.

Another source of disagreement is whether success could or should be measured. Int9(6) stated, that measurement is where organizational values, goals and progress meet, and it is imperative

to have developed pinnacle KPIs show what is on the horizon and where the company is headed. Int9(6), Int7(10), Int8(22) and Int12(18) agreed, that for executive alignment, this holistic approach requires a framework and an aggregation process, that is done by reporting figures which can be then made visible on a project portfolio or organizational level. The importance of measurement is also mentioned by Int6 (15), Int7(10), Int8(22), Int13(14), Int4(14) in monitoring success and auditing project investments. Meanwhile, measures exist on three levels: team, project and organizational; moreover, checks can be done either throughout the project (Int9:8), or after the project launch (Int8:8). It is also understood that team level should be linked to the core values and guide activities proving continuous improvements (Int6:15; Int9:6).

Respondent-identified practices differ, however, in whether an official framework exists, whether they focus on project progress or results, and how measures affect future decisions. From a project management perspective, the most popular measurement technique, while an agile methodology is used, is velocity (Int6:14; Int7:10; Int9:6; Int10:6), meaning to measure the periodic complexity and timeliness of development deliverables sprint by sprint. It is a team driven metric, the project team itself is in charge of designing and implementing it. For project and organizational levels interviewees distinguished measurement framework depending on department and product type (Int13:14) and OKR (objectives and key results) in order to align activities (Int7:10; Int7:12; Int13:14). A novel approach to measurement comes from realizing that the value creation does not link to project phases, rather, it is generated continuously (Int9:8). This approach, according to Int9 (8) has not been implemented in product development yet, but, contrary to prior practices, it takes probability into account in assessing project outcomes on an increment-level. The purpose of this metric is to look at the project in a more resource-cautious manner, embedding a kill-switch into each increment to stop the project and cut the losses as soon as it is indicated that the project will not be successful.

Skeptical towards the benefit of having team level metrics, Int1 (16), Int2 (18), Int3 (24), Int5(22), Int12(21), Int13(20) emphasized the drawbacks of the measurement practice: difficulty in interpretation, might lead to reward the incorrect behavior and result in interpersonal conflicts, fail to signal the right information to management in innovative environments. As Int5(22) explained, innovation requires taking risks that the project managers and teams might not take if they were under tight control of KPIs. This relates back to the psychological safety of innovation. An opposing point of view was introduced by Int8(22), who talked about the accountability for fulfilling the goals of a project. According to that, every project is launched to fulfill a purpose in value creation, and if benefits are not realized, correcting measures should be taken by the project owner. Without measurement, the benefits are also difficult to realize.

"There are strategic, tactical and operational indicators. Enabler metrics, ones that measure the team performance, product metrics, such as adoption rate, stability and financial aspects, and on the top as a North Star KPI, the targeted benefits."
-   Int7 (10)

"I derive my KPIs from SMART goals, not from Agile. (…). Then we use KPIs to measure and specifically communicate to management about how their assets are performing. KPIs can be a little bit difficult sometimes, it may drive incorrect behavior. You always need to have that in mind and have a constructive dialogue about every KPI that you need to be able to revisit as well."
-   Int13 (20)

4.2.4 Resources

Every project goes through an approval process, where the resource owners (budget and talent in the interviews) decide on the deliverables and agree on the timelines (Int3:20; Int4:8; Int5:20; Int7:12; Int8:22; Int11:22; Int12:41). The availability of resources largely defines whether a project can be launched with a specific scope and location (Int12:41, Int5:24). Resource deficiency may also create bottlenecks within the project, if the availability is not granted for the entire lifecycle (Int10:16). The practice of measuring, but at least benchmarking is crucial in this process, because resource allocation is an alignment between different organizational bodies (Int4:8; Int5:20; Int7:12; Int8:22; Int10:6,12,16; Int11:22). Moreover, as Int7(12) and Int8(22) hinted, industry specific conditions may require prudency in investment management, therefore resource allocation, which limits the selection and approval of projects. Resources may be bound geographically or by time, and if organizations have international access, they may decide to launch projects in the most beneficial environment (Int12:41).

4.2.5 Methodologies

Methodologies could be understood as pre-existing paradigms in choosing the PMM for a specific project in an organization. The PMO office or executive management may pre-select certain approaches that are to be used within the organization, because they need to make sure that a consistent approach is followed throughout the firm, where this guidance could be a formalized framework, or a list of accepted methodologies (Int1:4; Int6:7; Int7:6; Int8:6; Int10:4; Int11:4; Int13:5). Even though, project teams were reported to be free to choose their way of working to a degree, it was found in the interviews that there are clear preferences depending on the scope: for software projects, agile methodologies are used, while hardware development follows a stage-gate (Waterfall) approach (Int1:4,6; Int2:12; Int3; Int5:4,6; Int6:3,11; Int12:6). This is in addition to the project scope, because the selection of a specific way of working for a project is limited by internal factors (methodology paradigm and hardware legacy for instance) and external supply of tested methodologies. Interviewees mentioned that potential new methodologies need to be proven before their introduction to the corporate environment. Int12(44) described their environment as only a follower of methodology pioneering companies, while Int11(14) explained that new approaches are often inspired by the competitors. Corporations may allow for experimentation in tailoring and designing new ways of working, although these experiments are incremental in nature, follow a strict approval process and have a local focus with limited scalability (Int1:26; Int6:39,41; Int7:6; Int8:8; Int11:2; Int12:6). It was found that Scrum and Kanban are the methodologies selected for the software and firmware development (Int1:6; Int3; Int6:3; Int7:6; Int8:6; Int10:6; Int11:2; Int13:5).

"It is very easy to do Agile the wrong way. An example is when you take on more tasks during the sprints. Or another typical pitfall is when you start estimating the tasks in time. It is also key to have solid competences on the manager roles, scrum master, product owner, project manager."
   -   Int10 (16)

"Some of the things that we do are inherently suited out of legacy for working in a waterfall model. Things that are newer are much simpler to adapt or start off in an agile way. In general, things that are closer to hardware or hardware-driven are much more likely to have a waterfall overarching set of rules. There is a lot of legacy in that, but also because hardware development

is inherently not so agile as software development. It is simple to change software, but hardware design can be difficult and costly to change."

- Int12 (6)

"If you have the mindset, you will not follow the methodology strictly. You will rather take things that you like and develop your own methodology - customize it to something that works for you. But the right mindset is the hardest thing to get."

- Int6 (43)

4.3 Organizational development

The core existence of every project is to create value. Value, from an organizational perspective also means that through projects, capability is built to execute tasks like project scope more efficiently in the future. The project, therefore, creates new knowledge and converts the project team's tacit knowledge into corporate know-how. The way how each project, organizational entity or the entire corporation captures and integrates know-how plays an important role in project expectations and execution too, therefore it links to the selection of methodology. The decision-making process defines how methodologies can be introduced in the organization. The more processes and rules there are in the organization around PMM, the less room there is for the project teams to experiment. Selecting a new PMM means introducing change in the organization. Resistance to this change was identified to be dependent on process maturity and organizational culture among personal attitudes discussed earlier.

4.3.1 Decision-making process

The corporate decision-making process, which initially decides on corporate values, selects frameworks for ways of working, but also has a control process in place to align corporate efforts, make executive decisions, allocate resources and initiate changes of magnitude (Int1:20; Int7:0; Int9:10; Int10:4; Int11:4; Int12:6). Multiple interview participants shared that their current way of working is a result of a recent executive change, where the firm changed from a stage-gate approach to become more agile (Int1:14; Int6:7; Int7:4; Int10:4). Measurements, KPIs, customer feedback, business results and employee feedback are influencers of these high-level decisions (Int4:14; Int1:16; Int6:19,21; Int7:6; Int8:14; Int9:4; Int11:8). Even though, such top-down decisions may lead to intra-organizational frictions (Int6:41; Int10:4; Int11:2). As Int9(2) added, transformational change initiatives are the result of a paradigm shift in management, as executives realized that more freedom and authority should be given to departments and project teams to select their ways of working. When comparing top-down, transformational and goal setting decision making to an execution-oriented bottom-up method, it was identified that both ways are necessary in organizations. Int6(35) argued, that sometimes top-down approach is necessary in order to define a guideline or make a change which developers themselves could not do. Furthermore, non-regulated bottom-up development leads to inconsistency and causes collaboration issues (Int7:16). Int9(3) stated that processes cannot be entirely top-down, because it inhibits adaptability and blocks experimentation and innovation (Int7:6,16).

The received answers showed difference, depending on the level of freedom that was given to project teams. There was general alignment that project execution related tasks are decided by the project executives (PM or product manager) (Int2:26; Int6:7; Int7:2; Int10:4; Int11:8;

Int12:6). The level of freedom in this regard could be understood as how much they can deviate from the corporate guidelines and processes, while less interconnected teams in less regulated environments, especially with a software focus have more freedom in leading execution (Int2:24; Int3:22; Int6:7; Int11:8; Int12:6). Nevertheless, one of the most important aspect of execution, the backlog-prioritization is still a result of project stakeholder consensus, that sometimes involves more executive participants, such as product managers, department heads and project portfolio managers (Int2:24; Int3:22; Int4:22; Int5:14; Int8:12; Int10:6; Int11:8; Int12:10). Int3(20), Int4(16), Int5(14), Int7(4), Int8(12), Int11(22) made a distinction between project execution, and overall product level decision making, including resource allocation, where the latter also serves as an escalation forum. This forum acts more like a stage-gate driven steering group and less like a sprint meeting, therefore is closer to traditional methodologies (Int5:14; Int7:4; Int8:12; Int11:8). This also limits the efficacy of selecting project management methodologies on a lower level decision making unit. It was identified in the answers of Int7(4) and Int9(2), that large scale agile transformations also impact product or organizational level decision making, for instance, the introduction of Scrum of Scrums in the company of Int7.

"The other thing is that if you are just allowing (processes) to evolve and organically grow that will not work, because you will breed inconsistency."
- Int7 (16)

4.3.2 Maturity, culture, change

In most of the conversations with the industry experts, interviewees referred to themselves or generally all associates as being part of a collective corporate culture (Int1:16,18; Int3:10; Int5:22; Int6:45; Int11:2,6). The organization could be thought of as a collective of people who work towards a corporate vision and develop a shared understanding of what is the conform way of this collaboration (Int7:16; Int8:20; Int9:6; Int11:2,6). If a new methodology is inserted in this environment, pre-existing culture is a factor that affects adoption, and it is one of the most difficult things to transform (Int7:16; Int8:20; Int9:6; Int11:2,6). For instance, on an executional level, purely following a new way of working, without understanding the purpose largely limits the methodology's potential benefits (Int10:16; Int11:6).

To be susceptible to change, the culture needs to be open to new ideas and experimentation, fostering this might require the redesign of reward systems or education that shows what is the most beneficial behavior in the new methodology (Int1:16,18; Int6:45; Int7:16; Int9:6; Int12:37). As Int13(38) explained, it is difficult to talk about one culture that applies to all of the organization, but the culture is more of a network of interlinked sub-collectives, particularly if the organization has a functional and geographical spread. Int11(2,6) added that functional rigidity also plays a role, because if an environment historically did not experience change (a mature function where things are set in stone), it is likely that employees working there appreciate things the way they are, and therefore are resistant to novelty. Int7(16) and Int11(6) agreed, that there are individuals who cannot adjust to the new methodology and employee-fluctuation is required and natural in adjusting the culture. Due to human nature, Int7(16) also suggested, that change needs to be enforced to take effect, and there is a "tipping point" after which the new methodology becomes an organic part of the organization.

"The right way of working is not about understanding what is happening at the moment but seeking alignment with the vision and aspiration of the organization."

- Int9 (2)

"It (new agile way of working) faced and still faces a lot of resistance as they try to put it in practice, the resistance mostly coming from senior associates, who got accustomed to the old and proven ways of working."
- Int11 (2)

4.3.3 Planning and risks

Planning requirements and organizational risk appetite has an impact on how methodologies are accepted. As Int10(6) explained, business plans might determine the number of releases and could go against the pace that an iterative, agile development would indicate. Planning is also important with regards to determining critical and non-critical features and in the assessment of cutting the scope for certain release phases (Int11:16). As uncertainty is a big driver of business transformation, it is a requirement for new methodologies that resource needs, dependencies and results are plannable (Int7:0; Int8:14; Int9:7). Plannability and risk mitigation support executives in managing big portfolios, and they are also important factors in executive buy-in (Int6:11; Int7:4; Int8:22; Int9:7). Tactical planning, continuous customer engagement and mid-development, continuous monitoring are possible techniques (Int12:12; Int10:6; Int6:11; Int7:4; Int9:7). On the other hand, this factor also relates to the industry, project scope, organizational risk management and resource intensity (Int9:7; Int7:0,2,4).

4.3.4 Knowledge management, lessons learnt and documentation

More interviewees agreed that one of the most value-adding outcomes of projects is the generated knowledge throughout the project journey (Int7:14; Int8:20; Int12:23). Knowledge management, however, is seen as a challenge for most organizations (Int1; Int6:27; Int7:14; Int8:20) but is extremely important in order to increase efficiency in the future (Int7:14). The idea of knowledge management is to deliver lessons learnt and newly gained knowledge to each relevant company member (Int7:14). Lessons learnt are living documents and need to be extended with incoming releases (Int11:2). However, it is a difficult task due to data storage complexity (Int6:27), as well as ambiguity of knowledge execution (Int9:4; Int11:24).

There are multiple ways to share the knowledge within the organization, depending on the project team structure. Firstly, it could be inherent, if the teams do not change in personnel and work together regularly on a multitude of projects (Int7:14). Another option is to be built on spoken conversation for co-located teams where the team set-up is changing (Int1:42). To ensure adherence and utilization, as interviewees mentioned, management may decide to include it as a project closure or kick-off procedure, where project managers confer and present their learnings (Int8:24). It could also be stored on corporate-managed cloud solutions (such as Microsoft Teams, Confluence, SharePoint among other tools), and access could be granted to relevant individuals to the files (Int1:46, Int6:31; Int8:24; Int10:14; Int12:25,27). There is a community-based approach, where internal corporate social networking is used to form enthusiasts around a certain topic (Int7:14). Lastly, project teams may decide to only have retrospective sprints as knowledge management practice, when they discuss key learnings (Int10:14, Int11:24).

The practice of keeping written documentation also raises concerns about the maintenance and utilization of such repositories (Int1:46; Int6:31; Int7:14; Int8:24; Int10:14; Int11:24; Int12:27). Concerns included the maintainability of different repositories and storages, incompatibility with legacy systems (Int1:46). Furthermore, it was stated that most project managers do not voluntarily check the repositories of past projects, searching for similarities (Int6:31; Int8:24; Int10:14; Int11:24). Even if there is a kick-off process around it, most learnings may be relevant only on a local level, or too general to be adopted for global projects (Int12:27). Most importantly, there is a chance that information turns into noise if the communication channels are not maintained properly (Int7:14). It is highlighted that documentation should be concise, should have a light structure and contain graphical elements, while having little text (Int6:27; Int12:27). It should be easy to the find necessary information, ideally it should be search engine optimized, providing relevant hits for the sought keywords (Int1; Int6:33). There should be a person responsible for data storage management (Int11:2), otherwise there will be a congestion of files that bring no value (Int7:14).

"Projects collect the lessons or things that we need to improve for the next project. Then we put this knowledge together in some sort of presentation and then in a report. That is then consolidated on a higher level. We don't pick all, we pick a few that we think we can achieve and then we go for that. We have a formalized process for this."
   -   Int12 (27)

"It's not just a challenge that we have, it is a challenge that I have seen in again and again in other organizations."
   -   Int7 (14)

4.4 Perceptions

PMM is a highly opinionated, ambiguous field, therefore, to gain further insights on what experts think are topical issues around PMM, they were asked about their personal views. Below is the collection of findings on main issues or bottlenecks within the interviewees' specific environments, opportunities where there is a potential way of doing things better, and practices that respondents think are being executed according to up to date PMM or industry knowledge. As we stated, interview fragments in this dimension are also categorized in different dimensions, since every best practice, challenge or opportunity relates to either people, or process, project or organizational dimensions. Therefore, this dimension serves as a summative representation of already introduced patterns in sub-chapters 4.1 through 4.3.

4.4.1 Best practices

The summary of interviewee-provided guidelines for PMM selection and project delivery can be found in the below table. It answers the question "How *should* PMM be selected and what are the important aspects to consider throughout the progress of the project?". Almost all interviewees provided input based on their experience in development, project execution and supervision from multiple industries. Most of the answers concerned the tailoring of methodologies, communication of requirements, alignment of stakeholders, continuity in delivering value and flexibility to change the approaches any time the environment indicates it.

Table 4.1: Summary of best practices reported by interviewees

Best practice	Reference
• Conceptualize the project with corporate values and goals in mind • Build a balanced portfolio of projects that have defined goals, focus on value creation and target all relevant customer groups • Involve all relevant processes and departments, select the right competencies in the project leadership team, keep a lean team structure, but establish resource availability • Give freedom to the PM to tailor methods to the task, combine various methodologies and initiatives • Choose agile methodologies for iterative, highly uncertain environments; use Scrum for developing new features for software, Kanban for maintenance related activities and stage-gate methodology if hardware is predominant, while carefully selecting all aspects of the methodology • Have the baseline of the project well set, ensure transparent communication, facilitate meetings carefully and be open to adapt • Make sure that requirements are translated to actionable steps, relay the information through a single source to the development teams, have the information flow through the least amount of proxies (starting from the customer) • Build the backlog with a both business and developer mindset, include corporate values and use the relevant KPIs to drive the prioritization, enable the contribution of all relevant departments • Have interconnected milestones for HW and SW efforts • Create an innovative environment by providing psychological safety for experimentation, adjust the reward systems to promote the right behaviour, stay connected to the outside world • Create a continuous engagement with the customer, deliver and test iteratively, take the feedback back in the development process, have the customers talk to associates trained for customer-facing tasks • Support executive decision making by continuously and transparently reporting project status, carefully selecting and publishing relevant KPIs • Facilitate post-implementation reviews, use an easy structure, focus on the key learnings and failures, have the results documented, searchable and accessible by the relevant parties	Int1 (6,8,26,36), Int4 (18,22,28), Int5 (10,12,24), Int6 (7,9,29,35,41,47), Int7 (4,6,8,14), Int8 (14,24), Int9 (2,9), Int10 (16), Int11 (14,18,26), Int13 (5,20)

4.4.2 Opportunities

Below, interview-answers were summarized based on potential, but reportedly unexplored improvements in methodology selection, project management and execution. Recurring topics are upskilling to foster the right mindset for change, utilizing the access to global talent and scaling teams beyond the tech domain, reconceptualizing project portfolio in an increasingly software-driven environment, novel techniques in measurement for better resource allocation, adoption of hybrid PMM to effectively manage combined projects and knowledge management driven by centers of excellence.

Table 4.2: Summary of opportunities reported by interviewees

Opportunity	Reference
• Agile coaches, external providers could help upskill associates and develop the right mindset, gradually adopting well-proven methodologies means less risk for the organization. • Inter-connected organizations have access to talent globally, launch and experiment with initiatives where the environment is most beneficial; utilizing scaling framework, the concept of product-teams could be extended beyond the technical domain, representing the holistic values and goals of the organization. • The realization of HW technology becoming more cloud-based and modular, and the dynamic growth of SW technology may lead to the reconceptualization of organizational technology-preferences, consequently rethinking project portfolio. Introducing better requirement setting, inter-coordination of different functions, faster alignment and automations in development and testing could mean more flexibility in development. This could support continuous delivery and better adaptability to changing market needs, potentially forecasting resource requirements. • OKRs could be introduced for inter-team coordination, connecting values to deliverables and continuous ECV-type metrics could monitor project performance on an incremental level. There are potential new solution providers for simplified portfolio management and reporting, creating more transparency around project investments. • A hybrid model could potentially be beneficial for combined development projects, where there is clarity on timelines and deliverables, however there is room for experimentation and iteration, and the model is not over-encumbered with metrics or control measures, providing freedom for methodology tailoring. • The knowledge management process could be managed by CoE teams, who champion cross-functional efforts. Documentation should consistently include ways of working, processes used in projects, the timely evolution of velocity, the benefits realized and should be search optimized.	Int1 (2,19,59), Int2 (28,34), Int3 (10,22), Int4 (24) Int5 (6), Int6 (25,33,45,49), Int7 (0,6,12,16), Int8 (28), Int9 (7), Int11 (10), Int12 (41,44), Int13 (43)

4.4.3 *Challenges and bottlenecks*

The below table summarizes the difficulties organizations are facing when changing the ways of working. Respondents shared aspects that *should* be done better from their perspective. Common themes are found in clashing personal, functional and executive agendas, the paradoxical concepts of PMM selection freedom and organizational consistency, capacity-planning of inter-connected teams, debated efficacy of project measurement and need for scaling knowledge.

Table 4.3: Summary of challenges and bottlenecks reported by interviewees

Challenge or bottleneck	Reference
• PMs are focused on methodologies instead of goals, which leads to an introduction without the reason behind it. • Methodologies might collide with business goals, particularly in case of combined projects, where stakeholders might have clashing priorities; overruling executive decisions might be driven by reasons outside of the project authority.	Int1 (2,18,20,22,34,38… …42,44,46,48,52), Int3 (8,10,22,26), Int5 (4,18,22,24,26,28), Int6 (31,39,41,43), Int7 (0,14,16),

- New methodologies create complex systems that are difficult to navigate, because multiple functions need to be aligned and a complex scope needs to be managed (both HW and SW elements). - The freedom of selecting PMMs, the uncontrolled spread of new methodologies has a mostly local, sporadic focus, without a framework in place to scale up new working ways, organizational inconsistency might occur, particularly in growing organizations. - It is difficult to change and tailor processes on an incremental level, most non-transformational change initiatives focus only on pain-points; however, open processes (especially in HW environments without clear requirement setting) may need to slow and costly iterations as interdependencies need to be monitored on a modular level. - In a purely project environment, idle periods might occur, in-between project closures and openings; when the project teams are inter-dependent, but have different processes capacity constraints or have unmet resource-needs, they may bottleneck the entire project pipeline. - Not meeting customer requests (either due not delivering on time or on quality) could exacerbate intra-organizational relations, particularly between development and business, which potentially decreases sales potential, as sales teams might lose faith in the product. - Following a project-end, if evaluation focuses on execution, benefits might not be realized as the team disbands, and the responsibility is handed over to the problem/project owner or maintenance teams. - A measurement system is difficult to build and implement, as organizations struggle identifying, measuring, reporting and interpreting KPIs, with further emphasis on their effect on individual behaviour, the identification of "good enough" (timely and quality) performance is needed. - Even though electronic project documentation repositories are created and informal guidelines instruct the use of already existing knowledge, PMs do not incorporate them in their project kick-off process; well-structured, concise, relevant, safely-stored and searchable lessons-learnt documentation is a well-known need across multiple industries. - Adoption and adherence of new working ways requires having the right mindset, which is difficult to achieve, moreover depends on the working ways of sub-organizational entities and departmental maturity. - There is no set of guidelines to follow to identify the right technology, capabilities and talent due to the VUCA environment.	Int8 (14,22,24), Int10 (6,16), Int11 (6,8,24), Int12 (21,41), Int13 (20,40)

5 Discussion

In this chapter, the empirical findings are compared to literature, contrasting the expected results of factors in PMM selection with the evidence from the different industries. The discussion follows the dimensions of the research framework, except for the subjective "perceptions" dimension, which, to avoid repetition, will not be discussed in this chapter.

Our findings, confirming the literature, indicate that the selection of PMM plays an important role in project success, moreover, PMM is interconnected with many additional factors around the organization. Considering the literature and interview participants both suggested, that this phenomenon is not specific to industry, but it is more prevalent in a context where the development concerns multiple functions that are managed differently. The problem which is therefore faced by a multitude of organizations is to effectively combine corporate resources, keep ahead amidst rapidly evolving technology and stay adaptive to sudden changes in the external environment while ensuring business continuity. This study focused specifically on organizational environments where the combination of SW and HW technologies play an important role in value creation. As Ciric et al. (2018) and Dikert et al. (2016) concluded, carefully selected methodologies contribute to organizational success in innovative product development. However, as the authors pointed out, scientific evidence is lacking, as most results are driven by isolated initiatives, where industry experts investigate enablers and challenges from a subjective point of view. Therefore, the thesis, following the structure of prior, but recent literature in project success criteria and combined product development (Almeida Ferreira et al., 2019; Bergmann & Karwowski, 2018; Fernando, Nelson, & Sandra, 2019; Pace, 2019; Totten, 2017), analyzed the relation to PMM selection from three main dimensions of the different aggregation levels within the company (people and processes, projects, and organization). Our dimensions and related findings show a significant overlap with the latest research in the field (Almeida Ferreira et al., 2019; Atzberger & Paetzold, 2019; Bergmann & Karwowski, 2018; Ovesen, 2012; Totten, 2017).

5.1 People and processes

The people and processes dimension investigated employee interactions in isolation of the technical aspects of a project and organizational-level control layers. Interview-findings indicated, that regardless of domain-specifics, similar roles and responsibilities could be found in different industries: developers, project managers, line managers, product managers, who are primary, and higher management personnel, business-side associates who are secondary stakeholders of project teams. According to Cesarotti, Gubinelli, and Introna (2019), the PMM techniques define specifically which roles are needed to deliver projects, therefore selection of new PMMs may require transition in the organizational roles. Evidence of such transition can be found in the interviews, as well as in literature (Jovanović, Mas, Mesquida, & Lalić, 2017; Ljung & Udesen, 2019). The responsibilities and interactions create a matrix, where the line manager takes charge of the workforce, while project manager and product owner together are responsible for delivering the project (Cesarotti et al., 2019; Jovanović et al., 2017; Ljung & Udesen, 2019). (Jovanović et al., 2017) further explains, that the project manager is responsible for

executional aspects, while the product owner is the bridge in-between development and business. As their efforts are integrated in higher corporate workflows, the involvement of management is also important (Jovanović et al., 2017; Ljung & Udesen, 2019). Also evidenced by the interviews, large-scale shifts in methodology are initiated by management, as seen in (Jovanović et al., 2017), regardless, they might still pursue an opposing, more bureaucratic approach compared to emerging agile initiatives (Ljung & Udesen, 2019). A conclusion from the interviews is that the power dynamics of these roles are largely dependent on other organizational, project level factors. Another finding from the interview answers, also confirmed in (Jovanović et al., 2017) and (Ljung & Udesen, 2019), is that the responsibility over PMM techniques may be assumed by the line manager, mostly in smaller less-interconnected teams. The roles therefore need different competencies to fill, the line manager roles shifting towards people leadership skills, the product owner with a holistic domain and business-oriented skillset, while project managers focus more on PMM execution (Cesarotti et al., 2019; Jovanović et al., 2017; Ljung & Udesen, 2019).

Schmidt et al. (2019) concluded in their survey study, that current practice in NPD shifts towards a collaborative approach, meaning more and more teams working off a shared backlog, as products become more integrated. According to the authors, this phenomenon on one hand require general knowledge and collaborative skills, however as product features also require highly domain specific knowledge (mechatronic products particularly), there is an increasing need for highly specialized employees as well. The need for specific knowledge is also marked in our interviews.

Mindset, buy-in, are both all key enablers of successful collaboration in an NPD environment, mentioned as one main challenge in all recent research (Atzberger & Paetzold, 2019; Ciric et al., 2018; Schmidt et al., 2019). According to the authors, the new working ways require adapting personal attitudes, more freedom on an individual level, but more responsibility for the team. The concept of "teaming" was also identified during the interviews, including the fact that it is the team's performance and not the individual's that should be measured and rewarded. Atzberger and Paetzold (2019) also emphasized that this comes with a loss of control on a management level, as teams start acting autonomously. Undiscussed in the literature, but important finding in this thesis, is the juxtaposition of freedom and structure in the role of the project manager. On one hand, according to our interview respondents, most organizational environments foster experimentation in selecting ways of working, however there is an increasing demand towards project teams to incorporate all stakeholder needs and ensure continuous alignment. This is combined with the rigidity of certain, more HW focused corporate processes and a still traditionally operating management. Therefore, a possible explanation of an issue marked by Schmidt et al. (2019), and also extracted from interviews in this thesis, which is that methodologies are implemented without the reason or understanding behind them, is the illusion of freedom in PMM selection. An inexperienced PM, unaware of inter-corporate specificities, might disregard certain factors when selecting the ways of working which would potentially result in not meeting product goals.

Our thesis suggests a further remark regarding the relation upskilling and resistance. It is the middle or high management's mandate to transform organizational ways of working, but is also a question of developer acceptance whether they conform to the new rules, suggesting that the entire organization is subject on upskilling on the new PMM, if the effects are global (Almeida Ferreira et al., 2019; Atzberger & Paetzold, 2019; Jovanović et al., 2017; Ljung & Udesen, 2019). However, our interview respondents concurred, that it is not only a matter of upskilling,

but personal attitudes and change resistance may play an even bigger role. Here, more senior associates (who assumingly are better equipped with domain knowledge) could possibly be more reluctant to change, and as interviewees shared, there is a tendency of increased employee attrition during times of transition.

Regarding the process environment and communication of the organization, Atzberger and Paetzold (2019) stated, that introducing new, agile PMMs into a traditional organization leads to interface problems between the departments, to which processes need to adjust. An addition to this reasoning, our thesis found, that the agile PMMs tended to overrule process rules, and opt for creating workarounds for faster and better project execution. This could potentially be another aspect to investigate, whether traditional control-mechanisms are uniformly impacted by the shifting ways of working. Our respondents shared ambiguity in this regard, as on hand, to boost adherence, new ways of working could either be quickly formalized as processes, but on the opposite end, in an increasingly agile environment, processes might be exchanged for inter-team alignments in a more dynamic fashion. Evidence for the emergence of informal networks is also marked by Palmqvist and Trifunov (2019).

Another aspect of communication, also one of the biggest enablers of project success is customer engagement (Almeida Ferreira et al., 2019). As indicated in our interviews, it could be thought of as continuous, external communication. Relating to the responsibility of this activity, it is debated whether development teams should have direct access or get feedback with a least amount of proxies from the product owner. Depending on customer accessibility, regulations and other industry variables, direct access might be warranted, to maximize velocity.

5.2 Projects

The project dimension entailed all factors directly linked to the project, technical aspects, such as scope, requirements and resources, moreover the project management paradigm followed by the organization, that explains how the organization interacts with the projects: measurements and pre-existing methodologies. Consistent with the literature, the empirical findings highlighted, that the project scope (what the project aims to deliver) is the main decider in finding a suitable methodology, however it was emphasized, that many other (inter-dependent) factors play a role.

The first distinction that needs to be made within new product development, or combined development is the share of physical or mechatronic components within the development (Atzberger & Paetzold, 2019; Ciric et al., 2018; Palmqvist & Trifunov, 2019; Schmidt et al., 2019). As the authors state, these components follow different procurement procedures, production cycle, testing and certification process, which means rigidity. Furthermore, as per the authors, this rigidity leads to stage-gate methodologies as preferred PMM. Contrarily, non-physical product elements can be conceptualized, designed and reworked much faster, agility as a way of working was first applied on SW development (Ronkainen & Abrahamsson, 2003). Practice and literature, however have made significant progress in the recent decades, and starting from experimentations within software and embedded software (Ronkainen & Abrahamsson, 2003), to full scale agile transformations in the manufacturing industry (Sommer, 2019). The transformation has evolved beyond isolated pilot experiments and is now in motion to change the way entire organizations work (Schmidt, Weiss, & Paetzold, 2018).

However, the biggest challenges in transforming traditional procedures remain close to the core of hardware development: to suit newer, incrementalistic PMMs HW development must overcome the constraints of physicality, as Atzberger and Paetzold (2019) phrases. These constraints include defining the MVP, modularizing, prototyping, access and production, certification process and synchronization with other processes (Atzberger & Paetzold, 2019; Garzaniti et al., 2019; Palmqvist & Trifunov, 2019; Schmidt et al., 2019). The conducted interviews reflected these challenges, however they also showed further complications. While the share of hardware components in cyber-physical is a good indicator, whether the product delivery could be tailored for agile methodologies, it does not speak of other scope-specific factors. As the interviewees stated, software product could also have contingencies relating to compatibility, interconnectedness with HW elements, supplier dependency, testing and certification requirements depending on industry and purpose. As a result, project-by-project, the careful investigation of the product architecture is warranted (Palmqvist & Trifunov, 2019). Bridging disparities between the functions showing rigidity and functions fit for pure agile methods, hybrid models are developed, although, according to a recent survey, they do not see a high share (Schmidt et al., 2018). Regarding the future outlook, it was concluded from our interviews, that the share of SW related components in complex products is increasing, while cloud solutions become increasingly available to substitute HW technology. Furthermore, there is an increasing trend in modularizing HW components, making incremental building more available (Palmqvist & Trifunov, 2019).

Linking back to the constraints of physicality, one of the key enablers mentioned in literatures and discussed in the thesis' interviews is effective requirement setting (Atzberger & Paetzold, 2019; Ciric et al., 2018; Totten, 2017). Interview participants stated, that the roadblock in defining what an MVP is, what are the steps in the development to achieve it and how to work with inter-related teams happens early on in the project. In the conceptualization phase of the project, requirements need to be clear on what is the expectation of the HW components and to what extent they could be changed over the lifecycle of the project. These requirements, stated as well in the interviews, need to reflect business goals (both corporate and customer aspects) and they need to be aligned across SW and HW teams. Both literature (Schmidt et al., 2019) and interviews emphasize the role of the product owner in managing customer feedback, alignment and domain specific knowledge to oversee the entire process and continuous delivery in order to keep release cycles short. It also needs to be mentioned, that as interviewees stated, the goal is not to transform HW development to be more like Agile, neither is to tailor Agile to be uniformly suitable for HW procedures for successful product development. This is where the other factors play a role. In an environment, where the market needs are well defined and unchanging, so are internal resources readily available with clear processes, an automated stage-gate model might be suitable. Continuous engagement, iterations or short delivery cycles are not needed if the environment does not require so. Implications of such requirements and access to them, therefore, also play a role in PMM selection.

Interview participants shared, they find traditional, stage-based, rigid budgeting and measurement systems unfit for their current ways of working. Classical value-based management (Koller, 1994), which cascades quantifiable, long-term corporate goals into strategic, tactical and operational targets top-down, could be ill-suited for today's business environment (Cooper & Sommer, 2020). Running and maintaining projects, making investment decisions, allocating resources requires the management of corporate investments, often aggregated on a portfolio level, where each initiative might have an amount of funds allocated, and decision are made centrally (Cooper & Sommer, 2020). This was also reflected in our interviews, as they detailed

that executive level project discussions were run in a traditional, steering-group manner. The projectization of corporate efforts, incremental delivery and experimentation, and loss of control of management do not support a purely centralized, yearly budgeting model anymore (Atzberger et al., 2019; Atzberger & Paetzold, 2019; Cooper & Sommer, 2020; Schmidt et al., 2019; Sommer, 2019). As the interview participants agreed, on many occasions the project costs, delivery time and market reaction could only be estimated, having a fixed budget or strict, time-bound profitability expectations. It is a paradox case of the inability to justify investments for the product, however the corporate value driver is indeed the product.

To overcome this difficulty, interviewees suggested taking a holistic approach in redefining corporate goals and measurement system. Accordingly, relating to literature, Cooper and Sommer (2020) suggests three techniques to provide executive support, ensure buy-in and the allocation of necessary resources. Firstly, the measurement system should be project and project-team linked and should relate to sprints or increments. This technique relates back to requirement setting, scoping and defining the backlog as well, since these elements are the best approximations to project completion (Cooper & Sommer, 2020). Secondly, using these incremental indicators and comparing them to expected profits creates visibility of how the project is doing against expectations at the end of each increment. Expected profits are assigned to a set of probable outcomes with an approximated probability. If the probability-weighted project value is below a set tolerance bound, it could (or should) be ceased. This technique could not be considered new and resembles real option pricing techniques which have been popular in the pharmaceutical industry for example, when estimating the financial outcome of R&D activities (Brandão, Dyer, & Hahn, 2005). Thirdly, having a consistent approach to incremental measurements and translating project status to financial figures, strategic budgeting techniques could be utilized (Cooper & Sommer, 2020). Instead of a fixed budget, a portfolio of projects (or bets) could be allocated to a moving fund and could receive funding based on corporate values or meeting incremental expectations.

Even if methodologies could be tailored, and companies foster the mindset for experimentation, while providing project managers the freedom to decide over the right ways of working, there are a few paradigm-related limitations to it. PMMs could be thought of as philosophies, loose guidelines of dealing with issues, setting an order and building a common understanding (Waldrop, 1984). As with every worldview, personal preconceptions or bias might affect the choice. It was found during the interview and in the survey of Schmidt et al. (2019), that organizations might also want to opt for well-proven methodologies, if they are inexperienced with adoption. Without a well-thought out transformation plan, it is less likely that they would deliver complete freedom for methodology selection. Furthermore, it was found in the survey, literature and our interviews (Atzberger & Paetzold, 2019; Ciric et al., 2018; Dikert et al., 2016; Schmidt et al., 2019), that there is a clear preference for Scrum in plannable and Kanban in less plannable activities that enable agile ways of working. Another finding of the survey is that the more acquainted the organization is with agile methodologies, the more likely it is that it designs its own specific version of PMM. Due to risk mitigation and alignment perspectives, not every corporate environment enables a complete free selection of methodologies, and they might prefer adherence to their preferred methodology-providers (project management consultant firms), which was remarked in the interviews.

5.3 Organizational development

The third dimension of our research framework dealt with factors attributed to the management and beliefs of the organization as collective. The literature also identifies this category, although it might wear another name, depending on which factors are considered predominant. The articles saw it either as a success factor or challenge to tackle. This thesis makes no distinction, based on the following reasoning: if something is required as an enabler, that is a synonym expression to the necessity of overcoming a hindrance. Ovesen (2012) titled this category "Education and Maturation", stating that new methodologies should be established on a collective, cultural level. Totten (2017) called it "organizational factors" and relate to the industrial and organizational acceptance of novel PMMs. Bergmann and Karwowski (2018) named it "organizational" factors and they relate to management commitment, organizational environment and team environment. In the study Almeida Ferreira et al. (2019) "Strategy" was the factor, that dealt with organizational and strategic alignment, with key factors being employee engagement and leadership commitment. Atzberger and Paetzold (2019) categorized it as "Scaling" with a focus on growing initiatives beyond a specific domain, while transferring knowledge, spreading the culture and shifting structures across the organization.

The above researchers and the interviewees agreed that the company culture, as holistic collective, can either be receptive or unwilling to change. As individual mindset could be discussed so should the collective too. Further findings of both groups indicated that it is their belief that the executive management's responsibility to set the organizational vision and manage the change that comes with the journey of realizing that vision. Making the organization receptive towards change, according to the former, includes creating transparency and a compelling vision, preparing people for the change, creating corporate wide alignment by reestablishing structures and transferring external and tacit knowledge to corporate know-how.

Disagreements begin when assessing how to embark on the transformational journey. Approximately equal portions of the interview participants either believed that the induction of change should come from bottom-up or top-down, meaning the legitimation of selecting the start of the transformation is debated. Some interview participants shared their experience in frictions indicated by a transformation project they did not agree with, but others found changes necessary and agreed that adherence might be more beneficial than free experimentation. A new concept introduced during the interviews was the existence of a "tipping-point". The topical expression relates to the fact that there is a critical mass which needs to be transformed by force before the change can "spread" organically to the rest of the organization. This phenomenon relates again to the concept of freedom and responsibilities. The thesis proposes that in a well-defined transformational journey, where the PMM philosophy and methodology provider is set or designed internally, or where process-driven management sets the way of working, project leadership in a PMM selection context is of diminishing importance. However, entirely different solutions could be found even within the same industry. In other cases, even within the same company.

During the interviews, it was reported, that in large (particularly in multinational) organizations, culture may not be organization wide. This is consistent with the findings of Atzberger and Paetzold (2019), who identified the phenomenon as "silos". As interview participants stated. employee sub-collectives may create islands within the organization, even if they are functionally related, which is an additional finding, compared to the purely functional implication of Atzberger and Paetzold (2019). However, as our interview participants mentioned,

organizations may take advantage of this by strategically placing their projects where the culture is more receptive.

Transferring knowledge was an obstacle that was identified by most of our interview participants. Even though everyone agreed that valuable information is generated in projects, they debated the importance of a formalized knowledge capturing and management process, referring to their current unutilized practices. Further remarks touched doubts on who should take responsibility in managing that knowledge (team members, project executives or a special organizational entity), whether they should be formalized as processes to grant adherence or not, or if they should be at least included in project kick-offs. Responders who had the option to engage in informal, interpersonal knowledge sharing did not consider a mandated learning process beneficial. However, respondents who were part of geographically spread teams, reportedly, saw benefits in documented and stored project learnings. Atzberger and Paetzold (2019) referred to access to past project members for knowledge sharing for listening to first-hand experience, however, this draws temporal and locational limitations. Interview participants expressed the need for stable, available, concise, illustrated, and digital repositories, albeit none of them could recall an instance where this practice was utilized.

6 Conclusion

Conclusion chapter summarises the research and highlight key findings. The first sections discuss how the study has met research purpose and answered research question. The following section emphasise on key findings of the study. And lastly, the implication for future research is established.

6.1 Research question and purpose

The stated purpose of this thesis was to explore why certain project management methodologies are used in different industries, where integrated product development (the combination of mechanics, electronics, and informatics disciplines) is prevalent in creating complex products. Furthermore, what are the main considerations, or factors, when selecting a certain project management methodology. Because the development of such complex products is done in multiple industries, the thesis also aimed to investigate whether these factors are generalizable. Therefore, the question this thesis was composed to answer was:

"What are the factors influencing the selection of the project management methodology in integrated product development?"

A short answer to this question is that there is a complex array of factors when selecting project management methodologies in integrated product development, which entail people, process, project, and organizational connotations. Certain aspects can be generalized across industries, however, industry, corporate and project initiating sub-organizational entity related specificities largely determine which factors are of the highest importance in methodology setting.

6.2 Key findings

Firstly, we identified factors, that were both mentioned by literature and remarked as of importance by our participants generally. Regarding the dimension of people and processes, communication was marked as a key factor in aligning projects. It may be sufficient to reach a common understanding in certain environments only through informal, inter-personal ways, however some industries and bigger corporations require a more formal, process-driven approach. Another generally important concept was the presence of relevant competences in project teams and project steering. The roles of product owner, line manager and project execution responsible (project manager) were deemed significant. From the dimension of projects, scope was uniformly considered most important by literature and interview respondents. Requirements also showed importance, especially regarding aligning the different processes, ensuring customer engagement, and making the development process responsive through that. Regarding factors that impact the organization as a collective, it was found that mindset, not just on an individual but a collective level as well, is a key enabler or roadblock in achieving a successful shift in methodologies. This was explained by the fact that a new methodology could be thought of as a paradigm and selecting a new (different) approach requires a change in attitudes.

Evidence was also found, as marked in literature, that there is a collective attitude for each corporate environment, that could either be receptive or resistant to change. Practitioners and researchers suggest upskilling and coaching to transform this mindset and emphasize transparent communication. However, as a finding from the interviews it could be concluded, that certain associates cannot tolerate change, and employee fluctuation is a natural consequence of every transformation initiative.

Comparing the empirical findings to literature it was also observed that certain factors carry ambiguity in their relation to other factors. First of such observation was made regarding the freedom of project manager in selecting the ways of working. More freedom could mean the opportunity of selecting from a wider range of ideas and better tailoring to the task at hand, however, they might hinder inter-team alignment efforts. Freedom also relates to the existence of the loss of control in the management. The concept of empowering teams and self-regulating teams are important tenets in making the integrated product development processes more responsive. However, reaching that requires decentralization and a hands-off approach from management. Evidence was found in the interviews, that control was not uniformly shifted with the emergence of new methodologies across all industries. Measurement was also identified critical in reporting performance and aligning management and project layers, especially in resource allocation. Our findings show, however, that not all interview participants agreed with the necessity of defining metrics or believed that they could potentially incentivize the wrong behavior. They argued that the psychological safety for innovation, therefore a less regulated environment is more advised in designing innovative products. Literature suggested new ways of measuring performance, including project increment-related probabilistic methods, however the implementation of this is still in early phases and needs a holistic approach from management. Interviewees agreed on the importance of passing learnings from project to project, ensure common understanding and align teams. They disagreed, however on the ways of sharing the knowledge. Of the formalized channels, most interviewees mentioned they had review-type project meetings to assess what went right or wrong in project. Communication was also marked as a key channel in knowledge transfer from project to project in environments where teams are of smaller size and largely co-located. Interview participants who experienced fluctuation in teams, geographic dispersion in employees or a high number of projects mentioned that a standardized repository of findings would be beneficial. There was no common understanding, however, who should take responsibility of maintaining such repository and in what form should the documentation be stored.

The outlook of the integrated product development is seen in increasingly software-based projects which is better suited to empower responsiveness since there are no constraints of physicality. Hardware development, on the other hand, is shifting towards modularity and cloud-based solutions, therefore showing more similarity in nature to software. These transformations indicate that incremental building will become more available in the future. Recognizing this trend, companies already started reorganizing their ways of working around the phenomenon and numerous attempts could be spotted in practice, where corporations transform SW related practices for responsiveness first and then following successful pilots, they scale up efforts beyond the software domain first (including embedded SW and HW), then to the entire organization in large-scale transformation initiatives. Important to note, that this transformation could only happen consistently in the organization if management sets a clear vision and mandates the execution until reaching a critical mass, after which change becomes organic and self-regulating.

6.3 Future research

The study concludes the factors influencing the PMM selection in integrated product development and highlights the key considerations. However, several major challenges are left to be answered by future research, which are marked ambiguous in the key findings.

Firstly, the research distinguished measurements as a factor with a high level of uncertainty, and can be misleading; moreover, that is difficult to establish as it requires constant revision and alignment with the organization. Therefore, we propose a topic for further investigation that will study the KPIs selection and its influence on project management, as highlighted in the study. Other factors that need further development are culture and employees' engagement as the ones that affect PMM establishment in general and particularly in geographically dispersed teams and complex organizational structures. The study has identified resistance and personal bias as bottlenecks of the project management transformation, and hence are important to address. Lastly, considering the experts and researchers opinion, knowledge management is debated for its importance especially in a formalized manner. However, very limited approaches are discussed in both theory and practice, consequently, a holistic view on the knowledge management technics is necessary to explore. In addition, the topics debating hard benefits, probabilistic valuation models, dynamic budgeting, and immersive studies can contribute to the academic knowledge due to being scantily discussed. We believe that empirical findings of this work can contribute to the future finding and serve for those aiming to investigate the topics above.

A.   Appendix: Literature review table

Table A.1: Summary of literature in applying APM in NPD

Authors	Central topic	Methodology	Main observations
Sharafi et al. (2010)	Analysing gaps in product development models	Keyword search (multiple keywords), 43 different models identified. The models were compared based on a unified comparison framework, clustering the production development tasks in three main categories: Product Concept, Product Design and Production Design.	• Models range from micro-, to macro-logic, depending on how much of the entire development process they are focusing on. • Most models cover only part of the tasks identified in the meta-framework. • Three main areas that are only partially covered in literature are simultaneous development, product development management and information management.
Shen et al. (2012)	Agile methods applied in embedded software development	Keyword search (multiple keywords), 40 studies investigated. The articles were clustered based on topical patterns identified within the text. Topics include embedded software development characteristics, agile methodologies used, agile techniques examined and the overall research methodology of the study.	• According to research, embedded software development requires higher, domain specific skills, as the processes are limited by current hardware capabilities. Competitive pressure generates performance requirements, while market conditions are changing. • Most commonly applied agile methodologies are XP and Scrum, while in other articles, new, holistic concepts, such as user-centred design, platform design, and test-driven development are introduced. Most articles detail tools for testing. • Considering research methodology, most sources are limited to a single-case application of a selected agile technique.
Kaisti et al. (2013)	Agile and lean methodologies in embedded systems development, suitability and evidence from practice	Keyword search (multiple keywords), 28 studies analysed in detail. The articles were grouped based on whether they discuss embedded software or system, the mode of the analysis (qualitative or quantitative), and the type of agile method applied.	• Most research aimed at software, and not systems, majority of articles performed a qualitative analysis, XP and Scrum were the most popular agile methodologies, while a fraction of the articles introduce new methodologies (test-driven, platform design). • The research is scattered and mainly driven by industry reports, while there is no consensus on the way forward. • Agile methods may be suitable to address the challenges of embedded development, however, tailoring is necessary, involving system-level documentation and specification. • There is no rigorous, controlled experiment, that would empirically prove the effectiveness of agile methods, conclusions come from experts' opinions and experience reports, the authors call for more research, especially in the hardware domain.

Authors	Central topic	Methodology	Main observations
Dikert et al. (2016)	Agile software development at scale, focusing on challenges and success factors of the introduction.	Keyword search (multiple keywords), 52 studies analysed in detail. The publications were categorized based on their types (experience, report or case study), contextual codes that were set prior the analysis (parameters of the transformation), and codes that were identified during the comparison of the articles (challenges and success factors).	• Literature consists mostly of experience reports, success factors and challenges are subjective. • Biggest challenges are that agile methods difficult to implement and integrate to non-development functions. Implementation furthermore faces resistance to change from employees. Lastly, requirements engineering still must mature. • Success factors are to carefully choose the methodology that fits the corporate environment, ensure internal alignment and management buy-in, start with a single case, experiment and pilot, train and coach associates to prepare the organization for change.
Ciric et al. (2018)	Agile project management applied beyond software	Keyword search (multiple keywords), 26 articles investigated in the final sample.	• Main areas of APM adoption other than software industry are innovation and product development, construction and real estate, education and the service sector. The adoption requires a high effort of the entire company, requires change management and a shift in culture. Most companies still embrace traditional approaches and structures. • Empirical performance studies on hybrid models are still scarce, but key patterns can be observed for benefits and challenges of their implementation. Hybrid benefits include gains in simplicity, self-governance, visibility, morale, flexibility, efficiency and delivering on customer needs. Challenges to be tackled are organizational resistance, reward systems, knowledge management, resource allocation, difficulties in tailoring, lack of scalability, embedding project teams in the rest of the organization. • Certain project characteristics signal whether APM could be implemented: poorly defined, but small scope; unknown timing, tasks, resources, requirements; small, co-located teams; user collaboration; complex and iterative project plan. This also suggests that the right methodology should be chosen for the task at hand. • APM is an extension of a stage-gate methodology, not a dramatically different way of working, where the extended models are called hybrids. There is no one size fits all, tailoring is key to project success.

B.   Appendix: Interview transcripts

B1.   Pilot interview 1

Line	Person	Content
1	Researcher	Could you please let us know more about the projects within the New Business department?
2	Int1	(…) we have many different hardware projects running within our two project areas, Audio and Axis Control Solutions. If we just go back a bit in time (…) New Business was running projects typically in a waterfall model. (…) In 2006, we saw that we have all these benefits in running normal projects for the software development as well, but every time after we closed a project and before we opened the next one, in this interim period, we were not being very efficient. So, we thought of using programs that were continuously running instead, with continuous development, in order to avoid those gaps. I could probably spend an hour just talking about this subject, because there are some obvious benefits in it, it is much more efficient, but there are some drawbacks as well in not running projects. Projects have a huge benefit in having a start and an end, tasks that are very well defined, and you celebrate when you finished. All these things can quite easily disappear in programs. That's typically how we work with the software that we use in different programs. We have (…) three different firmware programs, one for Audio, one for Axis Control and one for Network Door Stations. Then we also have a few more general software programs running. So, basically, all software development that is not directly connected to hardware is run as a program rather than a project. And then we have several projects that are for products. These products, better say product-projects, they are combined as you say. They also involve firmware typically. As you described earlier, it is a bit of a challenge sometimes to combine the methodology we use for software and also firmware in this case with the hardware product.
3	Researcher	For the other hardware projects, you use Waterfall as methodology mostly?
4	Int1	So, for hardware we use an in-house process here in Axis, called HPDP, Hardware Product Development Process. Actually, it derives from an earlier process we used to have in Axis many years ago that we just called Project Process, which we used for everything, even if it was not suitable. Basically, it was the seed for HPDP as we have it today. It is a 6-tollgate model, which is, if looked at from above, quite similar to models that are used in other companies, with a dialect that is suitable for Axis.

5	Researcher	How about the software program (methodologies)?
6	Int1	For the programs, I would say pretty much every product that we develop, not only in New Business, also in Axis, HPDP is used. And now there was another process, called SPDP called Sourced Program Development Process. But when it comes to software development, there is no one unified way of doing things in Axis or here in New Business. The reason behind is that we have different line managers and different project managers for each area, but we try to learn the best of breed. But there is also a huge difference in developing a software that is completely new, (…) compared to a program that has been running for a very long time where you make continuous updates. Also, in some cases, we might not need to have a huge backlog, more that as soon as we gather customer request that is when we will want to do something. So, typically, we work in Scrum-*ish* ways, when we talk about programs, but also there are some projects when we use Kanban to make sure we are working on the right things in the right order. If you look at the bigger software programs, we use Scrum, but we also use a layer above that we call SAFe, Scaled Agile Framework. When it comes to both SAFe and Scrum, I would say we use our own versions for each. But we take some parts from both SAFe and Scrum when we make developments on the software side.
7	Researcher	And for the combined projects, is it still more of a Scrum-*ish* way of working?
8	Int1	For those, we typically use Scrum. How we normally do it, is that we have these six tollgates, where the second tollgate is called Start and the fourth tollgate is called Freeze. Freeze is meant for ceasing both the software and hardware development. (…) Between Start and Freeze we have a tollgate that is called Plans Review that is more applicable for hardware, than software. In between these tollgates we run agile software development. That is how we try to do it. Work in an agile manner between these tollgates but try not to do it outside. That is normally what we do for completely new products. If you take, for instance, a new audio product, a new speaker, where we use already existing firmware, on the firmware side only an update is required. Sometimes, we add new features to existing products that come with a lot of work, but sometimes it is only an update that requires a small amount of mental work. So, when we started doing audio, it used to be a huge task for the firmware team, that now could be a lot easier. In those cases, when just make a small delta to the existing firmware, we do not normally even do it in a project. It is just ordered from the running firmware program that we have. Depending on how big the workload is we have different ways of doing things.
9	Researcher	…depending on how many changes are required?
10	Int1	Exactly.

11	Researcher	Are there cases when a new hardware should be created? For example, audio with some specific sensors?
12	Int1	Absolutely. In most cases we make a new product a lot of new features need to be added. (…) Maybe, a new speaker system needs to have a special microphone, because we want to be able to listen to sounds in the rooms. That will have not only new hardware, but also new software features so to say. But I would say, when it comes to Audio, where we have fairly mature firmware for speakers, it is more about making a delta and then the new features are rolled out not only to the specific product but the entire product line.
13	Researcher	What is the decision process? How do you decide what methodology to apply?
14	Int1	That has actually changed over time. Only about a year ago there would be a decision in the project office. Then we made an organization update where each product area is more self-running if you like. We have (…) a director for Access Control Solutions, where the way of working for firmware and so on, would be taken within the product area. Typically, the line managers from both QA, and all engineering line managers, together with product managers, will decide. We do not have a firm process for that yet, I would say. So that is typically being handled very locally, while it used to be a central decision within the project office.
15	Researcher	This means there are no set KPIs or factors that you should take into account when making a decision? The team gets together and decides?
16	Int1	Basically. When it comes to software, we don't have any centralized way of deciding this in Axis. If you visited other software teams outside of New Business, you would find that they work in completely different ways, which is strange, and could be perceived as a weakness. We could probably be even more efficient if we worked a bit more in a similar manner. Although, a software product could be so different depending on how mature the department is or how many people are making the software. Maybe you have a software that is developed by only four people, while in other cases you can have 50 people working on the software with many sub-teams, so they probably should work in a same way. So, we tried to be not agile when we *work* but we try to be agile when *deciding how to work*.
17	Researcher	Are there any success factors, that helps you understand what is the right way?
18	Int1	It is not our greatest skill in Axis to measure our performance. Normally, what we do is what we have project managers come together to discuss performance, it is more of a subjective analysis really, what is working well and what is not. If something is working very well, we might want to try in more teams. We do not have KPIs, or anything

		of that sort, what we would measure on. As far as I know we do not have KPIs anywhere in Axis. Generally, not just when it comes to project management, we do not use KPIs. It is much more a KPI-less judgement, I guess.
19	Researcher	Is this because of a current consensus or have you tried implementing them before and decided not to use them?
20	Int1	I think if you come from outside and you have worked in other companies, you would notice quite easily that we do not have a lot of KPIs here. Obviously, there are certain drawbacks when it comes to that, but we have been a growing company for a long time and we do not want to get stuck. So, when it comes to KPIs they can be very good, if you choose the exact right measures, but if you are not careful, it can be very bad for the company. So, for instance, we have this core value here in Axis, that is "Act As One", so basically finding help is very easy from a different department. But if we started measuring performance on KPIs, the helping person might think that they are losing time in working towards a certain KPI. The general decision in Axis is to focus more on what is important not what you are actually being measured on at the moment. This gives us a lot of flexibility and it works very well with our core values, but sometimes we miss finding things what we could if we implemented KPIs. (…) We have always been a bit afraid to choose KPIs from that perspective, but I am sure in the future we will use them more, while we grow. Because it will get harder and harder to know how we perform in each area.
21	Researcher	What do you think what the challenges and struggles are when deciding what methodology to use?
22	Int1	When it comes to product-projects, it makes it very easy for us, since we have HPDP. This is the process which should be considered as a toolbox. If you are an experienced project manager you may decide not to use the specific tool, if you do not find it applicable to your project. I think that process is working quite well, especially since we updated it a couple of years ago and emphasized that it is a toolbox, and you do not have to do everything that is in the process. A few things that are (…) mandatory are certifications that the project needs to go through, or certain papers, like letter of conformance that is to be signed by our CEO. Other than that, you can use your judgement. (…) But when it comes to software it is a bit more complicated and I definitely think we could do a lot more to work more efficiently. Because every time you change the process it is a bit of a pain. It costs a bit of money, but definitely a lot of time. If you have a process that works *okay-ish*, it can be quite hard to change it to something that might work a lot better. People already know the process and know what to expect, and they do not want to change every month because they get tired of changes. Yes, I would say that is a bit of a challenge to choose a process, from that perspective, and we do not change very

		often. When we change we normally make very small changes. We try to find the biggest pains and try to correct them.
23	Researcher	How do you address the change? You state what the pain point as a reason for the change and then introduce it?
24	Int1	I would say we normally introduce changes in between sprints, if you talk about Scrum, or since we use SAFe we have increments which contain three sprints. If you want to make changes you normally want to introduce them between increments, I guess. But it has been a while since we actually made changes. I think the increments are applicable to all programs, so we try to use the same increments in order to align resources. But when it comes to smaller changes in each product area, most of the times I am not even aware of them, because small changes may be decided between team members, project managers and line managers. It is not always a big decision that has been broadcasted like "now we are doing this change", it is mostly being handled on the fly.
25	Researcher	Does this mean that the initiators of this change could be both managers or developers?
26	Int1	Absolutely. If we look at historically at Axis, a lot of the big decisions has come from bottom-up rather than the other way around. Sometimes we made huge changes that were being enforced by managers, but a lot of the things have come from underground. (…) Let's say we have one way of working, or people working in a similar manner and you have one team somewhere in the organization that tries something. If that thing works really well the team next to them might try it, and it could spread like a virus. I should not use that word right now, but it could go the same way. Good ideas can spread easily in this company because we do not have these KPIs, we do not have things holding us back. If we see something we want to try, we can easily try it. Same thing with HPDP and these processes. A lot of the changes historically started with a team wanting to try something else, if that worked, they might have told their managers and the change came from the backdoor into the processes. Like someone tried it and actually worked better, so now we are changing. (…) I am in a steering group that makes the changes in HPDP. It is not like we always tell everyone "now you are going to do this change", it is rather that we notice that someone tried something else that worked, and we bring it to the process.
27	Researcher	Were there any situations when developers think a way would be better, but managers could not support the idea? How would you solve that situation?
28	Int1	I guess here in New Business, typically the line managers have not been that involved historically, but the project managers and team members. I cannot think of any good example. (…) You can always

		have different point of views clashing, sometimes the team members think they should work differently because that is better for us, but they do not always necessarily think about the end customer, so the project manager or product manager might be a little bit more aware of the outside world. That way of working might be great for the team, but it could be worse for the end customer. It could be for instance that we want to make a certain amount of releases each year and the team thinks that if we made only half as many, that would greatly simplify our way of working. It could be true, but it could be that the end customer could need the updates. That was not a real example, but it could have been one. (…) I cannot really remember any time when we had a conflict about this. Historically the way of working has been led by project managers, with obvious inputs from line managers and team members. Project managers are the ones most interested in *how* to work. The most recent example we had was in audio, when we had teams working with front end and other teams working with back end. We then tried to make a few things combined instead. This change was initiated by the project manager with an approval from the line manager. But still, it was something we wanted to try if it works more efficiently. Most often the actual team members are not actually interested in the way of working. There have been a few occasions but not that very often I would say. Most team members are happy if the process does not get in the way of working. They want it to be a tool they can get help from. If it takes too much time they want to avoid it. It is always a balance. You do not want people to spend too much time reporting, I want them actually to deliver value to the products instead.
29	Researcher	As you said, let us take the example where developers want to have half as the amount of releases, but that could be bad for business. Then the project manager could think that it would be even better to have twice as many releases than before. This would be painful for the developers. How would this be solved? Would it be a compromise?
30	Int1	In that example the line managers would be deeply involved to see how we can solve it. If you look at any software program we are running now, we are not running it the way we want to from a business perspective. Typically, we have a long-term goal, like frequency of releases (…) and we know where we are. The line managers are responsible for the long-term transition towards our goal. (…) If the end solution seems way too stressful for the team members today through this journey, we actually have to make sure that it will work in the end as well. So, we would never just double the amount of releases, because if we do not have time, we do not have time. Quality, when it comes to our products and solutions is very important, and we would not stress it if we know we could not make it. (This is) because the Axis quality is quite a big thing here. At least we like to think so.

31	Researcher	What else is important when making these decisions? Would you consider all your stakeholders what they want? (…)
32	Int1	At least when we talk about projects, when they are started and we have the initial order of the project it is emphasized what is important: quality, number of features, or time to market. Normally that sets the tone in the project. Sometimes, in New Business when we release something completely new, it could be that quality is something that is still important but time to market is even more important. Because we know we are not going to sell a large number of the (initial) release, we just want to release something and get feedback from the market. So, we can bring value to the market, but maybe even more importantly learn from the market so we can make maybe software updates and make it even better and the next version of the product can be even better. Sometimes, it is actually better to make something that the market can actually try rather than just sitting scratching our heads for five years before we release something that we think is going to be perfect. So that is about projects. When it comes to programs, it is more of a running change or running process. Sometimes we have smaller software features that are just being prioritized and we do not talk much about it if it is important or quick or not, it is more of a matter where we prioritize and the order of doing things. In some cases, it could be really big features that are basically projects themselves, and then in those cases, sometimes we have a separate order of things, and decide what are the important aspects, such as time to market. But I would say even if we do not mention quality is most important, our threshold is quite high, because obviously we have a reputation to think of, and obviously that is not mature enough we would drown in customer cases... preventing us from releasing new things. It is not just for our customers' sake it is also for ours. (…) When it comes to customer cases, we have a first line support, which it is not part of New Business, but a central function in Axis. So, if customers have complaints that is normally where they end up and I do not know the percentage, but I am guessing they resolve most question there. They have a good knowledge of our products, and when a customer complains about something quite often it is not even an Axis problem, but a network issue or something else. So, they take care of a lot of things. But if indeed, there is a bug, we have system CST, Customer Service Tool, where basically our service staff, or first line support, raises a ticket, and this is then not handled directly by the team members, there are product specialist in our organization as well. They are the ones who receive this ticket and maybe they try it for themselves, whether it is a bug. If it is a bug, and it has to be changed or fixed, the product specialist will make sure to speak with the product manager and obviously product and project to prioritize it in the backlog. That is typically how things flow into the teams' backlog. It is actually a bit different depending on the product area. We do not do

		it exactly in the same way because our product specialists work in a different way. We do not have any engineers on call.
33	Researcher	Should there be something missing from the testing phase and it is an urgent task how could that be prioritized?
34	Int1	Do you mean that you release a software and shortly after realizing that it has a severe bug? Worst case we would stop production. (…) If it is a fairly quick fix, we continue building but stop the shipping from our plants until a bug fix is released. When it comes to software not connected or products that are already out, we maybe need to update on Axis.com with new software versions. (…) We would stop all the work and fix it and make a service release as soon as possible. If we have a severe security issue, we could basically stop doing everything else and just release a service as quick as possible before resuming all work. If we look at the Video organization, they have one organization that makes new products, as soon as they are released all the work and all the responsibility of the R&D product if you like is handed over to P&T, product maintenance organization, and they are the ones that take care of the updates. When it comes to New Business, we typically own our staff ourselves. It is the same engineering team that makes the new products who fixes sever bugs, if they are related to our specific area. If it is a general Axis firmware bug, it is handled by P&T. If it is a bug in our code, we handle it ourselves. This could be a problem sometimes. If you are planning to release certain new features and there is a sever security bug coming it could stop all development which is a very bad thing This is something we need to address in the future. While we are growing, we are able to specialize a few more people to do more P&T work, so we do not interrupt new features too much. That is, I think, a very exciting challenge going forward.
35	Researcher	Yes, because these activities could potentially be predicted?
36	Int1	Exactly. Very good point, because we used to be always surprised when it happened. Until about two years ago when we sat down and realized that we probably will have a huge security update that needs to be handled outside normal scale. So, it is better to plan for them and when we talk about how many people we need. We might not have names on each task, but we might say we need two heads that do not do any new features, but they should work on P&T actions. And the reason why we do not have a well set-up P&T organization in New Business is because we are quite new. Fairly recently we did not have any products on the market. We started releasing our first product, at that point you do not need a P&T department. Whilst maturing we have more and more products on the market and some of them have been out for quite some time, they need a P&T organization.
37	Researcher	What could be the opportunities in this field?

38	Int1	Combined projects and how to align software deliverables with products. Sometimes we do it as a part of a product with tollgates. That works sometimes well, sometimes it doesn't. Sometimes we just have a running firmware program that delivers. Problem then is that we have two different project managers. So, let's say, the product project manager might think that a feature is absolutely crucial, and we can't sell the product without it. That might be true, but you can have different product mangers working on the actual product and in theory we could run into issues where we do not have the same priorities. Normally, we can handle this because we are a fairly small organization and everyone knows each other, but that is not a flawless process. I think also we can probably generally we can become much more efficient when it comes to how we release software and so on and discover the best practice. For mobile apps we might want to release very very often, but when it comes to firmware, the need for high quality is much bigger. If you release an app with a sever bug, you can just go back to the earlier version, but with a firmware you might already have shipped to customers who are not aware of the bug and might not even connect to the internet for updates. There are huge differences in the need for quality and the process might be different for mobile apps and firmware. Looking into those differences could be very interesting. The whole way of combining products and software development would be very interesting. Because we have so different, when the products have a start and an end and then we deliver the product and it lives for a few years, then you do a new product and so on. But you always have to think about backwards compatibility. The firmware program always has this responsibility for all the products that are out, not just the new products. From a project management perspective, how these different initiatives can live next to each other could be very interesting. (…) What are you most interested in looking into?
39	Researcher	We were thinking about combined projects and how to deal with conflicting methodologies and priorities. How to meet at one point. We were also thinking about the freedom decision making on the project manager side, to what extent can it go against the general Axis way of doing things. Also, the knowledge succession is also a thing to consider, where quality, even if not standardized, but could be secured to be delivered every time.
40	Int1	Fully agree. Sometimes we make excellent products, when not just the product itself but the process went really, really well. But the next product we make might not actually use the same process. "How can we make sure we use the good examples?", and so on. That would be really interesting as well.
41	Researcher	Is there any knowledge sharing process?
42	Int1	As a project manager when you start a new project you should always scout the company for similar projects that have been done before and

		go through the lessons learnt made from those projects. Sometimes we are a bit sloppy with that, but the process actually stipulates, that "First you should look at the previous projects and see what they learnt!". When it comes to programs, we do not have much documentation regarding that to be honest. It is more of a continuous development. I guess, an upside to that if you want to change something in the program, we can do it very quickly, like in the next sprint or something. In the product-projects that might run for 18-20 months or something like that, it's like "Oh yeah, we made this mistake, so in two years' time when we do the next one let's try and not make the same mistake again". It is a much much longer feedback loop.
43	Researcher	But you still have the opportunity to document it somewhere?
44	Int1	Exactly, since there are hundreds of product-projects going on at the same time, you always have a few colleagues who have done something fairly similar very similar who you can talk to. (…) It has become an interesting issue where to document. A few years ago we only had Galaxis (online intranet repository) and everything was supposed to be stored there. When you started a new project, you sent a ticket to IT, saying "I am a project manager and this is the cost center, and I am going to do this project." They would deliver the project site for you. The project site has a front page and a repository underneath. A good thing we have at Axis is that repository is always the same. In the future if maybe a mechanic wants to check how a certain thing was done in the past, they can just go into the project and they can just go through the structure which is always fixed and they should be able to find the knowledge in the right catalogue. So that works quite well. Galaxis as a tool might not be the most appreciated tool as I hear because it is quite hard to search. If I misspelled something it would not find it. Or if I write a fairly common word, it would not present you the file most people look for, it just present you the text that fits the best. Anyways, we have Galaxis as a repository which is quite good. But since there are other much better tools, more flexible tools on the market, Axis have introduced them as well. We introduced Jira and Confluence, mostly for software development for instance. Which is vey good. And if you work in software programs, you tend to want to store all the information in Confluence instead. Which I understand. It is a much nicer tool to work with. If your work with firmware in a product, when you make a firmware for a physical product you might want to use Confluence. But then we have a disadvantage of someone else not aware that Confluence is used for a project, they will search for it in Galaxis, but they might find the project but they can't find the information. So now we have two places of storing them and you can't search for in one database for hits in the other one. So what I tell my project managers is that when it comes to (…) temporary documents it could definitely be stored in Confluence, but on long-term, it should be made available on Galaxis, at least by links to Confluence. But you should not store things that are going to be used long term (…) only

		in Confluence, because some other person in Axis might not know where to find it. It also is a matter of access. Galaxis, if you work with R&D you can access most things within that area. In Confluence it is a bit different, depending on what department you are working in. (…) I was the project manager for our first thermo-camera that we did here in Axis ten years ago. We had this really super important document that we got from the Swedish authorities that allowed us to sell a thermo-camera, because it is not like selling any ordinary camera. So, we stored that in the right place and so on. That was in our old intranet. Only like a year ago the product manager for thermal cameras approached me and said "We could not find the document and the Swedish authority said that we never were allowed to sell this and we will get a huge fine". I just went into our old intranet and found the document. You never know when someone is going to need something in the future. Almost ten years after I stored the document, we needed it, so it is super important that you actually store things where they can be found long-term after it.
45	Researcher	Are all the documents from the old intranet in Galaxis?
46	Int1	The intranet today is Galaxis, we have another intranet that is read-only, everyone can access it and it is called Insight at Axis. You can still find it. But when it comes to where to store things it is something that we are still learning. On top of that we started using Microsoft Teams quite recently, so a lot of the teams are using Teams now to store things there. Those documents can't be found in Galaxis either, so we should have stricter rules on where to store documents. Because it might be okay for now that everyone knows we store it in a certain Teams area, but in five years' time will anyone remember that? It is bit of an issue.
47	Researcher	Who is responsible for where to store the information and that all team members know this?
48	Int1	Let's say when it comes to product-projects, it is the project manager's responsibility to make sure that all the documentation of the project is stored in the right place. When it comes to programs it is a bit more difficult, I would say. Because we do not have any guidelines regarding that to be honest. Jira is now available; it is a tool most people like. People store things there. As far as I know there is no directive saying we should store things on Galaxis or Jira or Confluence.
49	Researcher	Is there a checkpoint following the role change or resignation of a project manager, when project documentation is checked?
50	Int1	In Galaxis, I think you can choose certain actions that will apply after a certain amount of time. Regardless, if the project manager leaves, the project is stored in the portfolio of that department, and everything should be found there. Nothing should be connected to a certain

		person, even though the project manager might have been a site owner, everything stored there can be accessed afterwards.
51	Researcher	Much of the information is under the supervision of the project manager and after their leave any responsibility checks are done.
52	Int1	When it comes to Teams, it is important to know this tool was made available to us a year ago, before we were using Skype for Business. It is a very good tool, honestly there are a lot of smart people here, so everyone finds great ways of using it, but I am not aware of any guidelines on how to use it. To be honest, I have not heard of many problems concerning that yet, but thinking long term it might become an issue. Let's say you and I set up the Teams because we want to store information, and both of us leave the company, who owns the area? Is it still available? Did it disappear when our two accounts were deleted? The rumors that I have heard is that IT is looking into the possibility of actually through Galaxis search through all our different repositories. If they were able to fix that, there would not be any problem with the future and information can be stored anywhere. As long as it can be accessed from a single point, our intranet would be well suited, I think.
53	Researcher	What are the most important things to look at, important documentations?
54	Int1	If we look at the example how to connect the firmware process with HPDP it would be good to go through HPDP, especially in between the tollgates of "Start" and "Freeze" to see, (…) if there are any guidelines how to work with this. Maybe HPDP would need to be updated by your findings or stored somewhere in the process documentation. (…) Since we don't have many central point for software projects it could be good to have it updated it in HPDP, if it is something that Axis would like to take on. It could take time to get things into HPDP and a lot of people need to accept the changes. But as a minimum it would be good to hand it over to someone who would have the responsibility to get it into HPDP, since you are not here for a huge amount of time. The other part is that we do have in New Business, currently in the Project Office Space, we have this catalogue called Processes. Actually, the Project Office will dissolve now. (…)
55	Researcher	Do you at any point refer to theory or existing knowledge in working your way through a project?
56	Int1	When it comes to HPDP the process is officially owned by our much bigger sister organization, the Video organization. So we are stakeholders to that. Not sure, if it goes back to methodologies, such as PRINCE2 for reference. I have some knowledge from waterfall projects outside of here as well, and I can say that it definitely has elements of that and much more generic processes as well. HPDP is so mature that it is a process of its own if you like. If you work here and

		you fully understand HPDP you can easily work in another company that uses another Waterfall methodology. And when it comes to software, I do not think we have anything centralized. In the Process catalogue we have some general information about SAFe and so on. But apart from that the project managers will get regular updates on Scrum and guest lectures, but it is not a set-up program, but rather ad-hoc in Axis. We try to make sure that people working in agile development have the right tools and skill to do the job, but we do not have any requirements if you want to work as a software product manager that you need to know Scrum and SAFe and Kanban.
57	Researcher	In general, when you make a decision, how do you Scrum? Could it be a hybrid model? There is an ongoing research in journals that covers this, and they are working with hybrid models and propose new solutions on models and frameworks. Does anyone take a look on this?
58	Int1	No, it is definitely bottom-up. We have a lot of highly motivated people here. Typically, I would say if there is a new theory coming up that would derive from Scrum, what would happen is that somebody would tell us about it and it would be a bottom-up process. I do not think we have ever had an occasion when senior management at Axis said that "Now we are going to work this new way, we call Scrum 2.0". Never happened in the last 11 years of me working here. Typically, this works really well, because if you have a team that tries something that works really well, when the other teams are made aware of this it is very easy to get everyone on board. (…) Compare this to if a general manager for the R&D organization says that there is a new way of working that has never been tested before. That would not land very well. Top management at Axis are very happy to see changes coming from the bottom-up. It might sound very unstructured, but it is really meant in a way that good ideas should come from bottom-up having them tried before, and they could spread easily. If there is a Scrum 2.0 most likely a few project managers will try them out and if it works, it will spread. HPDP is more a top-down because we have a set process, but it derives from a lot older processes and anyone can make changes to the process. We have a ticketing system that anyone who is an employee at Axis can raise tickets to the existing process "I do not think this is working and you should look into this." And the people in the steering group would agree and then the process would just be changed. I guess, throwing out HPDP and doing something else that would be a much bigger thing. Obviously, you would need to sell the idea to top management. (…) It could definitely be done, but it would be a much bigger task.
59	Researcher	Are the best practices stored as some kind of documentation?
60	Int1	Along with HPDP a lot of documentation is stored, (…) as why changes are being made and what changes were. So I guess for projects and product-projects, yes, but for software, I do not know

anything like that. Definitely not in New Business. When I started almost 11 years ago, there was one project manager who started working agile, everyone else was doing waterfall. And let's say five years ago there were quite a few who started doing agile, but a lot of the project managers hardly knew what it was. These days I do not think any software is being created without working in some agile manner. I guess we are quite late to start, but now everyone is doing it. So, we have experience working with it, but we might not have well set up processes how to align the company and how to store processes. This is something to improve for the future. (…) For software we do not have a director or senior manager to set the working ways, it is much more diversified. Maybe in the future we will need to have slightly better control over that. Most software teams are quite small still if you compare to Sony, where there are hundreds or thousands working on one thing. So the need has not been characterized just yet, because the way we organized working in small teams. (…) We have grown so quickly. New Business used to be only a handful of people ten years ago. Five years ago, we could fit in a school bus and now there are 200 of us. So sometimes processes have our focus has been that there is a new product and a new software, and the process is that we need them, but we do not develop the process first, but the other way around. Just the fact that we have a lot of new line managers and directors in place, who just recently started, our chance is to work more efficiently is much better because we have many more people thinking about this. Few years back, it probably was just me who thought about how we should work and now we have many many more managers. So. I think we will develop much more quickly in the future. If you are looking for low hanging fruit, combined front end and back end teams. We have examples when one team does not have much to do and the other team has tons of overtime. Obviously, there is something wrong then in the way you work. Those guys that don't have much to do always help the people who were super stressed. That's the change what we made that I think would be very good for us. That's more of ways of working than project management process. Something that comes to my mind is how we start projects here in Axis. We have a process how to start projects, but it is far from perfect, because when you start a project you obviously need a project manager and need staff. You also need some kind of order and you need to close a few risks before you actually engage all these people. And the whole process how we start off projects currently we are in a situation where some of the projects that were scheduled to start this autumn actually did kind of start but everything was so unclear that basically we still haven't started them. We have a lot of investigations and so on but I am sure the whole start up period could be much much faster if we thought things through. (…) Is our process really well fit to start off completely new things…? Typically, the rules written for Axis are mostly written for Video organization, and they made tons of cameras. So when they are going to make a new camera they know how to do it, even if it includes a lot of new features. Sometimes when we

		introduce new projects it is something we have never done before. So the process is that we should have an order, a project manager, and let's get started! But then we think "should it have a display, or should it have buttons?". I think from a process point of view, when it comes to products, we could probably be much much more efficient, especially when we do new things, start things the right way. Sometimes we lack staff, because people are tied up in other projects, and sometimes we say let's start a project and we pull in 20 people and everyone is stalled because they can't start working as we haven't decided what they should be working on. Sometimes the start-up of projects can be very costly. (…) It is a very good example when we have much more complex tasks, when we try to have a common graphical user interface for Axis products, where you have many different departments involved and we do not have a common process. There are more examples like that when we want to have a common development together with other parts of Axis. When I started 11 years ago pretty much everyone was doing hardware and electronics, very few working on firmware and software. (…) But these days the majority is working on software and if you look into the future software would be a much bigger development than hardware. Not that hardware will be small, but software will become much bigger. So, when it comes to having lean processes and common processes it will be quite important in the future to handle complex tasks in a good way. (…) It is hard to find time for automations, but it is really required in the future. Historically we made a lot of manual tests in Axis, and we have a lot to learn from new line managers who come with knowledge how to do that. It is an investment we need to make to get there. (…)

B2. Pilot interview 2

Line	Person	Content
3	Researcher	First of all, we've seen that at Axis there are different kinds of managers. So, can you provide more information what your position is about and what are your responsibilities?
4	Int2	Yes, I am responsible for the Line - for the people and team. That is my main responsibility. I am managing around 20 developers. That is my main task. But I am also managing the area of building speakers. At my first years at Axis I was also Project Manager for developing hardware products.
5	Researcher	Was that at New Business as well?
6	Int2	No, it was at EBP.

7	Researcher	Alright. And what are the projects in more details that your team is working? And also if it is related to your previous position. What are the types? Is it combined - when you work with hardware and software and firmware, or it is only one of these?
8	Int2	My main responsibility now is a software. But that software goes into the hardware products so I am also responsible for the hardware products and making sure that they are complete products. But there is a project manager that is developing and is responsible for the project. But I have the line responsibility.
9	Researcher	So it is still have to be aligned with the hardware even though the main focus is on software.
10	Int2	Yes, because that's software going right into hardware - embedded software.
11	Researcher	I see. What are the types of methodologies that you are using in your projects?
12	Int2	It depends. We have software program were we do all the software and there we have Agile/Scrum teams - they are working with Scrum methodology. But then we have the hardware side of it working more like (I would say like Waterfall), but that is the sequential work.
13	Researcher	Alright. But then how do you combine these?
14	Int2	Is it not that hard. The hardware guys design the electronics and they say to the software: please, do the requirements on the hardware (how big memory do you need, how fast should the processor be and all these things), and then hardware guys define it, and then people from my organisation they are reviewing and helping out and designing. Then they work together, so when the software arrives, my people are getting it up and running. So we have these kind of milestones, where we cooperate and then in the end the software program delivers the software to the (could have been) product project. So some synchronisation and aligned timelines.
15	Researcher	We heard from previous interviews that there were something like a 6 tollgate model. Is it the same? Or is it something different?
16	Int2	No, it is not that formal. We have HPDP process at Axis, but that is how we are running the hardware projects as well, but at New Business it is different we don't have the software development within the project. We have it on the side. So little synchronisations and discussions on the side, but we have not seen any problems so far with this. But people are welcome to coordinate and what thing are important to check with the other teams. I think it looks nice.

17	Researcher	Alright, thank you. And what are the success factors or the KPIs that should be satisfied?
18	Int2	We do not use KPIs at Axis. The most important is that the product has high quality and all the features are good and well tested. And, of course, try to meet the timeline.
19	Researcher	Yes. Because you can face the risk that you will try to measure everything and then you will not be flexible.
20	Int2	Yes. We are doing new things all the time. So it is hard to say when starting how it will go, because some things will be adjusting, taking away or adding. It is also hard to know new things that we have not tried before, how hard it will be to fix them and how long will it take.
21	Researcher	What is the decision process when you decide the methodology? Or is it always the same, because you said it is flexible. So what it is the decision process when you should decide how to go and what are next changes to make in the process?
22	Int2	We have tollgates that are defined for the hardware projects. And also for the software it is software program, but in-between those tollgates it is everything… or every project manager can decide how they should work.
23	Researcher	So it is more a local decision?
24	Int2	Yes. Axis has a lot of local decisions. It is the team who decides how to work and what best suited for that team and that project and that product that is going to be build.
25	Researcher	Can it be that team is always working in the same way for different kinds of projects?
26	Int2	Could be, but normally for hardware project it is different people every time. So for every project it is different people. The project manager in the team has to decide: in this project we have to work like this, because that is the best way for us. As long as you the tollgates and have everything in place for them then it is up to you to decide.
27	Researcher	Do you think there are challenges that teams are facing?
28	Int2	It put high demands on people that they have to take all responsibility, but they also have a lot of freedom to choose how to do things, so maybe it is not suitable for everybody, but for those who like to have more freedom and a way to influence their own work, then I think it is fantastic to work like this.

29	Researcher	So when we are saying about the decision process, you said that the most important thing to take into consideration is: quality, time and that all features are done basically. So these are the only. It is not like stakeholders or something else?
30	Int2	It can also be the cost of the product depending on the market segment and so.
31	Researcher	I see. So regarding the topic itself ... What are the best ways to apply different project methodologies and what are the micro factors. What do you think can be the valuable outcome or if it can be valuable?
32	Int2	It is good to know the pros and cons for every methodology, so that you can easier chose one that suits you and mb that is adapted to fit the project you are working.
33	Researcher	So more a guideline that shows you what to do?
34	Int2	Yes, I think that is good. For example, if to take the Scrum way, you can say it is almost perfect, but if we do this adjustment this will work perfect for us. It is good to know the strength and maybe the weaknesses or kind of a description that can be easily seen: this bullet points are perfect, but these we want to adjust, what are the main ingredients in each methodology.
35	Researcher	Is there any documentation that you use? Or what is the knowledge sharing process? Let's say when you start a new project, is there something that you should go through to see how other projects went.. some guidelines that you should follow?
36	Int2	There are all these processes like HPDP on hardware projects, or there is one for software as well, and then each team has their own process. Ours is very well documented, because we put it in place only a year ago, so there were a lot of investigations on how we are going to work to make it the best way possible. And then there are also things on the product (like the requirement specifications and the ordering and the design documentation and so). We document things and then we have this software process that we are showing and getting feedback. There are a lot of things that are documented but not exactly the same way in all teams.
37	Researcher	When the project is done is that you should document results or some knowledge that you got during the process?
38	Int2	Normally we do these lessons learned in a project. That is part of the process at least.

B3.   Pilot interview 3

Line	Person	Content
1	Researcher	Could you please tell me about what your work involves?
2	Int3	Yes, I am working as an Engineering Manager at the New Business department at Axis. I am manager for the project in mechanics team at New Business. I've been through the big part of the Axis journey. I am Electronic Engineer from the beginning, my team is working in the development of different kind of products.
3	Researcher	This is mostly with hardware type of projects, if to sum up?
4	Int3	Yes
5	Researcher	Can you share more information what are these projects about? What are the processes you have and what methodologies you use there?
6	Int3	My team is developing hardware for our product - electronics and mechanics. As for development model we are using, it is more or less of Waterfall-like methodology. Since this is hardware you really have to do things in the certain order. The processes are classical: arrive, start phase, planning phase, execution phase, acceptance phase, then you go to production and then you have a head over phase to operation or the production line. We are trying to build in more agile ways of working when we have sprints, iterative type of development. To some extent it is good and easy to implement, but on the other hand it is hard because when you are doing mechanical, the tool costs everything between 100 000 to half million SEK and it will take about 6 - 12 weeks to get the tool ready. Therefore, iteration cycle is quite long, and it is really hard to have quick changes. But we can have minor iterations especially with a new technology like 3d printers and so on. We can make a lot of prototypes much faster, but the prototypes are for mechanical proposals only. You have to make real hard tools. Same applying for electronics, you can only do some minor tests. After all, you have to produce PCB and then PCBA (PCB with multiple components on it). It is very expensive and also takes time, in the best world it takes 2-3 weeks before we get the PCB, but normally it takes 6-10 weeks before we get the multiple PCBA. We also have to order components in advance, so the iteration period is quite long. That is the main thing different from software.
		Overall, we try to go in that direction, try to have small iteration, make small PCB, small test boards, try to isolate parts of the PCB, just test the LED or just test the IOS, we take everything else away. But we are quite limited. Moreover, when we develop the hardware it requires cooperation with external companies. The same for electronic, we have a lot of cooperation and external dependencies. It make it kind of tricky but that is the fun part of putting everything together. We also have a lot of internal interests and stakeholders at Axis since we have a lot of

		different operations. The mechanical parts are central in projects and everything is circled around it. As we are building up the products, we have to deal with material booms and so on by the mechanical engineers. We try to learn as much as possible from the software development teams because they have been there for a long time and we are quite new in this area.
7	Researcher	Is it that something is changing during the process, can it be that requirements to the product are changing?
8	Int3	Yes, it could be changing during the entire project, absolutely. And in different phases you should have certain amount of majority. Of course, you have a concept, but everything is more or less open until the project is closed. That's little bit hard because for EMC you have to have compatibility, and you can't really say that you are to fulfil the standard until you have the final product at hand. You have to keep track of every single part, every single demand in the product during the whole process.
9	Researcher	Who introduce the changing requirements? Is it one person who is responsible for that or are there any limitations like when the project is started you can't change this?
10	Int3	The Axis way is never closed, we always have new things, new changes, and you have to start when everything is open. When you have the planning phase or the concept phase as we call more in hardware, we try to narrow down the scope to see what can we do and what should we promise to deliver. The scope of the project and product requirement specification is locked here. After that point you actually have to add formal written change order to introduce change in the project, so that's much more formal, if you are following all the rules. But sometimes what we are struggling with is a wage PRC, so you don't know if you are actually changing the requirement or not because its wage. PRC is what we have a potential to improve, but we aren't there yet.
11	Researcher	Are these change requests something that you see a lot in the project? Are there a lot of requests?
12	Int3	Not after class review, there we are quite good to keep the project. Scope creep might happen (…) the hardware project in average is 18 month long, but if it takes from the start and 18 month later the world has moved on. The teams are changing quite rapidly so it might be that some aspects of the product have been tweaked during the process or we had learnt more from the market, relating to customer demands. So absolutely every project have some changes but not that much after the class review. At NB we have this challenge because we are moving into new areas both for our sales and also for our linear team, at certain areas we are really beginners and there we learn something new. Especially in the concept phase when the product owner has the idea what

		to do and we try to narrow it down, make PRC and dig down the scope. As we are building an understanding, the scope is really fluctuating and moving from the one side to another and sometimes we came up with the completely different product. However, this is not the optimum for project planning and for roadmap planning. We have to find better way to work with all these uncertainties in the beginning, so every suggestion will be appreciated.
13	Researcher	Is it that sometimes you have combined projects? like that other teams that develop software collaborate with you?
14	Int3	Yes. In the project we have electronic engineers, we have mechanic engineer, firmware engineer, some form the web teams and a lot of different teams that are involved in this and QA teams. There are a lot of dependencies, always firmware really needs hardware to actually run the firmware, and we need firmware to test the hardware, there we have a lot of collaborations.
15	Researcher	But as we understood the firmware and software projects are using agile approach (like Scrum). Are there any issues when you collaborate with them? Cause they probably demand more changes from you and they have little bit different way of working? Are there any challenges that you have seen?
16	Int3	Yes. One challenge is now with a program, they are depending on the backlog with ongoing priorities, so they really cannot say if they can deliver on. In that we are little bit struggling, so Project Manager have to follow the team every day to see if the backlog is changing, if priorities are changing and cause the program team is not the 100% allocated to the project, the priorities in the program can change in a minute. I don't say it is a big problem today, but it is a challenge to track that.
17	Researcher	And these are the different project managers that set the priorities?
18	Int3	Yes.
19	Researcher	But who is the main person to set the priorities?
20	Int3	In the end it is the head of the department, and product management team. Department heads are running the program in their respective areas, and that is up to product management if they can't decide by themselves. But in the project that is the project manager that is running tasks. So it is a little bit complicated, a lot of dependencies. In the hardware projects we had a steering group, there we aim to have all people that have something to say about the prioritisation: we have sponsor, those who run the project, and also directors (program managers), also the main line manager and representative from the operation part. And depending in the complexity of the project and how many problems the project had, we have the steering group in different

		frequencies - some every week, others are more smooth so we have them once in month.
21	Researcher	What is basically the process of decision making when it comes to the methodology that you apply. Lets say you have been more Waterfall-ish but then you decided to have agile iterations, who is then the initi-ator of these decisions - improve, develop or change methodology?
22	Int3	Everybody decides. At New Business we have the opportunity to work in other ways, we do not necessarily have to follow the HPDP process. But we have a lot of collaboration, so if we are changing the process, we will have big challenges to cooperate with other teams outside NB. But with that being said if we are following the main part after the main deliveries and main things in the process, how we are doing in-between these tollgates doesn't matter. We try to find for every differ-ent project which is the best way of working for people, because there are different people in the project and different people like to work in different ways. Some are very blue in the way - they want to have eve-rything listed exactly, others want to have all the goals, with some we are working really agile and iterative. So we try to have this freedom in the project but with that said we still try to have red line - something to hover around so we do not go too far away because people are com-ing and going away in the projects and if every product has completely different project is it really hard to actually to move in new resources in product and get help in the project.
23	Researcher	Are there any success factors? We understood that there are no KPIs at Axis, but then what is the most important? That you measure success in the very end? How do you know you are on the right side of using the methodology?
24	Int3	If everybody is happy at the project. (…) In the end the bottom line is the time of the project. If you try to narrow down what takes the most time of the project, very often you come back to the methodology, in which order we did things, and what decision we took or not on the right time of the project. But if you talking to the project team even if some project has taken 24 months, we have been quite efficient during and people are happy. You feel that in the team if the methodology is working, everybody get input, get the data at the right time in the pro-ject. And also, if the methodology is working really well, you will re-ally see it in the acceptance phase when we do all the major testing at hardware, when all parts are fitting together, and the production is run-ning smoothly. If you don't have the right methodology in the begin-ning, you will see that in acceptance phase and very often the product will be more expensive also. If you have the good methodology that catch all these tricky things and all these possible risks at early stage and close them, the acceptance phase will go smoothly and save a lot of time. But in the end, you will see from the time, that's the best KPI.

25	Researcher	Are there any knowledge management? So let's say at the end of the project you see that the methodology was perfect and everybody was happy and it was right amount of time. Can you store these knowledge somewhere and do you?
26	Int3	That's the hard thing. Every company is struggling with lessons learnt. This is easy to make a list of the lessons learnt in the project. You can have some different views on how to collect them every month or in the end of the project. But nevertheless, the tricky thing is that every project is struggling with how the spread lessons learnt after the project. Sometimes we have really useful lessons learnt but they are stored somewhere long deep in the project library.
27	Researcher	Are there any documentation that you use in the begging of the project, some guidelines?
28	Int3	We have sometimes. For electronics we have document with best practices for different development parts. We have collected them in knowledge database, but that is for development and we try to make engineers to read it. If you talk about the processes, we don't have the same lessons learnt collected. From methodology perspective we can make something better.
29	Researcher	So you think it will be important and helpful to have?
30	Int3	Yes. But then how to make that and what type of information should be there. Because nobody has time to read everything. You have to have a way to manage, sort, prioritise and lift out really important things. There should be an owner for the library to collect and bring it together, to take out main points in lessons learnt.

B4. Pilot interview 4

Line	Person	Content
1	Researcher	(…) Could you please state your position within Axis?
2	Int4	I am global product manager for Axis Control.
3	Researcher	What kind of projects are you working with? Both projects and products?
4	Int4	In short products are physical devices that come in a box which we call a sales unit. They are pieces of hardware running on embedded software that can take care of opening and closing doors. That is for Axis Control. Then we have a new solution (…) managing the software to support the products. That is more like a solution. Both

		software and hardware now. That is basically in the product we have. Projects can be aimed to support the release, launch and maintenance of the products, and we have different kinds of projects depending on the purpose. Development projects (…) are about how to build and manufacture products. (…) Maintenance projects, which are about supporting the product and getting the defects repaired, are post of sales projects. Different kinds of projects are involved depending on the lifecycle of the product. In addition to this, there are services also. The one I am mostly involved with are the development projects, to get something from scratch and try to build the total product for our solution.
5	Researcher	Is the final product always a combination of hardware and supporting software?
6	Int4	(…) No, we also have accessories that are purely mechanical. They are passive products with no codes running on them. We have products that are pure software, that does not have any containers. We have for example ACS , Axis Camera Station, a product we are working with, a Windows based application. You need to run it on a Windows Server. So there are different kinds of products, overall we provide solutions to our customers.
7	Researcher	When you develop a product, you plan to build a hardware and also the supporting software. And then you divide it on to projects and managers and teams are assigned to that?
8	Int4	Yes, generally that is the process, but I am only a small part of the whole process. So my perspective, as a product manager, we are closer to the regional team and the customer from who we collect the feedback and do the marketing research, we have a business development team, who are supporting us what type of products we could be building, best of our technology and capabilities. Then from a product manager perspective, which is about collecting all the information and then make valid business plans along with the product proposal. We would build a product proposal with a valid business plan, a business case to support that, that would be including what could be roughly the cost of the product when it comes to raw materials, what could be the gross profit we want to get from the products, and what is the volume and timelines we want the products to be released. Basically, we give an outline or framework for the whole product. A little bit for the portfolio perspective, we have a long-term vision, it is not a single product, but more like a product line. That is it for the product perspective. Then we hand over the product proposal to the development team and to the top management team. The top management team needs to align with the different function teams and different business development teams to really make sure that "Okay, so the products we have in our proposal really makes sense for the whole scope of Axis". Other part would be the development team, what type of capabilities, resources and time plans would be required for these products.

		We need to get an agreement at some point, "We want to have this product and everyone is on board and this would be the cost and time plan to launch the product" (…) Once we get an agreement, the project can start. So, they will separate different projects to support different functions, as a part of the total solution or part of the product. For example, in Axis Control we have products, we have a project running the firmware, but we also have project mechanicals and electronics, that is dedication and testing, and also, we have projects taking care of the pure software development. Some projects not mentioned before, that are out of the New Business scope, but still act as supporting projects, are customer support and industrial projects. The goal is the same, always want to have a successful product launch and good business.
9	Researcher	You mentioned you decide the timeline, what are the factors influencing this? Teams, people, something else?
10	Int4	No, that is not part of my consideration. When we build the product proposal, we look into our side, from the market and competition perspective. Our need for this product for keeping and getting new customers. We also need to get our salesforce team to agree, to be aligned and on board. They need to be ready to support the launch of the product and try to get customers on this product.
11	Researcher	And the company needs to stick to this timeline?
12	Int4	We have the proposal for the timeline, but it is not set in stone from the beginning. We have a buffer. We give a clear directive though in the product proposal, for example we want to release this product in Q2 2020. Then the development team will study and do an analysis, in my experience, based on current resources whether they can agree to have the product launched in Q2, or if the earliest is Q3 or Q4. Or something like that.
13	Researcher	How do you monitor the progress? Do you have tools or success factors?
14	Int4	To be frank, the only thing we measure from a project development perspective is the launch time and quality. That is only from a development perspective. From a product perspective the thing we focus on is how the sales goes. What are the volumes and the feedback from the customers and from our regional teams. That's the KPI for product management. (…) We are not deeply involved in the project development process. (…)
15	Researcher	Do you have meetings with project managers to check the timelines and if everything is going right?
16	Int4	There are two aspects in this teamwork. On one hand, which is related to product development, the product is not a fixed box and we keep

		receiving requests for new features and to improve the product. We need to work closely with the projects to make sure this happens. On the other hand, we normally have a steering group, that would include top management, project managers, product managers, possibly other functions' teams. It is a small group for each of the products, where we regularly review the status and try to understand the risks before the launch, and how to mitigate them. Basically there are two levels to this cooperation.
17	Researcher	Do you have any struggles or challenges with this system?
18	Int4	To be frank with you, everything will have challenges. But the problem is how we keep on going and moving in the right direction. For example one challenge we have now is the corona virus. Some teams working from home and so on… Anyway, once we face these challenge we need to realize we have risks and come up with fast responses to adapt and change. It happens all the time.
19	Researcher	What are the most important factors to take into consideration?
20	Int4	Firstly, it is not up to me, but more to project development. It will be a team decision as it is a joint work. When it is about the priorities, they are whether we can keep the product proposal or plan. Because a lot of other teams are involved in launching and maintaining these products. From a product management perspective, we need to make sure that everyone outside the development team in the same company needs to be aligned and prepared for the potential change and issues and also we need to have really good communication to the customers to make sure they understand and accept the difference or changes. Of course, that is not something we are really looking forward to. We want to have a smooth release and launch and every customer happy. That would be a dream world.
21	Researcher	Let's say you are trying to introduce a change and the engineering team says it would be too difficult and it would take an additional amount of time and resources. What would be the process to measure the profit the new feature or to decide if it is viable to introduce it?
22	Int4	I think I understand the question. In short, it would always be case by case to be frank. We do not have rules set in stone that you need to follow. The simplest rule is I would say is that everything has a cost. If you want to have something and want to change something there will always be a cost. The cost could be, as you said, delays or more resources. This time we need to balance. To me this balance is quite important. If something has a high priority, form a product management perspective we are always prepared to sacrifice something. Either features, or products or sales figures, revenues coming, or losing customers. It is always a balance. In the end of the day, from my experience there are no rules to apply. The communication is really the key. Once we make decisions, we really need to make sure to involve

		everyone from launch to maintenance. Everyone needs to be aligned to be conveyed the same message. Of course, there will be a lot of uncertainties, hard to say if the way we choose is 100% right. It is tough, sometimes.
23	Researcher	During the planning and concept phase the requirements are more or less set, but sometimes they can be quite vague, which leads to difficulties in later development stages when changes need to be introduced. What do you think the best approach is to deal with this?
24	Int4	Again, from a product manager perspective. Most of the changes and deviations to the plan are not introduced from the product manager side but are requirements from the market and the customer. The key is to respond fast and to be agile. From our perspective this is why we push to be agile. Waterfall product development or business development does not work. One example is that we work on software development on our camera stations. One of the requirements in the product proposal is that we want to have an *agilish* release, basically we want to have high frequency releases. Every six to eight weeks we should have a capability to release a new feature or new service release with bug fixes. We already considered our agile capabilities of the products into part of the products right now. We want to define as a product proposal to have this flexibility to continuously involve in the products. So that is in the product proposal and passed on to the project development. And from the resource planning, capability planning perspective, we as product managers, really hope the project can cope with these requirements. I understand, that of course, there will be, again, case by case discussions and also changes will always affect the existing development plans, of course. That we understand. That is why we really try our best to keep clear plans, feature requests from the beginning and try to be the frontline of the future to the outside and make sure to follow our plans. But you never know. And customers always have a strong say here.
25	Researcher	How do you collect customer feedback and how do you channel it back to development motivating the need for features and fixes?
26	Int4	It happens on different levels. The customer does not provide feedback directly with us. They share it with the regional support team or regional post-sales team. Then the post-sales team they have their internal filtering based on our agreement before. They will relay the information to the regional business development team. Our champion team, so someone from the region team, a second line of support to the business development, to take care of this type of feature requests. They somehow relay this information back to the product manager levels in the headquarters. Of course, we work really close and try to shorten the distance on the different levels. (…) Basically, the product manager acts as a central hub to collect all the information and also try and make the priorities and try to get the set priorities agreed on

		internally and externally. External is more about regional and customer levels. Internal is projects and development.
27	Researcher	Sometimes it is a question how much we should listen to customers. They might want to introduce a new change, but sometimes it is difficult to satisfy everyone. What would you say about this dilemma?
28	Int4	To me, to be frank, to be really clear, I think the customer is definitely is the only most important voice we listen to. Of course, we have two different kinds of customers: one type is the existing or short-term business opportunity customers. We basically want to get revenue we want to get the projects to make them happy on a small issue development or a short-term performance improvement basis. Another type of customers we call virtual or long-term customers. We are trying to solve what type of products should we deliver to get more customers in the future. This goes back to the levels I mentioned before: we get input from both internals and externals, to understand what a potential need from the customer from different verticals could be and also, we have a second level which is business development. The business development team is looking at 3-5-10 years long business plans. These are not short-term visions. The regional business is representing the long-term vision customers inside Axis, so we listen to them. To me, it does not matter which type, the voice of the customer is what's most important.
29	Researcher	Would you like to have more agile development processes? As we understand with hardware, even if they try to introduce more iterations, it is still hardware and the quality is very important and they might not be able to develop in Scrum. Would you say from a product management perspective you would like to have a clear agile way of working or would you settle for a *waterfallish* hybrid solution?
30	Int4	I cannot speak for other teams or other product lines. If I look into our counterparts for hardware perspective, before we had kind of 2-3 times releases per year and every single release will require a long time of testing, modifications and that is really painful for the product perspective. Some customers have a new feature request or want to have better solutions and our response is really slow. Customers pass on this frustration to the salesforce and they might lose their patience, their interest in the products. From a salesforce point of view, we always want to make the customers happy and want to be confident in the product itself. That is really the key in driving the business. So, if we cannot really cope on their requests, which is on behalf of the customers, they will lose the customers. Then they will not actively promote the products. That will bring trouble in the future. That is why I was thinking to be more responsive both internally and externally. If you look at different solutions from a software perspective this is why a lot of the solutions go to the cloud or a more easy-to-deploy mode. You can run the updates then any time you want. It is really low-cost or no-cost from a customer perspective, which is very important to us.

		There will be a balance, I fully understand. I was a developer before, and I know it is hard to keep adding new features and responding to requests and there is a need to receive clear guidance. But to find a good balance between these two worlds is very important. My message to project managers would be "faster and higher". Higher quality, performance and product standards, higher costumer satisfaction while faster responses. That would be my conclusion toward project managers.
31	Researcher	Do you have any internal documentation describing or guiding this process?
32	Int4	Not that I am aware of, no.
33	Researcher	One more question, if I may, about the message to project managers. Do you think they are aware when to have higher quality or how the project influences customer satisfaction? As we understand, there are not many measurements in place to track project success.
34	Int4	That is the way how we want to work as a team. When I say "faster and higher" it is a general feedback. But looking into the products we have a very clear communication and aligned in the targets. Since there are different positions perspectives and angles, it is really good to have different foci on different targets. This is how we can balance to have a good output. My message was only from a product perspective.

B5.   Pilot interview 5

Line	Person	Content
1	Researcher	Can you please tell me what you position involves?
2	Int5	Yes. I work as a Project Manager for one at the access control projects we have in New Business. So my main focus is to do an integration where we integrate access control software into another solution ACS, which is an internal client here developed by Axis. And I have been working as a project manager for 2 years now.
3	Researcher	What are your views on the project management in general and in combined projects? What methodologies, overall view?
4	Int5	There is a big difference between hardware project manager and software project manager. In Axis the process for being project manager within hardware is very straightforward, you have different tollgates where you are not allowed to move forward until everybody has agreed that you have reached a point where everything is set. And then

		you keep on building out according to Waterfall method. In software it is much more agile of course, where we don't have visualised milestones all the time. And it's also looser with the deadlines compare to hardware. In my opinion. In my previous project we were working more with the deadlines in a higher level, but in this project we were not able to commit ourselves to a deadline unless we did more hardware; having hard deadlines with milestones and making sure everything is aligned in another way that we are used to. One of the main reasons was that we have different teams that works with different schedules, we have different working methods and also have a backlogs which integrates to different teams or different projects. So that was one of the main reason we are still trying to do a more Waterfall principle compare to what we are used to do when we are working with software.
5	Researcher	Do you think a model that will help to combine projects in agile way is useful and necessary?
6	Int5	I see a lot of benefits with working agile and do agree on some of the benefits but being agile doesn't mean that you do not have deadlines. We still have to be able to have some kind of milestones to make sure that we are delivering stuff on time and that we are delivering the right stuff in time. But I know I have been doing lessons learnt with all the project members when we did half the project and all of them agreed they want to work more agile then when we had done initially with this project. So I will like to have a process that allows developers to be agile and feel that they can build something really small and then keep on building something bigger until we reach MVP but I still want to take that process and make it applicable to roadmap work and deadlines. So some kind of hybrid method between both world would be great.
7	Researcher	What do you think the challenges or struggles are for the processes?
8	Int5	I think one of the things I am struggling at the moment is to do good enough and not to do the things that will make this great, because if we want to continue to make everything perfect without taking shortcuts, then we never going to reach a point where we can do a release, so I think it is to find that balance, where the product owner says this is good enough, developer says this is not something we are all excited about, but it is good enough, it is working and then we have to have something that we can still keep and maintain but maybe not in the extend we wished for.
9	Researcher	But how can you measure that it is good enough?
10	Int5	We are doing that by having demos, so once every other week the developers show what they have implemented, we have QA doing tests and performance and stability. And then we are having review meetings trying to have one stakeholder from each area together to do

		the estimation if this is good enough. So at any time QA can say no, because the performance is too bad we want to improve before we do the release and then the project manager/owner can say well, I think it's more important to move on to the next feature or yes, I agree, we have to do the improvement. And then developers can go in-between and say well, if we are going to do those improvements it's going to take another three weeks. And then me as a Project Manager can help them find a good balance between all the different stakeholders.
11	Researcher	So how would you rate the responsiveness of this method. So let's say you have a release and you have some feedback from product managers or even the customers. How do you find a balance of how much you can actually listen to the customers and how fast you can respond to their demands?
12	Int5	So, all the customer feedback is coming from our product owner, so he is the one making request but also taking care of the feedback of the current pilots. So there is one flow into the project on request. It doesn't have to be like that, it can also be directly to developers or product specialists and so on. But my goal for the project is to have one backlog where all the different stakeholders help me prioritise which is more important - is it to do customer feedback, do the bug or start working on a new feature and they help me together to do the prioritisation of the order. For instance, at the meeting (3 times a week) we have developers, QA, product owner and product specialist together talking through the backlog. Then, the most common solution is if got customer feedback or any feedback saying we have to do that important - then many times we will do a smaller improvement that makes it good enough to make everybody happy, but many times we don't do it to the full extend because it takes too much time. So we have to also consider if we do an improvement maybe we're making one customer happy but it's up to the product owner to say okay, will this sell any more product or does it only cost us a lot of effort instead of focusing on a new stuff.
13	Researcher	Relating to the meetings, are you the person that can make the final call of what should be the optimal priority of the backlog?
14	Int5	So if we don't reach agreement, it is always good discussions, a lot of feelings involved but we usually solve it at the meeting. If we don't reach agreement, then I have a steering group and they will help me during prioritisation. At the steering group meeting I have the sponsor, the person who is holding the money bag for the project, I have the project product owner, all line managers and all project managers. So, if we can't solve it on the first level, then we will escalate it to the steering group meeting and they will help me to prioritise which is more important. But usually it doesn't come to that.
15	Researcher	What would you say how often is that you have the right data to support the argument that helps to prioritise. Especially when it comes to

16	Int5	customer feedback, other bugs that need immediate fixing. Because I suppose it is a very tough decision to make the order in the end.
16	Int5	Yes, it is. So we have a system that takes care of all the bugs and it can also be a tool for change request and so on. So if people create a ticket saying that this is bug, we always try to have a high level of a good enough ticket, if it is just a one line, no picture added, no descriptions on how to reproduce the problem, then we will send the ticket back to the person that created the ticket adding that can you please add more information before we can do the prioritisation of the ticket. And hopefully they will do it in a day so we can talk about it at the next meeting. Of course we can't prioritise if it's not enough information. But most times at least one person that represents the person that added the ticket is at the meeting and can fill in the gaps.
17	Researcher	Is there any way to measure internal efficiency?
18	Int5	So, about 75% of the project members is working according to SAFe. So once every seven week we plan what we are going to do the next six weeks. We have the full day when we are looking through backlogs of each team, looking for dependencies, risks. And then the teams themselves commit what they think they are going to do in the next six week including vacation and so on. In the end of the day we put up notes on the board, where we draw all the dependencies and seeing if one team wants to do a feature but they don't have any web support then they can't finish the feature before web is free to help them. So we are trying to plan according to all the dependencies between the teams. The struggle in my project is that 25% of the project team members is not working according to SAFe. They just working with the Kanban, and the most important things at the moment. So I think it's working really good with SAFe, when people commit to it, but it doesn't help much if there are some dependencies who doesn't commit to the work ahead. And once every week within the six weeks (3 times in increment), we do a demo for a team, what they've done and then we can see in the backlog how much is left. So they can highlight, we had three person sick last two weeks, so we haven't done as much as we hoped, we can mitigate by doing this and that. Or otherwise we just look at the backlog and say, okay we are not going to do all of it, so what's the most important, where are all the dependencies or we will have to do a small replanning. And that is also a good way to show the velocity of the team and seeing how much they have delivered every six weeks.
19	Researcher	You said that SAFe could be something that works, but you would prefer a hybrid model, so we were thinking like when you try the roadmap what are the most important factors there?
20	Int5	I would say when we are doing the roadmap work its always the product owner, who initialise the meeting saying this what I'm wishing in

		the upcoming one, two, three years. This is the vision; and I'm hoping I can get everything in the timeline said, but this is just a wish list. And then all the line managers together with all project managers go out from the meeting and have about few weeks to discuss if it's possible we do estimation of the work on the high level using the T-shirt size. Instead of saying weeks, we are saying this is extra-small, small, medium and so on. To have something to benchmark with. We are not saying exact days or which competency we are going to need. Just the gut feeling and then the project manager is trying to see if we have correct resources and plan in which order we can do and see if there is more efficient way to deliver and then we meet again after few weeks together with the product owner and tell: we can do all of these in one ear, but maybe we can do 75% in this order, without this feature. So I would say the product owner is a key player but it's always a joint effort to make it happen.
21	Researcher	But back to the KPIs. Why do you think at Axis you don't use KPIs? Is it something that should be introduced when the company is growing, or the flexibility is more important?
22	Int5	So I do see the benefits of not reporting like that, but I also think it is easier for company like Axis, where we are doing huge profits, especially for department that is working in new areas, not to have the pressure that we should gaining much from a project. We want to explore new areas and see if this is Axis new big thing. For us it would be really hard to measure KPIs and stuff, because we won't take the risk on that we expect to do. It's hard for us, but maybe for the rest of Axis that is working with the video there are both benefits and not.
23	Researcher	Do you have some good examples or best practices related to methodology?
24	Int5	When you are working within teams, when you have all the resources dedicated for the team, I think Agile work is most beneficial, maybe not focusing that much on the estimation, but building something small and improving, until we have something good enough, its a good way of working, because we are not focusing too much on the wrong stuff, and it is including everyone to keep on reviewing where we meet somewhere in the middle. But in our project, it is hard to keep on improving, because we do not have all resources dedicated to us all the time, they have different backlog. I have to do the estimation to make sure we have the right people at the right time to create features.
25	Researcher	What documentation you are using? What do you think about knowledge sharing?
26	Int5	Within access control we are trying to share all the information. We have four teams, and we ask to do a feature the team that have the specialisation within the area. But we are trying to spread the areas,

		so that another team can make the same work and also so developers feel they learn new and explore new areas. And it is hard to find balance. Because we want to make feature as fast as possible, and it is easier to talk to person that is experienced in the area. I wish we are better at it.
27	Researcher	What changes needs to be done when the company is growing to stay efficient?
28	Int5	I think it is keeping small teams. It is hard, because we are becoming more people and we can't know everything, we are splitting in more teams focusing on different areas. We need to have someone who leads in the area, but also have a ground where everybody has enough knowledge to help each other. So we don't have bottlenecks.

B6. Interview 1

Line	Person	Content
1	Researcher	Could you please let us know more about your position and responsibilities?
2	Int6	I have a long career history as people and project leader, steering software, hardware and change management initiatives in an international homeware retailer. My responsibility is to lead any digital project that comes up. Could be software, hardware or change management of any kind. That is what my department does.
2	Researcher	Could you tell us about the project management methodologies used, and when you mention software and hardware, what those projects entailed?
3	Int6	It can be very different. I have been working with a lot of different software projects. That is my main area of working. Everything from standard waterfall to very agile, working with Scrum, or Kanban projects. Developing both new solutions but also changing older solutions, modernizing them. From a hardware perspective I am currently working on a hardware rollout project, so we are switching out Wide Area Network hardware in the entire company I work for. The hardware project is more of a waterfall-based way of working, as you need to know what you will order. We do not manufacture hardware in the company, so it always comes out with a procurement. The thing with hardware is that you cannot change it as you go. Therefore, it has to be a waterfall approach. Then of course a hardware implementation project can have agile influences still, but for the actual procurement you need to know what you want to buy.

4	Researcher	What about the requirements for the hardware projects? Are they set in the planning phase and you develop it until it goes to production? Can these requirements change throughout the process?
5	Int6	It depends on what kind of hardware we are delivering. As I said we do not manufacture hardware. (…) What we do here is we have an IT solution (service), where we have software and hardware. In order to develop that solution, we need to identify what hardware we are going to use. Of course, that would definitely be done in the requirement phase. When you have gone through that phase, you would start the procurement, going out to vendors asking for that hardware, which fulfils the requirements.
6	Researcher	Do you have strict guidelines that you need to follow in the projects or is it up to the project manager or steering group?
7	Int6	The company I work for had several phases. I was working as a project manager for some years and then I was a line manager and now I am back to project management again. When I did my previous session as a project manager, it was kind of strict. We were using Practical Project Steering, developed by Tieto. It is a project steering methodology mandatory to use with its decision points and templates, so it was very steered. For software development, way back, we were using Rational Unified Process as our mandatory tool, but as agile came in more and more into the company, we started using influences from Rational still, but we were kind of doing whatever made sense for the purpose. For example, design documents. Sometimes we used influences from Rational, but sometimes we did not. We basically picked what was popular on the market. If you look at how it is nowadays, we do not have a forced project methodology that we use. We still have PPS as one of the tools we can use. It can be customized for agile as well, so we are not hindered to use that, but the company is much more open to take whatever methodology you can find and what is suitable for the project. We are much more flexible today than we were before about which methodology to use. So, for example, when you work with an agile project, you basically, from a methodology perspective, or from a work perspective, could use Scrum or Kanban, or a combination of those two, or whatever you want to use in agile. And when, of course, it comes to the documentation, many times you pick up what is the best practice and use that, and there are no rules or guidelines what to use. And from a project perspective, you could use PPS as an overall method, but you could use any way you want to steer the project with actually. We have PMI for an overall guideline, as the rules we want to use in project management, but as you know, PMI is not very detailed. It is very high-fly.
8	Researcher	What do you think are the benefits or drawbacks of changing things for a more agile manner? How much can methodology influence the outcome of a project? Could strict guidelines help stay closer to the

		scope, but a freer approach could deliver closer to the customer needs? How do you see this paradox situation that IT is going through?
9	Int6	My view is that methodologies are very useful if you are new and do not have much experience. As you build up experience, usually the methodologies are not that important anymore. They are more like key components of project management that you learn to understand. You learn to understand, why you have certain methodologies and why they are good, and then you start to, maybe, develop your own toolsets based on that. Many times, if you look at the methodology, or framework, like PMI for example, there are key things in that, which are really essential, but PMI does not describe so much *how* to do them. They (only) explain what is really important. And I think that is where the experience comes in. Yes, you can use methodology to support you, but if you have experience, you are usually not that bound to the methodology anymore. You can actually do a lot of things by yourself as you develop over the years as project manager. (…) If you have a project where it is very clear what you are going to develop, regardless if it is hardware of software, you still could use a more Waterfall-ish approach, but agile is very good at handling changes. So, if you don't really know what you want to do, then it is a lot better to work with agile. From a control perspective, my experience is actually that you have a better control when you work with agile. If you really are using the methodology as you should, then you have a much much better control over what you will deliver at what point in time at what cost, when you use agile. That is my experience at least.
10	Researcher	When it comes to combined projects, is software development the final stage before production, or does it happen mid-development when you start a hardware project?
11	Int6	If you have a project that is a combined software and hardware project, I would say, there is a requirement phase where you need to work together with hardware and software. You need to understand what kind of product or IT solution is going to be built. In order to understand what requirements you have on the hardware, you also need to understand, on a high level, what kind of requirements you want to have on the software. This is, actually, one of the things I would say is the key, if you work with agile. There needs to be some kind of tactical planning even if you work with Scrum, for example, where you create a backlog of user stories. You still would benefit from a tactical planning, because then you have some kind of idea what kind of features do you want to include in your final product. Even if the features that are developed may be changed or replaced later on, it is still a good idea to have a tactical plan that stretches more than three weeks ahead. A plan that maybe looks about 3-6 months ahead to say what is approximately what we want to develop on a high level. When you talk about features or epics this is what you want to have in the product. Then, if you have that understanding, at least on an epic level,

		that is what you want to do with the IT solution. Then you can have the requirements coming in, "Okay, this probably would mean that I would need this hardware". Now, we don't do that very much in my company, but it could be, that you are developing the hardware solution as well in some aspects. You maybe need peripherals to the hardware solution that you would find out as you go, but the core hardware solution I think, you would need to understand doing the requirement and design phase. That would be my answer to your question you had about how to combine hardware and software. I think, that you should do the requirements and design phase on a high level, even in an agile project, to get an overall understanding what kind of IT solution you are going to build, Then when you have an understanding, then you would start working much more agile, developing user stories and features as you go, and maybe you will change the detailed requirements as you go as well, because you get feedback from users on what you have developed. But I think, the initial phase, doing a requirement analysis and a high-level design, still is valid even if you have agile software delivery.
12	Researcher	How do you select the way of working in agile? What is the decision-process?
13	Int6	To me, it is very dependent on what you want to do. I have done pure Scrum projects, done Kanban projects and I have done combination of different things that were more waterfall-ish but with agile influences. It depends on what you want to do. Last project I had was a big big software project. I had a lot of experience with Scrum and I like to work with Scrum, but there you have these two- or three-week intervals where you need to decide what you want to do. You need to kind of stick to them otherwise the method would break. During those weeks you need to understand what you want to do otherwise the methodology could not suit you. In that project the uncertainty was so big, that we said that we cannot really commit to two or three weeks sprint intervals, we actually wanted to be much more like a manufacturing industry: we take in the requirement, we try to develop that and if that takes two weeks or four weeks, we don't really know, so, we just take them in and we develop them as we go, according to the priority we have. So, the level of uncertainty is the main criteria when you take the decision. If you are very certain, of course, you would then actually go to waterfall, then, that might be the best way to do it. The more you are insecure how the actual end product will look like, you will tend to go for different solutions. My preference, when you are totally lost and you do not really know what you want to do, then Kanban is really nice, because then you can just bring in the requirements and see what comes out. If I can, I would prefer to work with Scrum, where you have these time-bound sprints. Which could then deliver the result and it is a bit easier to control, I think.

14	Researcher	What are the measures, how do you control it? Are the success factors?
15	Int6	Yes, there really are success factors when working with agile and they are the metrics. If you don't have the metrics, to be honest, I don't think you are working agile. For me, with agile, you have a better control than you have in a traditional project. Here you work with *story points* for efforts, and you have the *velocity* to describe how much the team can deliver. These (metrics) are really key to work with agile projects. If you don't have those, you will never be able to actually do the continuous improvement that is the whole idea with agile. (With these metrics) you actually understand what you are doing, you can know how well you are doing, where you can improve. You can tune the process or whatever you need to do, in order to make an even better velocity for the team. I can see it in my company as well, that many times people start working with Scrum or Kanban, but they forget about the key element, "measure what you do". (…)
16	Researcher	What would you say what are the main factors in this measurement? Time, cost, satisfaction? What are the main things that you measure?
17	Int6	The main thing for me in agile is that you work on story points which is a combination of complexity, time and whatever, so there is a lot of information in that measure. The thing with using story points as a measure is it facilitates the discussion you have with the people who are going to deliver the software and the software who want to receive the software, the product owner. In that discussion, with having the the story point value, you will understand a lot more what you want to do. The story point as such is a good value to have to measure velocity. But the discussion that is based on the story point value that is really what brings benefit into it, because, for example if you have a discussion between the developer and the product owner where the developer says that a requirement would take 21 story points, and the product owner would say that "It is only a small requirement, you are only supposed to do that!" Then the developer would point out, that it is not what the requirement states, because it says something else and that would take about 21 story points. In that discussion, it might happen that in the end, the product owner would change the requirement to have it take only about 5 story points, because during that time they would find out that what they actually wanted is a lot smaller.
18	Researcher	What is the process of measuring these? Is it done daily, bi-weekly?
19	Int6	Usually, if you start with a software project, you usually start building up a backlog of some kind with user stories for example. Then the first thing you need to do is to estimate those user stories, both from a story point perspective, but also from a business value perspective. And the business value is similar, but that tells how much it is worth for the business to get the feature or user story. Those discussions are really key in order to kick off a development project. Then you should refine

		that backlog as you go, things that were not prioritized could be revisited, maybe there was a change of mind and they are not needed anymore and maybe the business value of those have actually gone down, so you need to continuously refine that. It can be done as a part of the tactical planning. Between the iterations or sprints that you do you also go back to the backlog to reiterate at least the things that will come into the sprint soon, so you can prepare the sprint before going into it. This is a continuous refinement you need to do on the backlog, otherwise there is a risk that you delivering things that are not so highly prioritized.
20	Researcher	Is there any rule of thumb when it comes to the prioritisation? What are the main factors? What can help you to prioritise what to do first? Some sort of criticality or anything?
21	Int6	Yes, that is also where the story point and business value comes in, because what I usually do, and this is not a mathematics in the end, but in order to present to the product owner, for example, that these are actually the user stories. that would give you the most business value for the least story points. Then you can have a discussion around that and say if it makes sense or not. Sometimes it makes sense, but sometimes it doesn't, so you shouldn't be mathematically steered, sometimes you have to involve feelings as well. (…) But I think it is a good way to discussion to have story points, which is the effort, and the business value, how much is needed of each. Then you have a discussion around that. If you see that you have really many story points with little value, then I probably would not prioritise those.
22	Researcher	What forms the business value? The customer feedback or opinion of product owner or product manager?
23	Int6	What I usually do when I work with business value is that when you have a discussion with the story points, for example, you have developers that are the key owners of the value for the story point, because they know how much it will take to program this, but we also have the business stakeholders - product owners, for example, and there can also be other stakeholders, that are part of this. Because then they will dig down in the understanding of what is the user story that they are asking people to do, what does it mean for the people who have to do it. The business value, I think, is the same thing. I would also involve, of course, the product owner and product owner's business reference people who are working in the area, those are the key inputs for that. But then I would also include developers, so they would get an understanding why does this have so high business value. I will always try to combine both of them. So I will not have all developers in the business value meeting, and not have all the business people on the story point meeting. But I will still mix them a bit in order to create a better understanding, that is also an important part of Agile - the communication and facilitating it.

24	Researcher	How is the customer feedback processed?
25	Int6	I guess there are many combinations of that, but usually the customer feedback comes to the people that are working with the business processes. Product owner, for example. And they take that (feedback) into consideration when they prioritise features. And if you have really good feedback loop, if you launch an app and you get direct feedback on that. Or you develop some features and you get that feedback directly. Then, of course, you can measure that in as well in the story point value setting. You could probably use some mathematics for that as well. Or you just take feelings of that and put it in.
26	Researcher	Thank you! Do you have any guidelines on the documentation of the processes?
27	Int6	On a high level, we have. (…) Most teams are using standard processes like Scrum or Kanban. We used SAFe as well in the company, but we are not focusing on SAFe as much any more, but we are still using influences from SAFe. But then it is very much up to the project team to see how much they want to document. When I was running Agile projects, I documented for the initiative of the project I was running. This is how we work, because there can be some customisation to the Agile, but usually (documentation) is on the very high level. Often, it is only pictures describing how it works, not a lot of text. So it's very light-weight documented, I would say. Mostly pictures, very little text.
28	Researcher	Let's say the launched project was successful, do you have lessons learnt from the project?
29	Int6	Yes, of course. But that is part of project methodology, that you always create lessons learnt after. So the lessons learnt from my perspective, one of the key lessons learnt for me from an Agile project, is you should believe in what you are doing. Whatever you come up with when you count about velocity and so on, that is very likely what will happen (that you believe in what you are doing). If you have a backlog of a certain number of story points and you have a certain velocity if you want to process that full backlog it will probably take the time that velocity indicates. One thing, the measures are really good in order to predict where you will end up. One other lessons learnt is, that you should never use proxies when you work with Agile, because they will not give you the correct result. You should not have "fake" people in the process. Like IT people that have the role of business owner. Because you will never get same efficiency that you would have, if you had the people that are really involved in the business talking to the people that are going to develop it. Then you will get the big benefit about agile. If you put proxies in-between, like business analysts or whatever, you will not have that full effect.

30	Researcher	Do you store the lessons learnt? Is there any way that you make sure that people that start new projects have seen these lessons learnt?
31	Int6	That is a good question, because that is always one of the challenges that we have had since I've been working in the company. I have seen several versions of it and it's always hard because when people start to work on an initiative, they probably have forgotten the lessons learnt they have participated in, and the projects are probably quite different, so it is really hard to collect them in a good way. (…) We store documents in shared folders. But I think we don't take full advantage of them, I don't think we are super good at taking advantage of lessons learnt, even if we document them and put them in shared folders.
32	Researcher	Let's say you have a perfect repository, with all the lessons learnt documented. How does it look like? What are the most important things in a lessons learnt document?
33	Int6	I would like to see the kind of pictures I've talked about - how they worked in the project. What processes they used and how successful they were. That I would like to see, because that is the most interesting. Also, I want to see how they worked with the velocity and how that was developing during time, what kind of improvements they made. Also, about mistakes they made, because when you work with agile, you always experiment and sometimes the outcome of the experiment is not as good as you expected, and those lessons are really important to understand what happened. I worked on an agile project when we did a reorganization, which we really thought would improve things, but after three months we had to give it up totally, because it was really a catastrophe and we didn't get the velocity during those three months. Those lessons learnt are really important to get about the failures you made, and you have to be open with them. Addition from e-mail: Lessons learnt should be smart searchable, meaning that the search engine should result in relevant hits, even if there is no exact match. For example "mistakes made in scrum projects".
34	Researcher	For the methodologies and the use of them, do people, like developers have any influence on the methodology?
35	Int6	Yes, definitely. That is how it should be. Usually developers are not that focused on the methodology as such. So usually you have to go in and facilitate the baseline methodology, you have to define this is the baseline how we work. But then, after that, you need to develop retrospectively and by continuous improvement, so after the sprint you discuss what has gone well, what has gone not so well, is there something to remove, something to increase or so on. And there the developers should really be the part of, to be able to influence. What I usually do, I let them control that process, so I just facilitate it. I

		create a baseline, so we start working. But then I let the team adapt the way of working as we go. And an important thing is if you don't have velocity and measurements in place, you can talk if it went better or worse, when you did the change, and why did it go like that. And sometimes you need to do some revolutionary changes, then you re-baseline the project. Then you will not have much influence from the developers, because sometimes you have people that are really resistant to change and don't really want to do something differently. Then you go in and you point a direction instead of letting it flow.
36	Researcher	So sometimes top-down decisions are still made?
37	Int6	Yes. For example, if the velocity continuously goes down or nothing is happening, you might go in break the whole boat and make sure that the pieces fall down in different places, so you can see if we can do anything new here. Sometimes you need to mess things up a bit to get something to move.
38	Researcher	Do you see some challenges in the current way of working?
39	Int6	Looking from my company's perspective, we were very much into SAFe couple of years ago. And that solved a lot of problems in large projects how to work together. I think that is one of the challenge we have today, because we are not using SAFe anymore. I think we have a problem to find another methodology. We haven't learnt what have we do instead of SAFe. (…)
40	Researcher	But do you see ways how to solve this?
41	Int6	To be honest, I really liked SAFe. That is my personal view. I think it was an excellent solution to a problem. But I think what was the problem with the company I work in, it is a common mistake when you implement agile, you implement the method, but you don't implement the reason behind it, so you lose the benefits, and then people don't see the benefit of it. It is like implementing Scrum you do sprints, you don't have any velocity, any story points, but you have sprints, backlog… it might look like you are working with Scrum, but you are not. So then you wont have any benefit of it, you don't get the three times efficiency. Because efficiency don't come that people are certain, it becomes more effective when you have a dialog, and better communication - that usually what increases the speed, not that you get more skilled developers, but that you have improved the communication. And that usual agile methodologies facilitate, it is a communication.
42	Researcher	Do you have benefits in the way you work now?
43	Int6	I can't say. I think the benefit is more that people can be inventive and come up with their own solutions instead of being steered by the framework. But from my personal view, it is not that efficient if you are using the methodology as a base. Because if you are not so

		experienced, you need the methodology to help you, get into place, do the right things and do the right process. The same is in agile: if you are really into it and really have the mindset, you will not follow the methodology strictly, you will take things that you like and you will develop your own, you will customise it to something that works for you. But to have the right mindset is the hardest thing to get.
44	Researcher	But what is the process to set the mindset? Because high-level management can introduce it.
45	Int6	If you need to work with it, you need to understand what the elements are. You can use agile coaches to support you, they are really good at the implementing mindset, but often they are not so good at solving situations that arise in complex projects. But they are good at setting the mindset, so they can be a good way to get in play faster.
46	Researcher	For a combined project, how to set the baseline there? If software and hardware are developed in parallel, what is the best way to work?
47	Int6	As we talked about before, we have an initiation phase in the project, where we do the requirements and the high-level design, then you can have connecting milestones, for example, if you have a IT solution, then at one point in time, there need to be connected milestone between the hardware and the software delivery. Eventually, you want to install the software you are building on the right hardware and start testing it. So besides the phase that you have in the beginning, where you actually combine the work with software and hardware and understand the total IT solution you want to build, you also should have connecting milestones where there are dependencies between software and hardware deliveries. For example, if you want to go into testing and test with the real hardware and not just virtual software you're running.
48	Researcher	What do you think the future will look like with the methodologies?
49	Int6	I think the hardware development will be more and more like software development as we are moving more and more into the cloud services. We don't have to order physical hardware, you can order virtual hardware, it will not be so difficult to change the requirements. My view is that hardware development will be much similar to software development since you will be building virtual devices in the cloud instead of buying physical devices. There will still be people that are building physical hardware, it will still be needed, and they still probably will have to build the project in waterfall. But most of the times you will have cloud hardware that you can deploy by yourself, and you won't need any physical hardware. I mean, I started my career in the ´80s, we were building own computers to run the software on, that's how we worked at that point of time. Because there wasn't any suitable hardware, that could run your software on. And then eventually the PCs started to come in, and then you didn't have to build

		everything yourself. Then you build cards that you put into the hardware. Compared to today, you don't even have to get your own equipment, you can just go to the cloud vendor and then you put the specifications there and you get it delivered the same day. So it's very different environment today when we have these possibilities.
50	Additional question over e-mail	Does velocity need to grow constantly over time or is there an optimal/utopian/blue sky state that it aims to get gradually closer to, in your opinion? Do you think measuring velocity might lead to pressure within the team?
51	E-mail response	Eventually a stable team will reach some kind of maximum velocity. Yes, velocity is supposed to give some feedback on performance which is some kind of pressure. I would say that part of agile is committing to things and deliver what you promise.

B7. Interview 2

Line	Person	Content
0	Summary of conversation prior recording	The pharmaceutical industry, just like others, is going through a digital transformation. Incumbent competitors are competing, and technology is one of the main drivers of change. This can be observed for example in drug development, how they look at marketing, digital becoming a core element of the strategy. Talent and building out capabilities are also important enablers in this change, a challenge being that there is no universal answer yet how to organize their ways of working. The current way of working does not help teams look at problems not from a technological point but how to effectively partner up with the business who own the problem and co-create a solution. Sales teams, procurement teams are working together with healthcare providers, discussing the benefits of developing certain drugs, essentially using digital solutions. The question is who the organization should engage in providing the best solution to the drug development teams. It is important to understand the best way of delivering value to the teams, the interconnectedness in the organization, the integration of multiple data sources and platforms. A possible answer to this is the creation of a product-team. Common questions to be answered here are how the team should organize itself, operate in a continuous way, act independently, manage interdependencies, break up the tasks into smaller bites but act as one towards a common goal, while scaling up within the organization. The team in its core an organizational concept. The company is currently running trials around it, how it fits within the environment and how it could

		be expanded beyond the tech scene. In the past the organization had success in enabling this way of working, which is called "product mode" in drug development and HR functions as well.
1	Researcher	What is the difference between teams working in a productized way compared to traditional project or program teams?
2	Int7	(…) Of course, it depends, on the wording. In essence, a project or program would have a start, a middle and an end. With a product and the way the product teams are organized, they exist while they continue to deliver value. It is kind of unpredictable as to how long that will last. So, the product has a lifecycle and the product team would remain intact and continuously evolve the product and drive value iteratively. Where a program or project would suggest that we know the *what*, the *how* and the *when* of the problem, the product team does not. Even though programs or projects can be run in an agile way, the difference is that you have that kind of visibility. Now, again it is all about wording. (…) Currently as an active transformation we want to transform these teams into this way of working and we have multiple significant initiatives we are working on. We are currently in the process of scaling up, building internal capability to allow us to take on more, but as an organization there is a bottom-up approach which has been basically bubbling up for some time, which is starting to evolve into this way of working. We are supporting them through the dissemination of information, but not with active coaching. The teams itself are about 9 people, and the team's product owner guarantees autonomy. They are positioned in a way that they ultimately can define what needs to be done. Also, the product owner always comes from the business side. They have a complete understanding of what customer value is, and they are entrusted to deliver that. The product owner is also accountable for maximizing the product value itself. (…) The team (consequently) is empowered to decide how everything is done, how they should operate, how they should function, etc. The concept of management the company is pursuing is to empower these teams to do exactly what they should be doing.
3	Researcher	Doesn't it come with a lack of visibility or control in a traditional sense? Accountability, that could support stakeholder buy-in before, and was attributed to a role or team, now is more of a shared responsibility.
4	Int7	I keep coming back to the product owner concept, and the fact that the product owner is pretty close to the customers and the end user community allows for that kind of buy-in, or adoption. This is a better adoption than what you would have with a typical kind of IT type

		project, which also is very much seen as IT doing it in isolation, based on a set of requirements that we don't even remember.
		Now, because we have that kind of continuous engagement, we can ask the end user to tell us what they think. Also, the concept of iteratively developing, where you are continuously adding value and features onto the same basis rather than delivering a set of features in the end. All of those assist towards that kind of buy-in that you would expect to ensure adoption. On top of that, still in infancy, but a big focus of mine, is around the product itself, carefully monitoring, as we release new features, whether those products are actually being adopted by the markets. Measuring whether we are delivering features that are being used, because if they are not, then we spent time on something that delivers no value.

As part of the cadence, anyway, you would have sprint reviews where you showcase what you have done in the past two weeks, every two weeks. You also invite key stakeholders there. It is actually very important who those stakeholders are at those meetings, and how the meetings are run. Because, as you transform from what would be kind of a project type approach to a product type approach, you move from what you typically looked at as a steering committee, which is more of a governance committee to a sprint review. So, one is where you are actually looking for a blessing, an endorsement of what you are going to do and also what you have done previously. Where the other one is very much like showing what has been done and asking for feedback. We can iterate based on the feedback and show what we intend on doing next time. The latter type of meeting is not looking for endorsement, and it is more of a connection point of sources, a different mindset, a different way of working. Less formal as well, which has been a big change too. To move from a governance steerco to this is really interesting, actually. |
| 5 | Researcher | To deliver changes of magnitude that potentially impacts all countries the department is supporting, these teams should be embedded in the organization, meaning strong ties for example to developer teams? |
| 6 | Int7 | With the current management approach of the company, this always goes back to the product owner. There is a concept, which is the absolute obsession with the end user. With that, the actual team itself is continuously connected with the end users of the product. They are continuously talking to the end users delivering features to them, and they are always looking for feedback for whatever they released. We call this continuous engagement. (…) Each of those teams need to be as independent as possible. The more independent they are the better able they are to actually deliver a pace, because they don't have any constraints coming from outside. They are also able, as they form, to become really efficient really quickly. So. this concept of teaming is a really important aspect. (…) Depending on the complexity of the problem, they are also focused on being innovative. (Being |

		innovative) is really all about information sharing, being connected to the outside world, the ability to experiment, and ensuring psychological safety in the team. (…)

Independence is important of course, but to guarantee the ability to scale is where you need a scaling framework or mechanism in place. We are still experimenting in such in that area. We tried for example scrum of scrums, SAFe is becoming more dominant, but there are some caveats with SAFe. Maybe less so in the newer versions, but the older ones seemed to be more traditional top-down driven, which, in essence, would not necessarily breed innovation in the teams as it was too directed in nature. (…) You want for the to be as autonomous as possible because they can experiment more in that way and they can pivot as they need. There are other elements too, in which we are definitely interested in experimenting within SAFe. The concept of that is multiple teams working together and jointly coming to a position of saying what is the work they want to achieve in the next timeframe, etc. That is something we definitely see is necessary. It's just around how you align that work on an ongoing basis. (…)

The management is also using scrum of scrums: you operate as scrum teams and you align your cadence. Every two weeks you are delivering a sprint and you also align between the teams during the sprint. So, you would maybe have 5 teams working together towards a shared goal, each of them working independently, but actually they are converging at certain points through these so-called scrum of scrums meetings. They can also work off a shared backlog, so they all understand there is a list of stories or tasks, pieces of work to be done referred to as stories. They each know what stories they should be working on. The continuous alignment that happens is what is called scrum of scrums, in essence a meeting. |
| 7 | Researcher | About the information flow, throughout the delivery process, let's take the input first. You mentioned customer obsession as one of the key driving engines of this way of working. What is the interface through which these teams can communicate with the customer? |
| 8 | Int7 | It is a mix, as different teams approach it in different ways. A principle here is the access to the end users for the entire team, which is something that we push pretty heavily. It is not always the product owner who is talking to end users. The product owner may be managing the customer and the stakeholders, senior customers, the people who are paying for it. You might want to protect access a little bit there. But for the end users, the people who are using it on the ground are the ones who you would look for the developers to have access to, and we do that in a number of different ways.

We have a concept and an internally developed tool, which allows us to trial certain things with end users and look for feedback through an interface we built out. As an end user you join this platform, which in |

		essence is a forum where you will be assigned to take a look at a particular prototype and provide direct feedback. Typically, it depends, of course, on the scale and where you are in the product life cycle. It may be the case where you are developing an MVP or it could be part of an initial exercise what we call discovery. Discovery is a design thinking type of activity, where you identify what a typical end user looks like. You would hope to have them included in the workshop and start a facilitated exercise to deep dive into what are the user needs. Then you would break that out into different personas, different type of end users. After that you would really be able to understand the full scope of what you are talking about. Depending on the project, you may only have one persona, where it is a well-defined personal role that you are focused on and then you can get that input directly from them. At a different stage in the life cycle, you would have certain elements that are built into the product itself, so here you would have the option to be provided direct feedback on the product itself.
9	Researcher	As you mentioned, measuring the usability of features or finished products is an important aspect of this way of working. Do you have a set of metrics that you usually investigate? Are those defined by the teams?
10	Int7	We started to develop a measurement framework (…). Visually, the structure looks a little bit like a triangle with a box underneath it, as a foundational element of the triangle. As a foundation, we measure the maturity of the product teams: how they are doing in terms of agile ways of working, how are they doing as a product team, how are they doing in terms of their ability to independently fund all of their activities. There are a number of different elements associated with that, which are really focused on the operating model of the delivery team. Some of those aspects are really focused on the team, some of them are on the team of teams, so they are spread across the different organizational levels. Another question here is whether the organization itself is supportive of a product team or is it perhaps perceived as a virus, which we often saw, as the organization reacts to these bodies. The organization is very hierarchically driven, it is typically command and control and when you plant a self-organized fully autonomous team in the middle of it, which is operating in a different way, the organization may want to try and reject it. That's something we have been careful about to try and make sure that doesn't happen. With the measurement then, this is the baseline. Then we have what we call team metrics, key metrics around the ability of the team, such as efficiency, velocity, quality, all of those kinds of elements. This is more interesting for the team and should be used

		as a part of reflection of how they are doing overall. Less of a monitoring metric and more of a feedback-loop for the team. Then you have what you call leading indicators, specific to the product itself. Might be the amount of features that are produced, whether certain commitments are made over the next quarter, etc. These elements will be ones that teams are continuously looking at, as a tactical piece. Then you have got two other elements. One is around product value as a consistent measurement. This is the previously discussed usage rate of the features. The other one is the adoption rate, which is the measurement of what ratio of users are using the product, as it is being produced for a foreign market. In essence, the question is whether you are getting full market saturation and does the market see value in using your product. There are other metrics here as well, such as technical stability and customer satisfaction, those which we use in other parts of the business. Then you would add in the financial aspects as well, how much you are investing in delivering this. This is really to try and get an overall picture of value. With these metrics you can then consistently compare and benchmark to some extent across multiple products. They are all very interesting, but everything comes back to what you were trying to achieve: could be an uplift in sales, or increasing productivity, etc., these would be the benefits that you declare up front. You would have a hypothesis. You are making a bet, in essence, saying if you do all of the following things, then you should be getting those benefits. This is a North Star for the team, the ultimate measurement at the very tip of the triangle.
11	Researcher	Maybe I could just recap to see if I understood it correctly. There are strategic, tactical and operational indicators. Enabler metrics, ones that measure the team performance, product metrics, such as adoption rate, stability and financial aspects, and on the top as a North Star KPI, the targeted benefits.
12	Int7	That would be a good summary of it, yes. One thing I forgot to mention, which you can see it in a lot of the leading tech firms as well, and we started actively using are OKRs (objectives and key results). (…) We are using these primarily to align some of the activities across teams, so that we can be absolutely transparent about what the commitments of the teams have been made on a quarterly basis. Both coordinating the activities and aligning what's important also becomes interesting when we look at how we fund and allocate resources, finding where we should best place resources. We look at it from a perspective to fulfill the objectives and key results from quarter to quarter. (…)
13	Researcher	A very exciting concept! Linking back to product teams and the way they are embedded in this framework, we would be interested to know if you have any processes in place supporting organizational learning

		coming from projects, experiments, good or bad experiences. Do you have any documentation supporting lessons learnt?
14	Int7	I would say we don't have a formal process around this. We are more conceptual when we look at it: we set up and we stand up communities within the organization, and this is something that is becoming more and more prevalent. The idea behind the communities is basically forming groups around topics that people are interested in. They can come together and have discussions, share information. We do have a formal knowledge management process and we are using some tooling around that which allows us to share and communicate that. We are continuously experimenting with other platforms with which you can expose the right information to the right people. This is a really big challenge. It's not just a challenge that we have, it is a challenge that I have seen in again and again in other organizations. There is an element when you can become *too* transparent, and that's where we are at. We use the likes of Teams and Yammer and we are all open and transparent. At a point this all becomes noise and it is really difficult to get to the information that is of the most value to you and allow you to improve and evolve further. That's something we find difficult in such a large organization, but it's something we are continuously working on. Can't think of anything we have done formally but it's something we are very conscious of. (…) We do have tools in place to make sure that there is full integration between the different elements, when recycling features from previous products, but it relates more to the software side. Something else that just came to mind in terms of one of the things that we have started to actually look at: when we are looking at the early stages of product development, when it is still more of a concept that we make a bet on, we will do a proof of value, proof of concept, maybe even an MVP, and then we will see if there is an opportunity to scale it. Always, the value there is around the information actually, what you will learn. One of the reasons why we try to keep the product teams intact rather than working on a project basis (disassembling teams after project closure), is that the learning will remain in the team, and we do not necessarily need to do a lot of documentation. This is one of the key elements associated with product teams, that a team as such learns together and builds internal knowledge. That scene is really important in the productized approach. That idea when we capture knowledge based on failure is something that actually is becoming more topical to the point when you can see it other companies where they celebrate failures and the lessons learnt from them and make them visible on the company level.

15	Researcher	Thank you! Our last question will relate to the future. What do you think the future will bring considering the new ways of working? What are the main obstacles to overcome?
16	Int7	We identified over a dozen elements that we need to address. (…) Each of these elements need to be addressed, some are more important than the others. With this kind of transformation, certain things are critical.
		One of these critical things is executive buy-in. If that's not there, there is no point to what you are doing. You can run an experiment, and it might be interesting, but in essence the organization might react in a way that it will be killed. What may happen at some point of course is that you store that information and maybe come back again and use it as apart of a conversation to get executive buy-in, but in essence you won't be able to progress it any further. That's one of the biggest elements.
		The other thing is that if you are just allowing this to evolve and organically grow also does not work, because you will breed inconsistency. By its very nature, Agile is reasonably fluid in the way that they look at things. There is a very defined and disciplined way in which you can run it. But then there's this concept of that you should organize the best way of working yourself and you should be as independent as possible. That suggests that your ability to be able to share information across the enterprise would be constrained straight away. That is a really big problem because you are effectively building silos that are really strong, but they can't scale, as they don't have the shared language to the other parts of the organization. So, you need to have a CoE (center of excellence) that acts as a holder of the dictionary or the language of the organization in this respect.
		Culture is also one of the biggest topics here. The culture itself has to shift at the core and you can't roll this out and then expect if the culture of the organization is not right and the reward and the reward system associated with it. You need to reward certain behavior to ultimately change the culture and change the way of working. Typically, you are not rewarded to deliver value iteratively, there is no benefit in doing that. The reason being is even just a concept of your manager having about one month horizon that they are actually judging you on at the end of the year. They are never thinking about the entire year. So how they feel about you at that time will ultimately define your ability to have a conversation if you are below, on par, or excel among your peers. The idea here is that iteratively you would be able to bring value over the year, which when compounded is pretty impressive, but that doesn't really work. This is why you need to continuously look at performance on an ongoing basis. Also, this performance should less be on an individual basis and more to be judged on a team basis. A large percentage of your performance

| | | should be on the basis of how the team itself is rewarded. Your goal is the same is the team's goal. That is also a big element as well. (…) |
| | | All throughout the journey you are going to get resistance, it is inevitable with change. Some people, though, are not going to change, and they will need to move. From what I have seen in organizations that really have gone all-in on this is that they are pretty aggressively pushed at the end with strategic intent. Because you also have mass associated with this change. You might have 20% or 30% you have moved towards a productized approach to where you reach a tipping point. This tipping point is, again, a little bit like a virus, where the new way actually takes over. When it no longer makes sense to operate in the old way of working. When you are disincentivized to do that because you are seen as being an outsider. That tipping point is always pushed. It does not happen naturally, there is always an executive pushing it over the line. They create an environment where if you are not able to buy-in, you end up leaving. Usually, they make it very easy to leave (for those who cannot or do not want to adjust to the new way of working). (…) |

B8.　Interview 3

Line	Person	Content
1	Researcher	Could you please tell us what is your role about? How does it relate to project management and what are the key steps you need to ensure to keep the department running?
2	Int8	For several years I have been working at this pharmaceutical firm, and before I had worked about a decade in a telecommunications company, in a similar role, leading the project management office. (…) In particular, I'm working in IT Project Management. IT is a global function in the company, and there is a central project portfolio office. I would say that their responsibility is to keep the raw methodology, as well they are providing the overall portfolio reporting. At the moment, they are focused on the budget planning, however they do not oversee the project execution. We are practicing a distributed PMO model. Each individual department - we call them functions - within IT decides on project execution itself.
3	Researcher	My understanding is that you have a project management framework in the company. Is it the central PMO the one that designs and maintains it?
4	Int8	Correct.

5	Researcher	So this is the main methodology to be used in IT projects, right?
6	Int8	I believe so. It is a Waterfall methodology, even though it has recommendations how to be used in line with Agile methodologies. But in fact, this methodology defines how the project manager needs to progress throughout the project lifecycle and what deliverables have to be prepared. In the end, as we are in the pharma industry, there are strong requirements for the computerized validation system, and everything has to be documented. Therefore, the project is always classified, whether it needs to follow additional standards. Whenever the project implements or changes the system that maintains data about customers, or data about medicine, these extra standards have to be applied. We also engage/assign a project quality manager to the team. I would say that yes - projects are managed according to our main project management framework, however, the individual work-packages or parts could be delivered different way.
7	Researcher	If you compare your experience telecommunications versus pharmaceuticals, what was different? Did you have strict or well-defined guidelines there in the telecommunications industry as well?
8	Int8	The key difference is that in telco, we adopted global methodology which was defined during the era when we outsourced the software development of projects. At that time, we agreed the methodology with the vendor who took all our developers and my role allowed me to oversee the methodology and evolve it locally, as I was working in the local operating company. Even though it was a big company of over 2000-2500 employees, it was not a global function, so we were not influenced. On the other hand, in pharma, I'm now a member of a global function, that means that we operate our projects globally - whatever we launch - we launch around whole world. Also, from this perspective, for the central project office in the firm it is much tougher to monitor how well the project management framework is followed. I would even say that nobody is checking proactively during the project execution. There are audits after the projects, so we see no additional value of checking adherence mid-project. (…)
9	Researcher	What could you say about project scope and size? Because you mentioned that in telco you were on the local level, so I assume that those teams could have been smaller and scope could have been more narrower, while in the pharma we talk about not only co-located teams, but international collaborations. Not only software but also hardware related projects, I presume?
10	Int8	If you imagine that you work for the local office of an international telecommunications company, then your projects will be, for example, launch of new products for the country. And this involves the whole company because you need to define the product itself, its marketing, and people from customer care need to define the requirements: how the product will be treated in CRM (Customer

		Relationship Management) itself, what is going to happen when a customer calls and wants to change features, or how we are going to deal with issues. Also, you need to discuss with the finance department how the product will look on the invoice. Then, you need to involve people from the engineering department and agree with them: how to track, how to run troubleshooting. Therefore, from this perspective the project teams we had in telco were even bigger. The project manager was in contact with many people. In pharma, in the function I am a member of, we are responsible for the information security and risk management. I can see that nature of the project is about the building the cyber security capabilities, we are selecting the right tools and react on what is evolving on the security, what are the directions and trends. We need to implement new solutions, and to implement these tools, usually, some hardware is needed. But we are not developing the tools. We buy and install the tool, we need to test it and configure it, and then we need to learn how to use the output which we receive from the tool. In both pharma and telco, I was working with global teams, as in telco we had to communicate with the global marketing and we had to be aligned with the global strategy, as well as the developers and testers outsourced to India or other places.
11	Researcher	I assume when it comes to the different IT functions within pharma, we are talking about different departmental maturities, different team sizes, different project constraints as well?
12	Int8	Sure. For example, in the function where I am, PMs are reporting to one manager, a so-called project execution manager. He oversees all the PMs, including external (contractor) project managers. But in other functions, for example, commercial IT, they have up to a hundred. But they are also scattered across the globe and majority of them are internal associates.
13	Researcher	It sounds like a fairly complicated system. We were wondering what are the challenges that you face day to day in managing and coordinating this effort? Assuming complexity is high just as velocity.
14	Int8	Yes. But that is a broad topic. But the main question is "How to ensure that project brings value to the customer?". In my experience, in last 15-20 years it didn't matter what methodology we applied in project management. I can see in many cases that people tend to care about how to do stuff primarily. We can have a debate whether Waterfall is worse or better than the Agile and so on. In reality though, what matters is whether we do right stuff. I always try to push the sentence: "Let's make sure that we do the right stuff the right way". In general, there are a lot of discussions about right way. But not enough has been said about selecting the right projects. To be able to select the right project you should have the right goals, strategy, clarity on what you want to achieve. The key question is "What do you want to achieve?". Then you need to think how to do that, what do we need and if we apply project portfolio management to it, then we need to define the

		goals. And if we have goals, we have to make sure that projects we select to be executed and to spend money on, should somehow bring benefits to the goals. This is in general what humankind is not good at, no matter what company you are in. We always need to work, but are we working in the right thing?
15	Researcher	Do you think this can be generalized into guidelines? Like listening to customers need, understanding value and then translating them into actual projects, while making sure they fit the company strategy, and that they are feasible and executable.
16	Int8	Yes. And I think there are two pieces. First, at the beginning you need to think about what is needed, expected, what brings value. Here I would add listening to the customers. But on the other hand, and there is a famous quote (attributed by many to Henry Ford): "If I had asked people what they wanted, they would have said faster horses.". He didn't make horses faster, he produced cars, which are much faster. So that is why we really need to understand the need and vision. We should have some collaboration zone where we can come with ideas, check them with customers and then build prototypes. That is exactly the place where agile methodologies are perfect. Because whenever you try to design something new and you don't know if idea is going to survive, we need to quickly develop something what we can test and show to the customer.
17	Researcher	How do you think the project management office could enable project managers or developers (or product developers) to listen to these ideas? And how they can understand the concept and transform it to a project, and then add the business value?
18	Int8	I would doubt it is feasible to do anything where we should engage project managers and developers, working on their projects, to contribute. These people are stuck with their tasks and running projects, so they are not set for success when they are supposed to invent new things in some session. There is a better solution I've seen - it was a collaboration zone. It was part of the central PMO, and they developed a methodology for inventing new ideas. The part of the methodology was that they let the idea "fly or die". They conducted workshops and invited people from the business, combined them with people from technology, legal, finance and others. So, people decomposed the idea and tried its feasibility during the workshop. But even though it was productive, in the end you realize, that it is expensive because you spend the time of a lot of people. So that is not something you can run for a long time. Again, it is about goals, what we want to achieve, to maintain what exists or invent something new. And if it is to invent something - we need to be ready to spend a lot of time on it during these collaborations; that is an investment and we have to hope that we will come up with proposals. Maybe one of them will be

		successful and we will focus on execution. There should be some flexibility how to design a new thing.
19	Researcher	If I could summarize, you believe that day-to-day operations should work in a lean manner, to focus on the core value creation. And when a need arrives, when there is a value we are looking to create, then it is a valid idea to bring cross-functional teams together, but that should not be on a continuous basis.
20	Int8	Yes. For me it is important to link to the goal. There is no need for the cross-functional team if there is no purchase order on it. This is all about goals and strategy, that is what is reviewed. My current company is a good example for this. There are goals that are valid, there is campaign that people understand, and then suddenly a new campaign comes, new goals and nobody provides any feedback on what was developed to achieve the previous goal, where we ended. Is it just a continuation, or something completely new and we just threw away what we did the previous year? Therefore, the feedback is very important. If you ran a project and implemented it, achieved some goals, the PM is considered successful, if the team delivers on budget, on time and so on... The question, however, is if the project output is really delivering what was expected, what was the benefit. And that is the question that for some people doesn't make sense, because money is spent already. However, that is what the company and PM teams should do - they should learn two things: whether it was a good idea, and whether the assumptions taken were correct. And take these learning into account when starting another project.
21	Researcher	I understand. This also links back to the measurement system. Is it a part of the project audit or do you have certain gates where you see whether the project is going according to the expectations or towards the overarching business goal?
22	Int8	I think we can agree that to approve the project or investment usually we should have some case for it. The project should either bring revenues or some savings, or its mandatory project due to regulation or corporate image (branding) project. Depending on the type of project, we should be able to write down what is expected, what is the goal. That should be reviewed during approval of the project. Depending on what it is, once the project is finished, the PM shuts down the team and hands over the output to the owner of the project. The product owner needs to check whether what he promised to board and what he got money for, was achieved. If it is a revenue or saving project then usually people in finance would be those who calculate the final outcome of the project, they will provide the data saying like "Half a year ago we approved the project and now we are three month after the project launch we can see that the revenue is not coming so quickly as we expected". Then the project owner needs to take some correcting actions. If you monitor the output, what is going on with

		the benefits, then it gives a chance to work on those indicators maximize the benefits.
23	Researcher	Another thing you mentioned is that one of the most important outcomes of the project is information and knowledge, something that you can share in the organization. What do you think are the best practices of making these lessons learnt, creating a repository of all the important key points of learning that come from project?
24	Int8	This is a very interesting topic. I've also seen several attempts to do it and there is only one I saw that is valuable and working. It was not any database or SharePoint but worked well in the telecommunications industry. After each project, we did a so-called post-implementation review from the perspective of how the project was executed. It was not from the business case perspective, that one also takes place but 6 months after completion. So, the first post-implementation review was completed within a month after the project launch and was managed by PM. PMs collected feedback from whole team and key stakeholders. It was important to define an easy structure: what was the learning, what was the situation, what were the symptoms and the recommendations. It worked well when we tried to talk about processes - like when we planned a purchase of hardware, it did not work well because it was difficult to define the timeline, and we clearly saw that there is a lack of qualified people within the team. So, we clarified those processes that didn't work. The output of the presentation was shared with a broader audience, all project managers, analysts and also other managers, people who might be interested in it. We were able to name concrete processes and say which did not work. At the end of the session we had a list of action items distributed to the process owners and they were able to implement the corrective actions. This way, the situations were not repeated in other projects later on. That was a healthy mechanism. Other than that, from the project manager perspective, I have never seen the PM trying to look into a list of learnings, even though there was a repository of such. But what I saw working well was that project managers learnt to ask other project managers about the pitfalls, and what actions should be taken at the beginning of their project. These dialogs really work.
25	Researcher	Do you think this will also work if the team is not co-located? Can this work over online?
26	Int8	I think it can work, I would say it is more difficult to discipline people, there needs to be somebody to drive the call. This is really important, and it is a skill to have. Like in the workshop - you need somebody who drives the room. If the person is poor in that regard, then the output of the workshop is poor as well. But I can imagine it works.
27	Researcher	One final question: What do you think the future will bring in the case of project and program management? What are your expectations for

Line	Person	Content
		the future? We know many companies are experimenting with Agile, but Agile is not always the answer.
28	Int8	Half a year ago I saw a tool for portfolio planning (Continuous Software), which could see use in the future. Exactly the topic which I started with - it is difficult for the senior management to translate the company goals into the project portfolio. This is the discipline which is difficult. The PM is strong in defining the project lifecycles, different tools and technics and templates and processes, skills for individual project execution. However, how to translate the goals into the project portfolio is something which is not covered enough. This is the difference between success and failure. We can spend a lot of money on successful projects; however, we are only successful from the implementation point of view, but we don't earn enough money because we didn't manage the right programs and the portfolio. So here, I believe there is a space for the improvement. We need to help senior managers, not to get stuck with their large teams and budgets.

B9. Interview 4

Line	Person	Content
1	Researcher	What are the guiding principles when choosing the way of working in an organization?
2	Int9	Choosing the right way of working is not about understanding what is happening at the moment but seeking alignment with the vision and aspiration of the organization. These vision points need to be clear, well communicated and understood by the associates. (…) Even, rigid, linear processes might be suitable, when the environment is predictable, but in general, there is no best practice or one best method that fits all. Organizations are built on values and principles, which process governance and measurement need to follow suit. Measurement needs to target value creation and not processes. On the other hand, when it comes to governance, if everything comes from the top, it inhibits fast response to the changing environment. Shifting from traditional towards hybrid or Agile ways of working, management takes a hands-off, eyes-on approach. (Management gives up control in defining the way how projects are executed but follow the process closely to ensure organization wide alignment and help remove roadblocks.)
3	Researcher	What is the difference in a case where a company decides to change direction take on more structure? For example, when a start-up grows beyond its initial boundaries?

4	Int9	The biggest question organizations, which traditionally had a start-up feel to their operations, must answer about structure is whether they can keep adding structure and keep value, while killing things that serves no purpose, similar to the "liberating structure" concept. It cannot entirely be top-down. Also, many teams themselves may want to have structure to some degree. Simulation exercises can help develop these concepts in a more controlled environment. However, these efforts also need to be documented, otherwise they will just vanish. Here, it needs to make sense for the entire team why and how the documentation is to be performed. It is up to project managers and line managers to set the vision for the documentation, but it is then the team's responsibility to execute it.
5	Researcher	Would you say that a measurement system needs to be in place, regardless of methodology, to ensure that the organization is making a joint effort towards its business vision?
6	Int9	A holistic, measurement system that is linked to organizational values needs to be in place to see where the company is going. So called pinnacle KPIs are put in place to show what is on the horizon, where the organization is headed, which signals the purpose of the company. In FMCG, consumer sales could be considered as a pinnacle KPI. It might be regarded as a financially focused measure, but overall, in the FMCG sector, the goal of the business is often to reach as many costumers as possible, therefore it is good for an approximation. Aside this, representing other corporate values, other measures, such as allocating a fraction of turnover to pursue non-profit related objectives, may also be introduced. The principle of value-based management holds on a higher level, although one needs to be mindful of the reality (when splitting up KPIs to its subcomponents and allocating them on tactical and operational levels), that the organization is not a machine. Measurement on its own is not value adding if the practice is to update figures in a spreadsheet that is never clarified on a tactical level. Teams should take charge of developing their own measures linking back to the pinnacle KPIs. (…) On a team level metrics should be linked to the core value, but teams should be responsible in deciding how to measure and guide their activities with it. If the organizational value is quality, teams should ask themselves if they are doing enough to ensure that.
7	Researcher	Recent literature shows an alternative approach to performance measurement, that, similarly to option pricing, aims to support decision-making at each iteration, rather than measure project outcome ex-post. Do you have experience with that practice?
8	Int9	A novel approach in measuring performance comes from a realization of value being created in chunks throughout the process, rather than after project closure. (The idea is to associate a probability to project, or rather iteration, outcomes. The measure itself is called Expected

Line	Person	Content
		Commercial Value.) This enables a closer investigation in especially innovative projects and making a go or kill decision at each stage or iteration. We did not implement this way of measuring for new product development, but rather for internal purposes, for simulations in a new digital system. While going pure agile, metrics like this could become an exaggeration, nevertheless, it helps create visibility across a large portfolio of projects. Another use of ECV-type metrics is in risk assessment, with a goal to help product developers estimate the risk across different projects (called ERV in that case), where associates, engineers of different backgrounds are present. Overall, it results in a hybrid system, that is close to the planning poker technique used in Agile.
9	Researcher	Do measures help in backlog discussions? What are the key things to consider in prioritizing?
10	Int9	When prioritizing the backlog, corporate values and return on investment are good overall approximators. The aim is to deliver value and bring the end product as close to the market as possible. It is not a mere guesswork, but it is built on demonstrating and piloting the product capabilities, while making sure that costs are balanced. Another important aspect is to have a balanced portfolio, catering to the needs to all of the targeted customer segments. For ventures that do not closely related to financial targets, but which are important part of organizational value (such as corporate social responsibility and charity related projects) might identify different value drivers in backlog discussions. There is no one best way of achieving this, also, there is no one decision tree that would fit all needs. The world is not one simple domain, where all factors are known. Checks need to be implemented and teams need to strive for balance.

B10. Interview 5

Line	Person	Content
1	Researcher	Could you please tell me about your industry and role in your company in relation to your team and other departments?
2	Int10	I am working at a software development company on server solutions that facilitate teamwork across multiple departments. Our users range in size from offices with only a handful employees to international conglomerates. We, as a company, sell these off-the-shelf products to our clients which then they can facilitate themselves. We also provide an alternative, software as a service version, that we maintain in the cloud, which version could be subscribed to. I am working on the back-end side of this, mostly, as a developer. On top of this, I have a lot of other responsibilities, relating to maintenance for instance. (…) I do not rotate often across projects; I have a set team who I am

		working with on this solution. Our team is focused on this specific product. On the side, there are a couple of company-wide initiatives or projects, where we have our role in developing certain things relating to this product. When you say project, in our team it always relates to modifications, features and the like, in the context of the product I mentioned. (…) Lately, I have been working on additional features to this product with which we can offer a wider range of integrated solutions to our customers. (…) My job is not directly linked to teams working on other products or the off-the-shelf versions of our products. My role relates more to the user access management, storage, and other cloud access features of the software as a service product. Our team, therefore, has limited connections to other teams in the firm, leaving us fairly isolated. The current strategic directions, priorities come from above in the organization. (…)
3	Researcher	What are the methodologies applied in your team and the organization in development projects?
4	Int10	We recently have undergone a shift in methodologies. While earlier you might have said we were working more in a Waterfall-ish system, although we were fairly free to choose how to develop. We had project managers who were more or less connected to customers, and the requirements were introduced to us by this person. The transition to agile happened corporate-wide. A new associate joined the company, who took the lead of the entire engineering process, and he introduced the new way of working. (…) It was an executive decision to transform the company. Although, our team was not impacted to a large extent. Our team is relatively small, and even before the change, we had strong ties to QA and UX, which was not common for the company. In other departments, it was more common that the development and testing tasks were isolated and there was no collaboration or close connection between those teams. It was common practice to our team before the change to meet the QA team daily, for example, in person and ask about what needs to be fixed. Of course, we had people who opposed the change or were skeptical towards it, which I can understand to some level. (…) I guess, we started having more meetings, but overall, the transition is going smoothly. We trained scrum masters and appointed a product owner internally. The product manager is who interfaces with the customers directly, which they then discuss with the product owner. The product owner is also linked to other departments and cascades the requirements further down to the development levels. Other departments include, for example, technical support. (…) This was a good change, as all requirements now go through a single contact person.
5	Researcher	Do you follow any specific methodology after the transition?
6	Int10	In essence, we are doing Scrum. The only difficulty is that we need to deliver according to deadlines. We have releases scheduled a year ahead, and you really can feel the pressure coming each release. Of

		course, it is acceptable to cut the scope if something cannot be done for a specific release. We have sprints and story points. We do have a lot of pointing activities and we measure velocity. We do not over encumber ourselves with tasks, Scrum helps give a framework to all of this, at least for developers. QA on the other hand is really over-loaded, I would consider this actually as one of our bottlenecks. This means that we have a low QA capacity, even though we do have in-house developed automated testing frameworks. (…) We have some legacy issues with testing, as older engines are not efficient some-times and scripting in those environments can be difficult. The unit tests are done by developers, us, and we are tasked with fixing the bugs identified there. We also have some advanced in-house integra-tion testing solutions. (…)
7	Researcher	You mentioned measuring different team efficiency factors. Are these measurement reports accessible to you as developers?
8	Int10	This practice still has a long way to grow, but yes, we can see our own velocity. We have not had a lot of sprints that could be evaluated just yet. They used to say that if you have high fluctuation within a team, then velocity it is not worth measuring. For us, in the least six to twelve months we had a few people coming and going, so I am not sure how relevant these figures could be.
9	Researcher	When you are prioritizing the backlog, how do you make decisions?
10	Int10	This is a part of the bi-weekly sprint meetings. We have planning and refinements for the backlog. So when we start a sprint, we already know what are the tasks that are going into the backlog. Points are usually already assigned at that time. We assign the points ourselves, and we notify the project managers how difficult those tasks are. (…) I would not say that either the project manager or product manager would step in and say that things should be executed faster, but they have a say in what to take first. The pace and selection of assets or methods to achieve the tasks is left to us, the order of things can be their decision.
11	Researcher	Do you have instances when there is no agreement in the priorities?
12	Int10	I would say there should not be such a case, because, generally, the direction in which the product is evolving comes from a single source. There could be instances when we know that the execution of certain steps requires prerequisites, but these requests are always understood. (…) We have technical debt stories, for example, for things that are in need of careful analysis and fixing may take a longer time, and a portion of our time is allocated to these stories by default. (…) We have other technical stories that cannot be related directly to user value, but you also need to provide proper tools for your developers who work on the products. We can introduce certain steps ourselves for this purpose. (…) As I mentioned, we are a bit bottlenecked by

		QA, so regardless how many features we develop, they cannot test it in time. These features therefore cannot be applied in the product. (…) Consequently, we have unutilized development time. That is one of the reasons why I work on technical stories sometimes. (…) We have a work log, where we need to record our time by the stories. From up top, they need to see how much resource is needed for a project. For example, how much time you spend on tech support, but they are not interested in an hourly split in general. (…)
13	Researcher	Do you have any repository for your projects, where you record what went right or wrong, an assessment of bottlenecks, pain points or success stories?
14	Int10	I do not think so. From a technical perspective, all projects are documented, but not in the structure of your question. (…) We have something where we state the problem, the current technical background and an ideal state. We have use cases documented too. They are more of a high-level assessment on the state of things. (…) We also have a list of potential bugs on the product, a list of things to be fixed, for example. (…) We do not have lessons learnt by project, but as in Scrum, we have retrospective meetings at the end of each sprint. (…) We do not store it for every single project as a collection, but they act as a follow-up for the meetings I mentioned. Project documentation is done on a separate channel, lessons learnt are linked to sprints, which get recorded elsewhere. This latter is more of a meeting memo. I myself do not really go back to these documents, because this is something I am aware of and work on week by week. These are not difficult to memorize. We do not really need to go back to that information.
15	Researcher	What do you think are the pros and cons of the transformation your firm is going through? (…)
16	Int10	I think benefits include the fact that it gets a clearer who is doing what. Prior to transition, you could have worked days on something which went unnoticed, or perhaps even got forgotten. It becomes clear what exactly it is that you need to be working on, and you cannot be assigned other things to do on a different channel. It could happen that you would need to work on tech support, which becomes your first priority, but you can announce this during the sprint meetings, so the team can adjust to this capacity loss. It cannot happen anymore that you are working on a project for months and the team would only realize in the end that it cannot be completed on time. (…) In the new system, we have better control and transparency over what is being done. You can also see which developers need help, or if they get stuck. We have standups every morning, and if you have someone say the same issue, they struggle with for the fourth consecutive day, then you realize that it needs to be addressed. (…) A drawback, which others do not really consider as an actual drawback usually, is that the system itself is very complex. There are a very few people who could

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<tr><td></td><td></td><td>express concisely in a few sentences why it is beneficial to work in an agile way. There are many who are skeptical and do not really *see* the benefits directly. There are a lot of things that cannot really be explained why they are good; we just *believe* they are useful. One thing for instance, is that we do not estimate time, we estimate complexity. It is known that people are worse in estimating time than difficulty. The point of this is to make different tasks comparable to one another, this is why it becomes easier to assign story points. This is how you would come to understand if Task A is going to take more time and resource than task B. But in the end, this might not be obvious to everyone. It may raise doubts in people, because not all aspects might be clear for everyone. (…) It is very easy to do Agile the wrong way. An example is when you take on more tasks *during* the sprints. Or another typical pitfall is when you start estimating the tasks in time. It is also key to have solid competences on the manager roles, scrum master, product owner, project manager. (…)</td></tr>
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B11. Interview 6

Line	Person	Content
1	Researcher	What are the guiding principles when choosing the way of working in an organization?
2	Int11	Let's discuss the main project archetypes I have been working on in the past decade. I have been working for the same company in the last decade. As you can imagine, it's a sizable endeavor, as it employs tens of thousands of associates around the globe, so you can easily get lost in the processes. I started as a software developer, and in essence, I still am working on software development among other commitments. I used to work on a couple of software development related projects where the aim was to introduce new features to the product. We basically added additional services to an already existing code. In other projects we provided maintenance services to software that was released earlier. We had bug reports coming in continuously for which we were finding root causes and were fixing them when possible. So, I had that chapter in my career history. Then I acted as a scrum master, actually first I became a team leader, before that, that was actually prior to Agile methodologies introduced in my company. Over the development related responsibilities of mine, I coordinated a small team, with 5-7 members in it, splitting the tasks among the members, taking care that the commitments we took on as a team will be fulfilled in the end according to the requests, and naturally, I was reporting to my supervisors how we do against the plans, noting if there are things where we are behind. Then I also became a scrum master. This happened when Agile and Scrum was introduced in my organization. To refer to your questions in the interview guide, this

		changed happened top-down, we did not request it, as developers, but it was decided quite higher up in the organization. The initiative related to a transformation journey that was rolled out by senior executives, aiming to achieve Agile software development. This transformation, however, was an uneven success. It faced and still faces a lot of resistance as they try to put it in practice, the resistance mostly coming from senior associates, who got accustomed to the old and proven ways of working. Fresh hires, of course, do not mind which processes they get trained for. Regarding my scrum master experience, I used to be supporting to teams at once, as it all belonged to a bigger development project, where I also tended development related tasks. Following that, I did other development and also research related projects. Now, I am responsible for the security documentation of the product I have been working on in the past decade. Nowadays my day-to-day mostly consists of communicating between the different teams that are involved, closely following the development that is being continuously released in the product from a security perspective. The security documentation is a living document, getting extended and changed depending on the incoming releases. Aside that, I am also a module owner, this is a maintenance related responsibility, running in parallel… (…)
3	Researcher	Do you follow different ways of working in your different roles and assignments?
4	Int11	I would say yes, as my newer scrum master role is vastly different than the team leader role that was assigned earlier. Different processes apply to the (Agile) teams, obviously, which requires a different approach from the scrum master, who could have been a team leader before. Roles changed, what you needed to do as team leader compared to be a scrum master is different. Meetings changed, the way how you go through features is different. You do demos in a more agile way, of course, looping back to what went well and what could be focused on more. Earlier we were close to Waterfall methodologies, now I would say that we are in-between Agile and Waterfall, somewhere halfway. With agile, I would say, we introduced feedback loops that can help us improve processes, development or the approach in general. If we follow them of course. The utilization of Agile methods largely depends on the teams, how much pressure they have either top-down or bottom-up to change their ways of working, how dedicated the scrum master is to follow the rules precisely, so it depends on a lot of factors. There are teams, where achieving so is pretty easy, because team members a like-minded and they find Agile or Scrum beneficial, but we have associates stuck in the old way of doing things. They do not concern themselves with meetings, they find them simply, a waste of time. Regardless the fact that we have a vision coming from above that we should use Scrum, it really depends on the team and first line management to really follow it.

5	Researcher	Would you say then that resistance is also a factor of time spent in the organization?
6	Int11	Yes, I definitely think they are related, moreover the personality types in the teams largely affect the adoption. Personal attitudes, opinions on change and Agile are very important. There are personalities that are so set in their own way of looking at things that you cannot possibly change their minds and make them start doing things differently. If these people is set against Agile, you will not be able to change that. They will participate in meetings physically, but they will not support the initiative wholeheartedly, it will be merely something they are forced to follow.
7	Researcher	Aside the personal discomfort of those associates, do you think if agile is forced that also leads to poorer performance?
8	Int11	It is true in a sense that associates showing rigidity to change may make it more difficult to follow certain agile processes. By the way, process adherence, of course depends on the organization, but I would say we are trying to be flexible about it. Flexible in a way that if the thing that we have at hand would be nonsensical to be done as Agile software development, we are not going to do it in Agile anyways, just to execute all processes in a literal sense, because they are not meant to be run that way. Let me get you an example, maintenance work, bug fixes and the like, is typically a thing that cannot be done that way. This is because it is very random when, how and what priority tasks are going to pop up in the near future. Many times, you cannot look ahead 2 weeks in the future and plan accordingly. Your job every day depends on how that specific day starts. It would not be beneficial to force Scrum on a task like this. You might want to experiment with Kanban or other methods then. So, overall, we are trying to manage these things flexibly, and management I have been working with was a partner in this. They are not interested in forcing a structure if that does not make sense. Even if you cannot make a decision in selecting the entire working method yourself, you can influence this corporate decision to a great extent. If there is a clear consensus that pursuing a thing in a certain way is not beneficial, but an alternative method would suit everyone better, then the manager, naturally, would also concur and approve workarounds. This works, of course, but again, it may depend on the management. I have always been lucky with my experience with management so I could only tell you about the bright side of things, but I could imagine having an example within our organization where this might be untrue. This is a very large corporation and the experience may vary on your bosses and colleagues.
9	Researcher	Do you think there is a way within your organization for best practices to "spread" informally, as more and more people start working that way?

10	Int11	Yes, absolutely. It could also be interesting to have four teams experiment with four different working methods to see what fits best for a certain task. Then you can learn from the experiment and select the best method for future jobs. You can even rotate these working ways among the four teams!
11	Researcher	What is the best way to really capture this knowledge, to better fit the working ways to the tasks in the future? Would you create an official process around these learnings and their application area?
12	Int11	If you want an organization-level adherence, then yes, you definitely should create a process for this. Or at least for organizations the size as the one I am working in. We actually do have people responsible for designing, introducing and modifying these processes.
13	Researcher	One thing is to have experiments with the ways of working and have lessons learnt documented which could be then transformed into processes. But when deciding the best way forward one might want to decide about how to measure success. What is your view on measuring projects? What, who and how should be measured?
14	Int11	For the who, I believe these competences should be embodied by the process offices in an organization like mine. Initiation for new ways should start there, as eventually, they should be responsible for introducing novel approaches, information therefore is better to be centralized. Of course, the size of these offices is dependent on the overall organization size. It probably is better to be centralized by some sort of subsections of the organization, departments if you will. Taking an example where you have hardware, firmware and software, these three workflows might actually require entirely different processes. Quite possible, firmware and software are related a little closer, it may work under one form of process governance, but I am not entirely sure of that. But I can definitely see that these three areas require their own separate processes. Overall, of course, the best way is not about finding the optimum or the different subsections, but the entire organization. These efforts need to be coordinated on a higher level. Naturally, when designing processes, all related parties need to be involved. Particularly, because adoption could only work if they had authority in the design. Even from a pure psychological standpoint, it is a lot easier to have someone accept something following their involvement and consensus. (…) Going back to "best practices spreading in organization", just like viruses, it can really be observed in large corporations that when something new enters, they tend to shift things around that. Then, after experimenting they conclude that they are a lot more efficient that way. This was the way how Waterfall or Agile was introduced, then I am not sure what the next big thing is going to be. Something spreads within the organization, then another novelty comes out, and the whole thing starts over. It may not even stop within one firm. New ways hop on from corporation to corporation, some may

		succumb to the new ways earlier than the others, nevertheless, in the end all of the change in a way.
15	Researcher	What do you think could be measured around the success of a project?
16	Int11	One important thing is to keep the deadlines. Second could be to deliver quality. The second could typically be measured with testing. How many tests would the new code fail till it reaches the customer for instance. I would prioritize quality first, then deadlines. Another thing that is important is whether we delivered what exactly was required by the customer. Scope in practice is settled in a way that we check when and what exactly would be required by the customer, and if we see that we cannot accomplish everything, we prioritize things, even involving the customer, figuring out what is non-essential in the first delivery. Those non-critical items could be scheduled at a subsequent release. In short, we cut the scope if we cannot fit the deadline following a mutual agreement with the customer. This is a fairly common practice in developing features, as the first idea tends to grow enormous, which cannot be delivered at once. Another thing that happens quite often is that for some reason a project is delayed to a point where initial deadlines could not be kept anymore. In this case, to release something that is viable for the customer, we need to cut the scope. (…) As scrum master, during sprint planning, we got together, and those who had domain knowledge split the tasks into chunks. These chunks need to fulfill criteria, that they could be scoped and measured well, having the "definition of done". You need to know by when it could be expected to be ready, how big the task is. We estimated all these things (while on sprint planning), and in retrospect, we revisited how successful we were in these estimations. After a while, it became very measurable and transparent how much the team can achieve in a given sprint. After a while, this gets stable for a team, how much work the can do in a unit of time. You need some time for the team cohesion to develop, and you will also have the experience to see how much work those teams and individuals can do. Even though you might not have the most efficient team, plannability could be much more important to have, as fluctuations in performance could prove a bigger disadvantage.
17	Researcher	When working on these projects, you mentioned that you often have a direct contact to the customer or end-user. How important do you think is that so that there is a feedback-loop to the development process?
18	Int11	This is something that needs to be in place. Not only in the eyes of the customer is very important that they can effectively say and influence what features are getting into the final product and which ones are not, but also it is important to you that you sell something that is actually needed by the customer. Even if it's through some loops (proxies) but this (feedback-loop) needs to be implemented. For instance, (in some projects) we managed to showcase what we delivered in

		every sprint to representatives that is in direct contact with the customers. It was very beneficial, by having the customer represented, to look at the project through the eyes of the customer, not only through our lens as developers. Their inputs were very informative and logical, and they have a completely different approach to things compared to us. Their feedback was critical, as we found out that even though we had an idea what to deliver, their expectations turned out to be quite different. We then were forced to realized that we did not consider the project from that specific angle. By the way, how it usually goes is that we also have a customer unit at our firm, who are in touch with the customer directly. This unit is also linked to the developer teams within the firm. We also have a first line support, us could be considered as second line, but this connection to the customer is there. Filtering needs to be done, however. First line and customer support know what can be presented to customers, how to approach them, how to communicate with them. I think direct connection in a literal sense between developers and customers are not advisable, but you should have a connection through a few proxies. Not too many proxies, not directly. You as a developer are most often not trained how to handle customers and things can easily backfire if you are too direct. Those associates in customer units are trained specifically for this purpose. It is a different story, of course, in industries where everyone is prepared to talk to the customers. For us it is necessary to separate these duties. (…)
19	Researcher	When looking at the backlog or the upcoming set of tasks for a project do you always have someone who "looks at things through the eyes of the customer"?
20	Int11	This role belongs to the product owner who is there. If the team is put together well and the product owner is well-trained, then yes, it is usually in place. At least this role has a better understanding of the deliverables from this angle. I am not saying every product owner can communicate with the customers directly, but they might have feedback on what other features are in the backlog for other teams, where those features are in priority, they have a better overview of the entire product. Because that is also important from time to time. Generally, it is enough to have the customer represented this way. At least Scrum works this way. Probably it is better sometimes to have multiple people with this sort of angle, meaning that they could brainstorm better. Nevertheless, my experience is that having one person with this competence could be considered good enough. (…) The product owners should have oversight on the priorities, and based on the feedback from developers, product owners should be able to assess the size and duration of tasks. They need to make the final call on the backlog. If they don't have the competence and authority to make these decisions themselves, they cannot really be called product owners. (…) It is not pure authority though. A good product owner seeks consensus based on the feedback from all related participants in a backlog meeting.

		Theirs is the final decision that is supported by all the provided information. Anyways, they carry the responsibility for it. This also does not mean that the team does not need to be involved in the decision-making process. (…) I am personally pro consensus, but the final decision should be made by someone who has the responsibility for it. (…)
21	Researcher	Who is responsible in these meetings to allocate corporate resources?
22	Int11	While the project manger's responsibilities relate to running the project smoothly and all resources should be made available specifically, the line manager is who actually allocates resources on projects. The line manager's job is that you are happy, motivated and occupied with meaningful tasks. Aside this, of course, they have a lot of other functions to fill within the organization. Above the project manager, who has responsibility for the completion of multiple projects is the product manager. But this structure, again, depends on the industry, company or even department. We do have product owners even in small teams, marketable modules of a complex solution, if you will, who are responsible only for this fraction of a product. Let's take a complex product. They might have tons of processes, where for every 3-4 processes you could have a product owner, who are skilled in these processes and are responsible for them. You can have product owners on multiple levels, depending on how much of a complex product they are driving.
23	Researcher	Do you have any views on documenting lessons learnt or using previous documentation in project kick-offs?
24	Int11	I would say that I do not really have experience in this. I never really have witnessed this technique work, that you would have the ups and downs documented and you would conscientiously look them up each time you start a new project. I saw this in on a smaller scale, at the end of the sprints as a retrospective review, when we discuss what were the pros and cons. There are teams who are practicing this, but I have not seen the outcomes written and utilized elsewhere. They share it amongst themselves, but nobody actually looks at it, in my opinion. I would say that this needs to contribute to the experiences of a scrum master. They should be able to utilize these outcomes later on. Now this is my guess as I mull over how we do things here. But again, I have not seen them documented in our organization. (…)
25	Researcher	What do you see as pros and cons in the current ways of working in your organization and what does the future bring?
26	Int11	(…) Regarding *how* it works, I can say, that if you are using the right tools for the right tasks, then every method could work well. In other words, if the method is tailored to the task at hand, then of course it could work right. Naturally, new methods will come up that would be always a bit better. Personally, I do not see that these methods would

		improve a lot so that we could be a hundred times more efficient, but I am sure that we will make small steps ahead. It is always possible to do a little more and a little better, but where the whole thing goes, I am not sure. What I see is if the methodology is used for the right task then obviously it will work well as it was designed that way.

B12. Interview 7

Line	Person	Content
1	Researcher	Could you please introduce us to your area of expertise and the type of projects you have been working on in your career history?
2	Int12	I am currently the manager of the project management office (PMO) for the software department at a local branch of a consumer electronics company. I started my career with the firm more than 20 years ago, doing all sorts of different things. I started as a developer, then I also was an architect, team lead and by now I have been working with project/program management for more than a decade.
3	Int13	I have been working for the company for more than a decade, started as an engineer, (…) then I worked as a project manager for software teams, meaning deploying agile methodologies, such as Scrum and Kanban to manage both onsite and offsite teams to produce applications, or maintain them in some way. For the past year I have been working as a senior project manager (…).
4	Researcher	Do you have set guidelines which PMM to follow instructed by the PMO, do you need to choose different methodologies in the different areas where you are working?
5	Int13	The most commonly used agile methodology that I have been deploying is Scrum. The reason for that, is that the teams I have project managed have been focusing on producing new software or improving that. That meant that you could have a prioritized backlog, based on product owner input, and basically, make a plan and have a clear workflow on that. When I say Scrum, I actually *mean* Scrum. There are a few key things you need to have in order to call it Scrum: team of a specific size, sprint plans, daily meetings, review meeting, and some other boundaries. The idea has always been to deploy Scrum as close to the textbook example of Scrum as possible. There have been variances specifically when it comes to offsite, where you need to have certain meetings digitally. Also, in some areas there has been more of a maintenance mode situation. There is no clear add-on of features, when you transition through design, documentation, development and delivery, but instead, you would be fixing bugs. That is

		more of a reactive situation, where I mostly developed Kanban. That is about choosing the correct tool for the correct situation.
6	Int12	There are general guidelines that I would consider more on an educational basis, coming from the top of the company. We as a company are free to choose methodologies and way of driving projects based on situations and needs. Quite different in the different contexts. Different parts of our organizations have not come as far. Not all departments are in the same place. Some of the things that we do are inherently suited out of legacy for working in a Waterfall model. Things that are newer are much simpler to adapt or start off in an Agile way. In general, things that are closer to hardware or hardware-driven are much more likely to have a Waterfall overarching set of rules. There is a lot of legacy in that, but also because hardware development is inherently not so agile as software development. It is simple to change software, but hardware design can be difficult and costly to change.
7	Researcher	Does your organization have projects on developing new hardware, which follows an iterative development process?
8	Int13	I cannot say that we are involved in that, but definitely, there is work that is in that direction.
9	Researcher	What is the process and what are the factors considered for the backlog prioritization?
10	Int12	The product owner role, as I see it, is a combination of different competences. Basically, a lead engineer, or some kind of architect or whatever we call them, who have deep understanding of the actual implementation. Then the project manager together with someone who has scope knowledge in what direction we want to move in. Those type of competences together allow for a correct prioritization. The reason for that is if there is a scope owner who only cares about the scope will not have oversight for quality. You want to build the software on stable foundations. When you add features, you do not want to add them on mud… together, these three competences (scope, implementation, quality) make it available to prioritize the backlog well, so that each sprint contains all of these elements to an optimal extent.
11	Researcher	When considering quality, would you further say that quality has an impact on the way you work? For example, do you have longer iterations in testing to ensure the highest attainable quality?
12	Int12	It largely depends on what asset you are looking at. In general, the technical quality, that you secure by various types of static testing activities: unit testing, static code testing, system testing, integration testing. Then of course if you have an asset, where you have a lot of UI, you need to complement that with a lot of exploratory testing, that mostly has been done through some kind of test-day activity which

		we plan in each sprint. Then we have a quality plan, normally, which dictates what type of activities happen at every commit, merge, sprint or conclusion. If you have a release, it will trigger some type of activities. On a commit you might want to have a requirement, such as a certain number of reviews on the codes, someone needs to give a "+2", before you are allowed to merge, for instance.
13	Researcher	Does the PMO consider quality in some way, do you have some measurements in place or is it rather the responsibility of the teams and PMs?
14	Int13	All projects have KPIs that they need to achieve. So yes, we measure quality per project. These are obviously, slightly differ across projects, mostly depending on department and product type. That can vary a bit. Generally, yes, we measure KPIs per project.
15	Researcher	What would you say the main elements are of these KPIs?
16	Int12	How do we build KPIs? Well, it differs a bit on the products we are working with. There are of course, factors, like economy and budget and restrictions in how many engineers we are allowed to deploy on a certain project. Apart that, if we are looking at product quality, we have, in general, we have a tight collaboration with our corporate quality office. They have generic KPI guidelines for the different types of products. We would typically focus on things linked to the product type. For instance, in things that operate on battery, battery life and power consumption is very important. Not sure if we should go into the details on this. Performance for instance is very important, to get the best possible performance from your hardware.
17	Researcher	Would it be possible to aggregate these KPIs on a portfolio level to help make better investment decisions?
18	Int12	Yes, this is done on a higher level, which is then assigned as a program or portfolio of projects that we cannot change. We are set to execute those. At a higher point, these things of course are aggregated. Then we will look at the performance of the different projects.
19	Researcher	What is your view on choosing methodology and measuring results in a Waterfall vs Agile context?
20	Int13	I would say that it is slightly correct that Waterfall-based KPIs are more intuitive, but it's certainly not impossible to do Agile. It all depends on the KPI. I derive my KPIs from SMART goals, not from Agile. I use Agile to drive the team to get good progress and have a "build, measure, learn" activity going on. Then we use KPIs to measure and specifically communicate to management about how their assets are performing. KPIs can be a little bit difficult sometimes, it may drive incorrect behavior. You always need to have that in mind and

		have a constructive dialogue about every KPI that you need to be able to revisit as well.
21	Int12	It is one of the things with KPIs, that they are extremely difficult to set on a meaningful level. It is difficult to set them and interpret them afterwards when you have a full picture. It is not always simple to say what is it that you can say from those KPIs. It is a difficult one.
22	Researcher	What do you consider project success? Is it about the satisfaction of KPIs or something else?
23	Int12	For sure, it is not only KPI fulfilment, at least I do not think it constitutes success. It is definitely a first gateway to success, you have to pass he KPI to go on with your release or whatever it is that you are doing. Of course, there are lots of other factors that go into saying what is a success. On a small scale, of course it comes into play that the team is satisfied with the work they have done, we can learn something from the results and implement them in the next step. On a larger scale, you need to make sure that the reception of what you did is good and customers are happy with that.
24	Researcher	How do you make sure that the lessons learnt can then be utilized in other relevant projects as well? Do you have guidelines or communication channels to spread the information?
25	Int12	Yes, we have a fairly well-structured process on how to work with lessons learnt and how to achieve benefits from that - meaning how to pick up things that are valuable and that we can implement in the following projects. I would say we have a way of doing that, which is kind of global actually and is true for the entire corporate structure.
26	Researcher	Would you mind elaborating on that? What is the way of accessing this information?
27	Int12	That is a good question. I would say it moves bottom-up. Projects collect the lessons or things that we need to improve for the next project. Then we put this knowledge together in some sort of presentation and then in a report. That is then consolidated on a higher level. There are things that we learn in different fields from each other. Most of it stops at a fairly local level at least in the same company, because it is difficult to draw conclusions that are valid for many entities, because products are completely different, and teams are not working exactly the same. But within a company, we learn from project to project. Basically, before starting a new project we go through the improvement suggestions or the lessons learnt from the previous projects and then we pick the number of things that we think would be sensible to implement in a new project. We don't pick all, we pick a few that we

		think we can achieve and then we go for that. We have a formalized process for this.
28	Researcher	Concerning process documentations and guidelines, would you say that they are living documents in your company, with feedback loops to lessons learnt?
29	Int12	Yes. I would say they are. The processes are not static, they will change over time both from process changes, the input from methodologies, and then, technology that changes sometimes change how we work. We always learn a smarter way of doing things.
30	Researcher	About customer satisfaction: how do you link external feedback from customers to the development process? What is the process of it? Do you have proxies between developers and customer support?
31	Int12	Yes. We do. There are proxies. Today it is easy for anyone to look at review sites and all sort of technical sites where you can find information on how end consumers perceive our products. And we try to follow that, we have a special team to do that. Feedback is collected monthly and sent back to the projects. And then, of course, we have our own digital communication channel where you can ask a question and people also give feedback on stuff, so that is also a source for end-user communication. We collect information from repair centers and stores, as well as any other places where we might meet our end customers. We try to collect as much information as possible on who are our end-consumers and what they think about our products.
32	Researcher	Do you think that proxies can alter the information of feedback relayed back to the development? Is it a concern in your company as well?
33	Int12	Sometimes I guess yes. There is always a risk that you lose some of the data in communication. And when you get information that is relayed by someone, that is summarized from many different interviews or discussion and then sent to the development organization, it is not obvious that you always get the correct information or the full information. But in most cases, we get sensible information. However of course, you lose some detail.
34	Researcher	Would you say that developers in your company understand business processes and business value they bring with the software they develop.
35	Int12	Yes, definitely. (…) I'm not sure there is a process (behind it), but there is definitely education on the subject and of course encouragement. Engineers are encouraged to bring forward their views. If someone has ideas, then they are encouraged to bring it forward.

36	Researcher	How would you describe the company culture? Would you say that corporate values, goals and vision help define the ways of working, therefore feed into the methodologies and building KPIs as well?
37	Int12	Yes. I think we have a very open company culture. You are encouraged to bring forward any ideas, objections, concerns. (…) Culture affects the processes in every company to some extent. There is an overarching set of values, goals of the company and that affects the way we work.
38	Int13	And also, we are a big company and we have development sites in every part of the world. So, the culture is not a small thing. When you do large projects, there are multiple sites involved and every new product is different. There is a certain amount of culture variances as well, even within the company. And sometimes it works well and sometimes bad. (…) Off the top of my head, security and privacy are good examples we take very seriously. They really drive everyone towards making sure that we do keep our users' private data.
39	Researcher	What do you see as challenges or opportunities in the current way of working?
40	Int13	I think the challenge is about understanding that there are large differences between planning and executing development in hardware-related aspects and comparing them with software. It is fundamentally different. Hardware is basically like blocks you put on each other and you can a Waterfall plan work. In software, if you add something you can (still) change everything. You don't build software by adding one block on the top of another. The biggest challenge is (also our strength), that we are a hardware company and we do that well. In hardware projects, there are hardware specialists who might not always understand software challenges in various shapes. But the opportunity for us as for a large company is that we are good at many things (even software), so there is a great potential to continue doing great products.
41	Int12	Our company is in essence a hardware company and that is the foundation of who we are. (But) we are also an extremely skilled software development company. We have some products that are only built on software. However, there is a lot of learning still going on for software. One of our big challenges is in maintaining our workforce and slowly growing, finding the right competence and slowly growing with the right people. As we have sites basically in every corner of the world, it is a challenge to make all that work together. It is also an opportunity. Because if you can't find the right people in a certain location, you can find them somewhere else and start a team there. And that was done before.

42	Researcher	As the last question, what are your future expectations on the methodology and combined product development?
43	Int13	Continue making small improvements, I would say.
44	Int12	Yes, gradual improvements and I think, we will slowly move forward. From a development perspective, our company will not always be the company that is in the absolute forefront of the methodology development, but we are keen followers and we do develop with the methodologies that are developed.

C.   Appendix: Intercoder Reliability Tables

Table C.1: Intercoder reliability by the main nodes for pilot interviews (first round)

Interview	Organizational development	Perceptions	Projects	Roles	Average
1	85%	89%	78%	86%	**84%**
2	100%	92%	77%	97%	**91%**
3	91%	100%	65%	88%	**86%**
4	78%	85%	68%	91%	**80%**
5	81%	91%	73%	96%	**85%**

Table C.2: Intercoder reliability for pilot interviews (second round)

Dimension, factor / Interview	1	2	3	4	5	Average
Organizational development	**97%**	**100%**	**100%**	**93%**	**86%**	**95%**
Organizational development\OD-DMP	95%	100%	100%	98%	83%	**95%**
Organizational development\OD-KMD	98%	100%	100%	89%	82%	**94%**
Organizational development\OD-MCC	100%	100%	100%	94%	96%	**98%**
Organizational development\OD-PR	95%	100%	100%	92%	85%	**94%**
People & Processes	**100%**	**100%**	**89%**	**100%**	**100%**	**98%**
People & Processes\PP-CP	99%	100%	94%	100%	100%	**99%**
People & Processes\PP-RER	100%	100%	90%	100%	100%	**98%**
People & Processes\PP-TI	100%	100%	85%	99%	100%	**97%**
Projects	**95%**	**97%**	**68%**	**88%**	**91%**	**89%**
Projects\PJ-M	96%	98%	83%	97%	99%	**95%**
Projects\PJ-MS	98%	93%	75%	79%	97%	**88%**
Projects\PJ-R	100%	98%	58%	95%	75%	**85%**
Projects\PJ-RQ	93%	96%	59%	82%	93%	**85%**
Projects\PJ-S	88%	100%	68%	87%	95%	**88%**
Perception	**93%**	**100%**	**100%**	**85%**	**99%**	**95%**
Perception\P-BP	98%	100%	100%	87%	100%	**97%**
Perception\P-CB	91%	100%	100%	90%	99%	**96%**
Perception\P-O	90%	100%	99%	80%	99%	**94%**
All nodes	**96%**	**99%**	**89%**	**92%**	**94%**	**94%**

Table C.3: Intercoder reliability of consecutive interviews

Dimension, factor / Interview	6	7	8	9	10	11	12	Average
Organizational development	**92%**	**89%**	**83%**	**81%**	**88%**	**82%**	**98%**	**88%**
Organizational development\OD-DMP	87%	89%	76%	68%	74%	85%	100%	**85%**
Organizational development\OD-KMD	92%	96%	79%	83%	96%	75%	98%	**89%**
Organizational development\OD-MCC	98%	92%	93%	87%	91%	66%	94%	**89%**
Organizational development\OD-PR	92%	80%	83%	85%	91%	100%	100%	**90%**
People & Processes	**88%**	**88%**	**80%**	**72%**	**86%**	**85%**	**87%**	**85%**
People & Processes\PP-CP	87%	74%	83%	60%	70%	86%	71%	**79%**
People & Processes\PP-RER	85%	95%	70%	87%	88%	91%	100%	**88%**
People & Processes\PP-TI	92%	95%	85%	68%	100%	80%	89%	**89%**
Projects	**96%**	**92%**	**84%**	**87%**	**93%**	**90%**	**92%**	**91%**
Projects\PJ-M	90%	85%	90%	70%	74%	100%	93%	**89%**
Projects\PJ-MS	94%	94%	80%	100%	100%	80%	84%	**89%**
Projects\PJ-R	100%	97%	80%	68%	91%	95%	100%	**93%**
Projects\PJ-RQ	94%	86%	81%	96%	100%	100%	95%	**93%**
Projects\PJ-S	100%	97%	88%	100%	100%	75%	86%	**92%**
Perception	**90%**	**83%**	**86%**	**89%**	**86%**	**91%**	**93%**	**88%**
Perception\P-BP	86%	85%	79%	83%	80%	90%	89%	**85%**
Perception\P-CB	98%	83%	93%	100%	100%	84%	96%	**92%**
Perception\P-O	86%	80%	88%	83%	80%	100%	95%	**88%**
All nodes	**92%**	**89%**	**83%**	**83%**	**89%**	**87%**	**93%**	**89%**

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