



**CHALMERS**  
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# Reducing Product Development Lead Time With an Agile Way of Working

A Case Study at Husqvarna Construction Products

Master's thesis in Quality and Operations Management

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CHALMERS UNIVERSITY OF TECHNOLOGY  
Gothenburg, Sweden 2021  
[www.chalmers.se](http://www.chalmers.se)  
Report No. E2021:014



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## SUMMARY

Reducing time to market is a crucial aspect in product development as more products are being developed than ever before. Being fast to market can come with various benefits, such as a competitive advantage, being a technical pioneer, and higher profits from introducing the product faster. Consequently, it is valuable for companies to investigate how they can reduce time to market.

One of the newest approaches used in New Product Development (NPD) is Agile product development. The Agile methodology responds to the shortcomings of traditional development methodologies, which view changes as something that has to be eliminated instead of being incorporated. Today, companies apply the Agile way of working in the hope of reducing product development lead time and improving their overall processes. This has led to Husqvarna Construction Products (HCP) looking into the potential of applying an Agile way of working in their NPD process to reduce time to market.

A research was conducted at HCP in the form of a case study with a qualitative approach. The researchers formulated two research questions to fulfill the purpose of the study. The first research question was used to analyze if an Agile way of working could reduce the product development lead time. The second research question was designed to identify the challenges that may emerge when implementing Agile into an organization characterized by traditional development processes.

The study's findings support that an Agile way of working can reduce product development lead time if implemented efficiently. The study aimed at identifying challenges in HCP's NPD process. These challenges were divided into three categories: challenges related to the early phases, process-related challenges, and communication challenges. The researchers analyzed if an Agile way of working could solve these challenges by applying different tools, artefacts, and roles from Agile-Scrum. The study concludes that using an Agile way of working can be helpful to solve some of the challenges identified at HCP and achieve a shorter time to market. The study's findings also show that various challenges may emerge when transforming from a traditional development process to a more Agile way of working. The researchers recommend that HCP look into the Agile-Stage-Gate hybrid model because this approach has shown to be effective in reducing time to market.

Keywords: Agile, Agile Product Development, Agile-Stage-Gate Hybrid Model, Change Management, Lean Product Development, New Product Development, Reduce Time to Market, Scaled Agile Framework (SAFe), Scrum, Stage-Gate, Time to Market, and Waterfall Model.

## Acknowledgments

This thesis was written during spring 2021 at the Department of Technology Management and Economics, Chalmers University of Technology. Writing the thesis has been a challenging and rewarding experience. We want to thank all the people who helped us in the process. We want to express our gratitude to our supervisor at Chalmers University of Technology, Lars Trygg, who gave us valuable support and advice during this process.

We would like to thank our supervisors at Husqvarna Construction Products, Fredrik Sandinge, and Erik Silfverberg, for giving us the opportunity of conducting our research at the company and having weekly meetings with us to guide us through the process. They gave us helpful information and advice in performing our study. Additionally, we would like to express our gratitude to the people that participated in our research and gave us valuable knowledge and understanding of the challenges in product development.

Berglind Sigurðardóttir deserves special thanks for proofreading the thesis and giving us invaluable improvement suggestions and feedback. We also want to acknowledge the help we got from our opponents, Lovisa Arnoldsson and Karen Carbonell, who gave us important suggestions for improvements. Lastly, we would like to thank our family and friends for their support and continuous encouragement.

Lina Hallgren and Ástrún Svala Óskarsdóttir, Gothenburg, May 2021



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## **List of Abbreviations**

**APQP** Advanced Part Quality Planning.

**ART** Agile Release Train.

**BOM** Bill of Material.

**EP** Engineering Pilot.

**GD** Global Design.

**HCP** Husqvarna Construction Products.

**IT** Information Technology.

**MP** Manufacturing Pilot.

**NPD** New Product Development.

**PCP** Product Creation Process.

**PM** Project Manager.

**PMM** Product Management Meeting.

**PMO** Project Management Office.

**PPAP** Production Part Approval Process.

**R&D** Research and Development.

**R&R** Roles and Responsibilities.

**SAFe** Scaled Agile Framework.

**SBCE** Set Based Concurrent Engineering.

**SPPM** Strategic Product Planning Meeting.

**SQA** Supplier Quality Assurance.

**TPS** Toyota Production System.

**VoC** Voice of the Customer.

# 1. Introduction

Products are being developed and introduced faster to the market today than ever before, which pressures companies to reduce their product development time. By reducing time in the product development process, companies can introduce their products faster to the market, which is a precondition to stay competitive and ensure the company's success (Cooper, 2019). Zirger and Hartley (1996) emphasize that time to market is a significant competitive factor in product development, which is the reason why many companies investigate where they can reduce time to be faster to market. This is the case for Husqvarna Construction Products (HCP), which is a part of Husqvarna Group. Husqvarna Group has a company-wide goal to reduce time to market when it comes to their New Product Development (NPD) process.

HCP's NPD process has been consistent in respect to time during the past years, which has resulted in that the company has not experienced any time reduction when it comes to being faster to market. HCP's products have, in the past, been characterized by hardware but are in a transition of incorporating more software and electronics. This opens up the market for new companies from other industries and backgrounds to enter the market, and forces HCP to be faster to adapt to the new market conditions to ensure the company's success. Since HCP is facing new challenges in their product development, the process becomes more complex, and uncertainties increase. However, with new challenges come new opportunities to work in different and more efficient ways. Consequently, HCP wants to investigate if the Agile way of working could be implemented into their NPD process to reduce time to market.

As of today, HCP uses the Stage-Gate model to manage its new products. The Stage-Gate methodology was introduced by Cooper (1990) and consists of stages and gates that illustrate the process for product development from idea to launch. The model consists of an idea, five stages, five gates, and a post-implementation review. At each gate, a decision-making process takes place to decide if the product is killed or if it moves on to the next stage. This makes the model linear, and changes are often seen as something negative since it is associated with additional costs. On the contrary, the Agile methodology values responding to change higher than following a plan since changes are considered inevitable. Moreover, the Agile methodology is often associated with speed and flexibility since it utilizes short iterations in the development process (Beck et al., 2001).

## 1.1 Preliminary Aim

The increased competition pressures companies to find new ways to become faster to market in order to stay competitive (Cooper, 2019). One of the latest methodologies to reduce time to market is Agile, which has its roots in software development. Since HCP incorporates both software and hardware in their products, it is appealing to analyze if Agile would be beneficial for them. Therefore, the purpose of this study is to investigate if the Agile way of working would be useful to apply at HCP's NPD process in order to reduce time to market.

## 1.2 Objectives

The objective of the thesis is to provide tangible recommendations for HCP for their ongoing work to reduce time to market. One goal is to explore where the Agile way of working does apply within the NPD process to decrease time to market and detect where it would not be beneficial to implement an Agile mindset. The deliverables will contain recommendations and a booklet, to educate the employees at HCP on an Agile way of working in product development. Furthermore, an implementation plan of how Agile could be implemented will be provided for HCP.

To meet the objectives of this thesis, two research questions were formulated:

**RQ1:** Can an Agile way of working reduce product development lead time in an organization that is characterized by traditional development processes?

**RQ2:** What challenges may emerge when implementing an Agile way of working into an organization that is transforming its product development processes?

RQ1 is formulated to understand the problems and possibilities of applying Agile to reduce the lead time in an organization characterized by traditional development. Traditional development refers to the Stage-Gate model and the Waterfall model, which will be further explained in the theoretical framework. HCP has, during the past years, worked with the Waterfall model but now wants to investigate the potential benefits of applying the Agile methodology to reduce time to market. One of the factors that make HCP look into the Agile methodology is increased competition caused by new businesses entering the market. By answering RQ2, a greater understanding of potential problems that could appear when implementing Agile into an organization that has been defined by hardware development but has an increasing amount of software product development due to new technology. This would provide tools to either hinder or mitigate the adverse effects that may emerge when implementing an Agile way of working. By understanding the potential pitfalls, the chance for HCP to have a successful transformation increases.

## 1.3 Delimitations

This thesis will focus on the pre-study phase and the NPD process at HCP with the aim to reduce time to market. Other sections of the Product Creation Process (PCP) will be excluded from the study, see Figure 8 for clarification. HCP consists of six subdivisions, and four of them are located in Jonsered, Sweden. The organizational structure will be further described in chapter 4. *Company's Background*. The focus of this thesis will be on how to reduce time to market with an Agile way of working for the four subdivisions located in Jonsered, thus excluding the other two. Furthermore, the data will mainly be collected at HCP.

## 2. Theoretical Framework

In this chapter the theoretical framework will be presented. The chapter begins with a description on new product development followed by a session about reducing time to market. Traditional product development processes Waterfall and Stage-Gate are presented. Thereafter, Lean product development is introduced. However, the focus will be on Agile and different approaches are explained that are Scrum, Scaled Agile Framework (SAFe), and Agile-Stage-Gate hybrid model. Lastly, change management will be introduced to get an idea of how to successfully implement a change within an organization.

### 2.1 New Product Development

The business world is unstable, and for that reason, companies need to frequently adjust and develop their management processes to remain effective and profitable (Griffin, 1997b). Wheelwright and Clark (1992) describe how companies have had to adapt to the increasingly competitive environment that is global, intense, and dynamic when introducing new products to the market. The authors describe the new product development as a process of delivering an idea to a functional product to the market. In order to stay in the game, firms have to find new and smarter ways to develop products and deliver them faster to the market (Griffin, 1997a; Wheelwright & Clark, 1992).

New product development processes are crucial to staying competitive and becoming successful (Cooper, 1995). Today, organizations have to get the products faster to the market more efficiently, and the product must meet the customer's needs and expectations (Wheelwright & Clark, 1992; Cooper 2019). Cohen et al. (1996) mention that reducing the lead time of new product development and improvements in product performance are critical indicators for many companies to become outstanding in the market. However, Cohen et al. (1996) also illustrate that there is a conflict between these two objectives, and businesses should consider a tradeoff between performance and time to market. Griffin (1997b) demonstrated that if organizations do not update their new product development practices regularly, they are more likely to fail and lose their market competitive advantage.

Wheelwright and Clark (1992) demonstrate three critical driving forces when it comes to product development that are illustrated here below.

***Intense international competition:*** In today's business environment, world trading is increasing, and companies can now easily access international markets and have suppliers worldwide. This has created many different competitors that may have grown in different environments in North America, Europe, and Asia. Now, there are more competitors capable of exceptional product development, which leads to intense international competition and a demanding environment. (Wheelwright & Clark, 1992)

***Fragmented, demanding markets:*** Customer expectations and requirements have grown to become more sophisticated and demanding. Understanding the voice of the customer is essential in today's environment, and the customer wants products that solve their problems and are easy-to-use. (Wheelwright & Clark, 1992)

***Diverse and rapidly changing technologies:*** Technology is changing fast, and frequently, new knowledge is integrated. New understanding and development of

technology result in new solutions for engineers to use in product development in different areas. (Wheelwright & Clark, 1992)

Griffin (1997b) pointed out these three factors as well, but also added shorter product life cycles as a driving force that has emerged with the frequent changes in the business environment. These driving forces have motivated organizations to speed their product development and improve the efficiency and effectiveness of the new product development processes (Griffin, 1997b). Since the business world is even faster, less predictable and more global than thirty years ago companies have had to adapt to these challenges (Cooper, 2019). Therefore, shortened product life cycles and the importance of reducing time to market will be further presented in the next chapter.

## **2.2 Reducing Time to Market**

Pawar et al. (1994) explain that time to market is a strategy that concentrates on reducing the time it takes to bring new products to the market. Reducing time to market and getting products faster to the public has become a crucial strategic objective for many businesses (Zirger & Hartley, 1996). According to Zirger and Hartley (1996), one of the greatest advantages of offering new products quicker than the competitors is that it gives organizations competitive advantages and has become very important in today's business environment. According to Pawar et al. (1994), the organization that accomplishes the earliest introduction to the market leads the way and manages to reduce development costs and makes higher profits.

The advantages of introducing products to the market faster than the competition are numerous. For instance, shorter time to market can grant firms the opportunities to set the product standards, be a technical pioneer, get customer feedback faster, be able to change the product according to the input, and get a higher profit due to the early time to market (Zirger & Hartley, 1996). An early introduction can also result in getting customers' loyalty before their competitors do, giving the firms increased market share, and improving the company's innovation image (Pawar et al. 1994). Kessler and Bierly (2002) go as far as saying that being the fastest to bring new products to the market is the most crucial factor to becoming successful. The authors further demonstrate that by emphasizing speed it may be a factor of high-quality focus. Stalk Jr and Hout (1990) mention the advantages of being a fast innovator are, for example, improved quality, happier employees, and a better working environment. Pawar et al. (1994) state that bringing new products simultaneously as the competition or later increases costs and lowers profit. Therefore, reducing the time to market is an important strategic objective.

Some challenges may emerge when trying to gain time to market successfully. Zirger and Hartley (1996) emphasize that to successfully achieve a shorter time to market in new product development, managers must avoid quick fixes and localized solutions. Additionally, the authors state that it is also important to focus on coordination and commitment and combine it with product strategy, processes, and human resources management factors. According to Kessler and Bierly (2002), the biggest issue in managing new product development is meeting the schedule. Therefore, the authors suggest putting more focus on management commitment and that leaders should concentrate on shortening the time to market.

Zirger and Hartley (1996) demonstrated that companies that succeeded in bringing the product quicker to the market had dedicated cross-functional teams and a shorter lead

time as a development target. Cooper (1995) comes to the same conclusion by stating that cross-functional teams were one of the key factors to successfully launching a project early, and having a dedicated project leader and top management support. In their study, Zirger and Hartley (1996) conclude that managers can accomplish high success in reducing the lead time by emphasizing on building a strong team structure. Cooper (1995) describes that putting more time and effort in the early phases and doing the up-front homework of the new product development processes will eventually save time. Cooper (1995) also demonstrates that the key factors to achieve profitability also led to a shorter time to market. The key factors are true cross-functional teams, put focus on the up-front homework in the early phase of development, and maintain a strong market orientation and customer focus. Cohen et al. (1996) indicate that even though a firm manages to shorten the cycle time in their new product development process the company does not necessarily bring their product earlier to the market. However, it leads to improved and advanced products (Cohen et al., 1996).

There are different ways to reduce lead time, such as having cross-functional teams, as mentioned above. To be able to meet the customer's requirements, reduce time to market, and compete in this intense international competition, different product development processes and models have been introduced over the years. In the next chapter, traditional product development processes will be introduced.

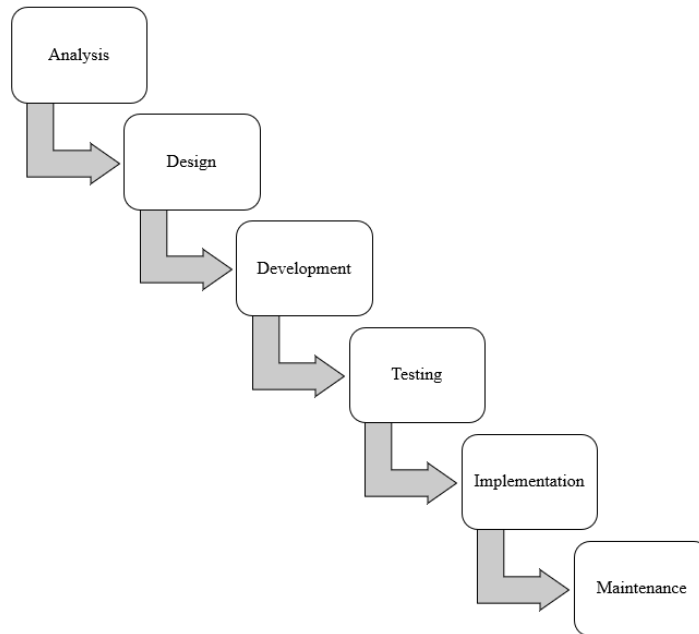
## **2.3 Traditional Product Development Processes**

In this chapter the Waterfall process and Stage-Gate process will be presented.

### **2.3.1 The Waterfall Process**

In 1970, Winston W. Royce was the first to define the Waterfall model to plan, manage and control the process of software development projects (Bassil, 2012). Royce first introduced the model for software development, but the framework is used in many traditional development processes. Balaji and Murugaiyan (2012) describe the Waterfall process as a sequential development model where each phase of development is completed before moving on to the next step, without any overlapping. Each step is scheduled and should be finalized within a specified time period, and in this process, each phase is frozen before beginning the next step (Balaji & Murugaiyan, 2012).

The Waterfall model consists of several phases, and the number of steps can differ between organizations (Bassil, 2012; Balaji & Murugaiyan, 2012; Petersen et al., 2009). Usually, the Waterfall model consists of five to six steps. Balaji and Murugaiyan (2012) provide an example of a six-phase Waterfall model, see Figure 1. The phases in the model are further described below.



**Figure 1:** Example of a six-phase Waterfall model (Balaji & Murugaiyan, 2012).

**Analysis:** The customer needs are identified, and the specific functional and non-functional requirements for the product are defined and evaluated for the design and implementation step (Bassil, 2012; Petersen et al., 2009). Balaji and Murugaiyan (2012) demonstrate that the requirements should be clear before moving to the next phase.

**Design:** The plan and problem-solving are characterized in this phase where the developers and designers create a solution based on the customer requirements and technical designs (Bassil, 2012).

**Development:** In this stage the actual development of the product takes place, and a functional product is created (Petersen et al., 2009). Before moving on to the next phase, the developers perform basic testing and use a quality gate checklist (Petersen et al., 2009).

**Testing:** This step is also known as the verification and validation phase (Bassil, 2012). The product is tested, and the technical feasibility and quality of the product are evaluated (Petersen et al., 2009). It is confirmed if the final outcome meets the customer requirements and specifications (Bassil, 2012).

**Implementation:** The product is released to the market, and it is further analyzed if the product meets the customer requirements and if the customer has accepted the final outcome (Petersen et al., 2009).

**Maintenance:** After delivering the product to the market, it has to be maintained. Maintenance is the process of correcting errors, and improving the performance and quality of the product by using customer feedback (Bassil, 2012).

Royce (1970) demonstrated that the implementation of the Waterfall process was risky and invites failure. The author further explained his concerns and presented five additional steps that must be taken into consideration when implementing the model to

mitigate risks that could eventually lead to failure. The five steps that Royce (1970) emphasized are:

- Step 1:** Program design comes first
- Step 2:** Document the design
- Step 3:** Do it twice
- Step 4:** Plan, control, and monitor testing
- Step 5:** Involve the customer

However, despite the steps suggested by Royce (1970), many companies have implemented the Waterfall model for their product development processes and reported numerous problems related to the model (Petersen et al., 2009). Challenges that may emerge when using the Waterfall model are various. One of the greatest challenges is coping with changes that are needed when errors are detected late in the process. These errors can lead to rework, which causes longer lead times and the process becomes more time-consuming and costly (Petersen et al., 2009; Balaji & Murugaiyan, 2012). Balaji and Murugaiyan (2012) illustrate that the test team is not involved from the beginning of the project. Therefore, the problems build up between each phase, which results in an inadequately structured system.

The Waterfall model is not known for emphasizing customer involvement and customer feedback on the product is provided late in the development process (Petersen et al., 2009). Even though Royce (1970) mentions the importance of involving the customer and understanding the voice of the customer, it has not been successfully implemented in the process and has resulted in dissatisfied customers (Bassil, 2012).

According to Bassil (2012), the main reason for these late deliveries and missing the mark for the customer is due to resource allocation. Project managers do not assign resources carefully, which leads to bottlenecks and late deliveries while other resources may be delayed.

Royce (1970) believed that documentation was essential when it came to software development. However, Petersen et al. (2009) demonstrate that documentation can become too extreme, which does not create any value and slows down the process extensively. Too much documentation becomes obsolete and does not meet the customer requirements (Petersen et al., 2009).

Petersen et al. (2009) mention more problems that might occur when using the Waterfall model, such as longer lead times due to the requirement analysis phase becoming too detailed and decision-making taking too long. Testing is also done way too late, leading to more errors.

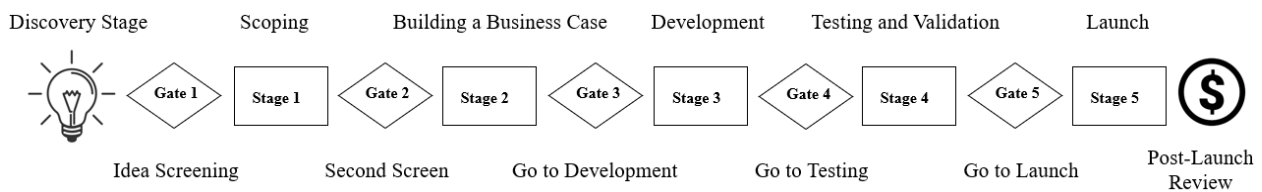
However, there are advantages as well from using the Waterfall model. Balaji and Murugaiyan (2012) identify several benefits from adopting the process. These benefits are, for example, that requirements are well defined in the beginning, before the design and implementation begin. The process is linear, which makes it easy to understand and implement the Waterfall model. Quality checklists and documentation are used at the end of each phase to ensure the quality of the product. Each step is finalized in a specific period before moving on to the next phase. (Balaji & Murugaiyan, 2012)

### 2.3.2 The Stage-Gate Process

Cooper (1990) introduced the Stage-Gate model as a new tool to manage new product development processes. Companies face pressure to reduce time to market and at the same time improve the quality of the product (Cooper, 1990; Wheelwright and Clark, 1992). Cooper (1990) developed the Stage-Gate model as a tool to maintain these challenges. It is a tool to manage, control, and direct the new product development processes more effectively and efficiently. The Stage-Gate system is both a conceptual and operational model that consists of stages and gates and illustrates the process for product development from idea to launch (Cooper, 1990).

Cooper (1998) explains the Stage-Gate model as a process where there is a gate between each workstation that acts as a quality checkpoint. At each gate, the work is evaluated, and the product must pass the quality criteria that are involved in each stage to be able to move on to the next stage. The stages are where the actual work is done, and the gates are to ensure that the product meets the quality criteria. A decision-making process takes place where it is decided if the product is a Go/Kill/Hold/Recycle and if the action plan is approved to be able to move on to the next stage. The product must fulfill the appropriate quality criteria in the stage to be able to move on to the next stage. (Cooper, 1998).

Cooper (1990) interpreted that within each organization, it can be seen as the processes are unique. However, Cooper (1990) demonstrated that the processes are quite similar in practice and can be integrated into the Stage-Gate process. The Stage-Gate model that Cooper (2001) created consists of several stages and gates, see Figure 2. Each gate and stage will be further explained here below.



**Figure 2:** An example of the Stage-Gate process (Cooper, 2001).

#### Discovery Stage

In this stage, ideas for new products are generated, and opportunities are identified. This stage is a crucial phase as the process begins with this stage. It is essential to create as many ideas as possible, and the need for great ideas is vital as they make or break the process. Activities in this phase are, for example, discovering gaps and opportunities in the marketplace and working with the customers to understand their needs and expectations. (Cooper, 2001)

#### Gate 1: Idea Screening

In gate 1, the idea screening takes place. It is decided if the project is acceptable to be further explored, and if it can move on to the next stage. If the project is considered to be valuable, the first decision is to allocate resources to the project. Here, key criteria are created to manage strategic alignment, technical feasibility, resource allocation, market attractiveness, and product advantage. It is common to make a checklist for the “must meet” criteria and a scoring model for the “should meet” criteria to prioritize the

projects. This is done to evaluate if the project meets the criteria and can be approved to move on to the next stage. (Cooper, 2001)

### **Stage 1: Scoping**

The scoping stage involves investigating the project's technical feasibility and assessing the potential in the marketplace. This stage is usually short and inexpensive. A preliminary market assessment is performed where key customers and focus groups evaluate the product concept to analyze the market size and potential. A preliminary technical assessment is also completed to explore the product's technical feasibility. Usually, a small team of people handles this stage, often from the marketing and technical department. (Cooper, 2001)

### **Gate 2: Second Screen**

At this gate, the project is reevaluated with regards to the new information collected from stage 1. Here, the project has to meet the criteria set in gate 1, and additional criteria may also be considered appropriate at this point. A checklist is used to assess the gate decision and if the project is approved to move on to the next stage. (Cooper, 2001)

### **Stage 2: Building the Business Case**

In this stage, the business case is formulated. This stage is a more detailed analysis of the customer's preferences, market attractiveness, and technical aspects. The customer's expectations and needs are analyzed and defined by the critical product attributes and specifications. The technical feasibility is assessed to see how to meet the customer requirements. In this stage, it is estimated how to develop and manufacture the project with the right budget. It is also investigated what investments are required to deliver the product. Competitive analysis is a part of this stage, as well as overseeing a detailed business and financial analysis. A specific project plan is created, and the outcome is a business case. Stage two is usually managed by a cross-functional team. (Cooper, 2001)

### **Gate 3: Go to Development**

This gate is the last gate before the company commits to heavy financial spending on the project. Each activity is evaluated, and quality criteria are assessed. The checklist for "must meet" and "should meet" criteria from gate 2 is once again checked. Evaluating the financial analysis is a crucial part of this gate because once passed this gate, it is decided to financially commit to the project. If the project is approved, this gate ensures that all plans and quality criteria are met and approved. A cross-functional project team is assigned to a project leader who has authority. (Cooper, 2001)

### **Stage 3: Development**

In the development phase, the development plan is implemented. In larger projects, there are milestones and project reviews within this phase. A physical product is developed, and tests are made to ensure that the product meets the requirements. The focus in this stage is on the technical work iterative with market analysis and operations activities. Customer feedback is essential in this stage and is used to develop a product that meets the customer expectations and requirements. An updated financial analysis is prepared, and patent and legal issues are resolved. The final outcome in the development stage is a prototype of the product that can be further tested. (Cooper, 2001)

#### **Gate 4: Go to Testing**

With more accurate information and data, the progress and the development of the product are checked. The quality criteria are evaluated, and the financial analysis is estimated. If all plans for further implementation, marketing and operations plans are acceptable, and the product meets the relevant quality criteria, the decision can be made if the product can be approved and move on to testing and validation. (Cooper, 2001)

#### **Stage 4: Testing and Validation**

The project's viability is tested and validated in this stage. The product itself is tested, and the process, financial aspects, and the customer approval of the product are appraised. The product's quality and performance are tested and validated, and it is made sure that they meet the customer's requirements. In this stage, the business and financial analysis is reevaluated. Sometimes, the project does not meet the requirements and is sent back to Stage 3: Development. (Cooper, 2001)

#### **Gate 5: Go to Launch**

This is the final gate before market launch and full commercialization. From this gate, the product goes to production or operations start-up. In the final step, the project can still be killed. The quality of the previous stage, testing, and validation is assessed. The decision to pass this stage is mostly focused on expected financial return. (Cooper, 2001)

#### **Stage 5: Launch**

In the final stage, the launch of the product is announced. The implementation plan for both the marketing plan and production or operations plan begins in this stage. Finally, a new product has arrived on the market and is hopefully a success. (Cooper, 2001)

#### **Post-Launch Review**

At some point, the project team must be dissolved. Before that can occur, the project performance and the process are reviewed and evaluated. A post-audit is carried out, and lessons learned from the project are noted down for further work. This review is the end of the project and the final step in the Stage-Gate model. (Cooper, 2001)

### **2.3.3 Reducing Product Development Lead Time With Traditional Processes**

According to Cooper (1990) companies have faced pressure to reduce the time to market yet improve their new product "hit rate" over the last years. Therefore, these traditional product development processes were introduced to deal with these challenges to improve the overall NPD process and reduce the lead time (Cooper, 1990).

However, organizations face many new challenges today (Cooper, 2019). For this reason many new practices have been introduced to NPD to handle these challenges (Cooper, 2019). Practices such as Agile development and Lean product development are few of these approaches that have been introduced (Cooper, 2019). In the next chapter Lean product development will be introduced.

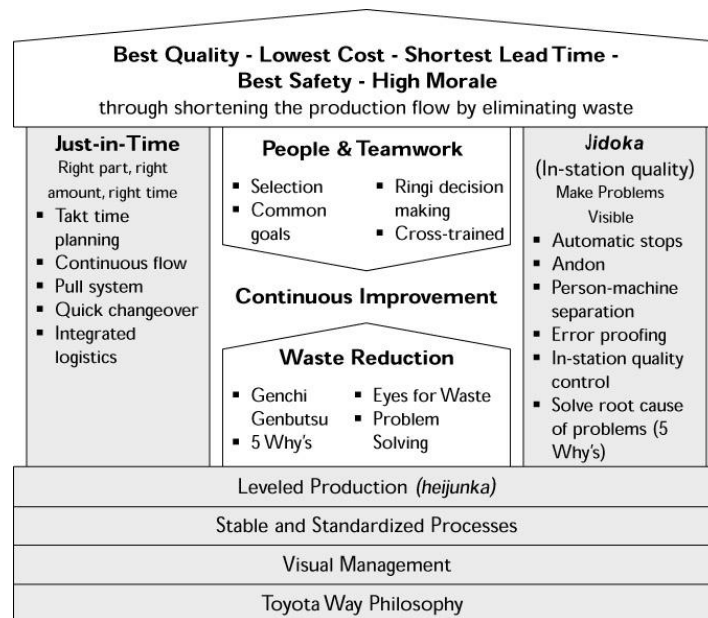
## **2.4 Lean Product Development**

To better understand Lean product development it is important to explain the Lean methodology. This is because Lean product development rests on the same foundation

as the Lean production (Swan & Furuhjelm, 2010). The Lean philosophy is known for methodologies like Just-in-Time, Kanban, Kaizen, Jidoka, and minimizing waste throughout the value chain (Liker, 2004). The seven wastes in Lean, also known as Muda, has become a well-known concept to identify unnecessary waste to maximize customer value (Sahay, 2015). However, it is important to acknowledge that Lean is larger than just a waste reduction concept since it emphasizes aspects like customer involvement, continuous improvements, and quality (Liker and Morgan, 2006). Another aspect that is important to keep in mind is that Lean keeps evolving and will continue to evolve over time (Hines et al., 2004).

It was during the 1950s that Toyota Production System (TPS) was developed by Toyota Motor Corporation in response to the limited resources after the wars (Toyota Material Handling, n.d.). The purpose of TPS is to provide the highest level of quality, lowest cost, and shortest lead time by eliminating waste (Kehr & Proctor, 2017). This has become the foundation for what is considered to “think Lean”, and is the most well-known example of Lean processes (Liker & Morgan, 2006).

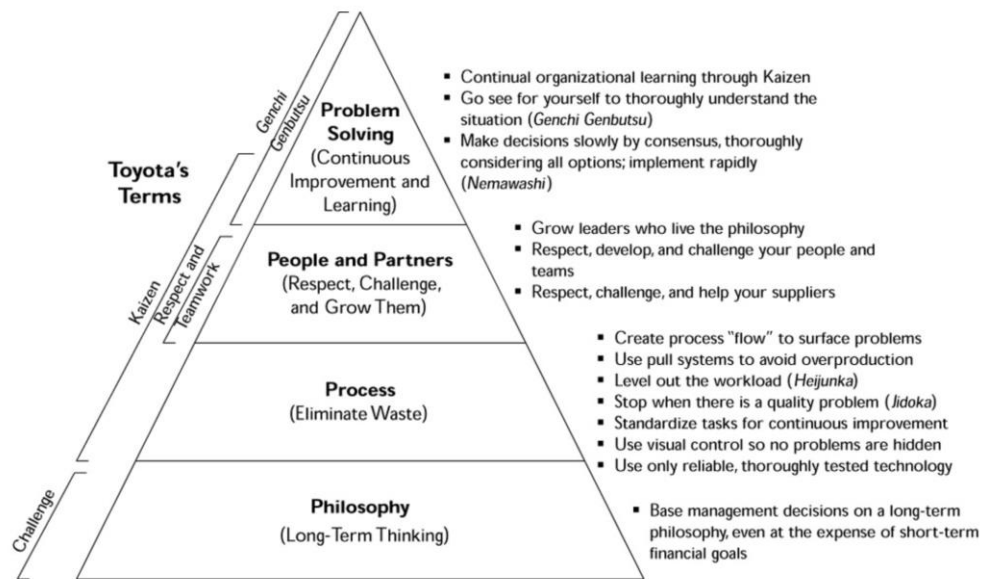
The TPS house is built on two concepts: Just-in-Time and Jidoka. The Just-in-Time concept implies that each process only produces what is needed for the next step, and Jidoka means automation but with a human touch. Together these two concepts are the outer pillars of the TPS house, see Figure 3. The house represents a structural system and is only as strong as the roof, pillars and foundation combined and each element reinforces the other. The roof represents the core goals of TPS, and the middle of the house represents the people and company culture. The foundation is based on the need for standardization, and stable and reliable processes. (Kehr & Proctor, 2017)



**Figure 3:** The TPS from Liker (2004).

The primary foundation is the “*Toyota Way*” principles which are 14 principles practiced at Toyota (Liker, 2004). These principles can be categorized into four categories, which are known as the 4 P model. The four Ps stand for Philosophy, Process, People/Partner, and Problem-solving (Liker, 2004). The 4 P model is displayed in Figure 4 along with the 14 principles that TPS relies on. Liker (2004) emphasizes that TPS is not the Toyota Way. Instead, TPS is the most developed example of what

the Toyota Way can accomplish (Liker, 2004). The Toyota Way is principles from the Toyota culture that facilitates the TPS to work accordingly (Liker, 2004).



**Figure 4:** 4 P model and the 14 principles (Liker, 2004).

A common mistake when it comes to integrating Lean thinking into a company is to view Lean as a set of tools and not something that is part of the entire company's production strategy (Karlsson & Åhlström, 1996). When managers believe that Lean is just tools, the results are often disappointing since the Lean initiative does not meet the expectations. This is because the tools only represent 20% of the Lean transformation (Mann, 2009). Liker (2004) states that many of the Lean implementations have been fairly superficial due to the fact that they have been focused on the tools, without understanding Lean as an entire system.

Toyota's product development thrives on the Lean principles which were copied from the manufacturing operations (Liker & Morgan, 2006). León and Farris (2011) mention that a clear definition of Lean product development is missing since the concept has evolved and now incorporates improvement techniques beyond Lean. Toyota's results have fascinated many Western companies due to its low cost, quick development times, and high quality (León & Farris, 2011). Toyota has been known to be one of the fastest when it comes to product development since they produce new cars and trucks within less than a year, compared to their competitors who need at least 2,5 to 3 years for the same task (Liker, 2004).

Lean product development aims to identify waste and value-adding activities, maintain a customer focus, and work with continuous improvements (Liker & Morgan, 2006). Swan and Furuhjelm (2010) state that the product development diverges from the production and administration processes. This is due to the fact that product development is a creative process which is identified by both uncertainty and variation. Based on this, a different definition for both waste and value is needed (Swan & Furuhjelm, 2010). The authors explain that the definition for value is instead any activity that builds or creates knowledge. Kennedy has developed a model with two value streams: Knowledge Value stream and Product Value stream. The knowledge value stream represents the organizational learning and captures the knowledge and

reuses it (Swan & Furuhielm, 2010). The product value stream represents the target-focused projects and includes the tasks in the development projects (Swan & Furuhielm, 2010). Karlsson and Åhlström (1996) mention some other Lean product development techniques that are listed below:

- Supplier involvement,
- Black box engineering,
- Simultaneous engineering,
- Cross-functional teams.

Set based concurrent engineering (SBCE) is another methodology developed at Toyota, which is considered to be one of the main enablers for the Lean product development (Ward & Sobek, 2007). In Lean, the concept “set-based” means to be working, reasoning, and communicating about numerous solutions in parallel (Ward & Sobek, 2007). SBCE means to work a variety of solutions and gradually narrow down the solutions after time (Lopes and Zancul, 2019). Compared to the more traditional approach that often focuses on one solution and working on it until it works (Lopes and Zancul, 2019). Some authors claim that SBCE is four times more efficient compared to the traditional Stage-Gate processes (Raudberget, 2010). In Belay et al. (2014) study, their findings showed that one of the benefits of SBCE was reduced time.

#### **2.4.1 Reducing Lead Time with Lean Product Development**

Toyota has been known to produce cars and trucks faster than their competitors during the past 20 years (Liker, 2004). There are also studies showing that Lean product development has been able to achieve a better product development lead time by reducing waste (Yang & Cai, 2009). While others claim that SBCE is four times more efficient compared to the traditional approach (Raudberget, 2010). To conclude, it is believed that Lean product development can reduce lead time, if it is implemented in the right way.

The following chapter will begin by introducing the history of Agile and its values and practices. It will be followed by explaining three different practices: Scrum, SAFe, and Agile-Stage-Gate hybrid model.

### **2.5 Agile Methodology**

Highsmith and Cockburn (2001) state that it is impossible to deny that the business environment continues to change and in order to thrive in a turbulent environment, companies need to adjust and enhance the changes instead of viewing it as something that needs to be eliminated to reduce cost. The traditional development approaches assume that it is possible to reduce cost by removing change and view variations as a form of errors (Rigby et al., 2016a). As a response to the traditional development approaches' shortcomings, seventeen practitioners from different IT development backgrounds met up in Utah in 2001 (Highsmith and Cockburn, 2001), and wrote the Manifesto for Agile Software Development (Beck et al., 2001).

The Manifesto for Agile Software Development consists of four core values and twelve principles (Beck et al., 2001). The four values are displayed below, where there is value on the right side. However, the left side is valued more.

*Individuals and interactions over processes and tools.  
Working software over comprehensive documentation.  
Customer collaboration over contract negotiation.  
Responding to change over following a plan.*

The first value is to value *people over processes and tools* to motivate and empower the individuals and the teams. The individuals who are executing the projects should be encouraged and given the support they need to get the job done (Rigby et al., 2016a). The second value emphasizes the importance of *working software over comprehensive documentation*. The third value is *customer collaboration over contract negotiation*, which Rigby et al. (2016a) state is critical since customers cannot often predict what they want. By having constant collaboration with the customer, the chance of delivering what they value increases (Rigby et al., 2016a). The fourth value is *responding to change over following a plan*. This is important since an over detailed plan can waste time and money (Rigby et al., 2016a). However, a plan is needed, but an understanding within the team that the plan can change is needed to be able to give better results (Rigby et al., 2016a).

The second part of the Agile Manifesto consists of twelve principles called “Principles Behind the Agile Manifesto” (Rigby et al., 2016b). These principles were developed in the following months after the meeting in Utah. After this meeting, frameworks that were aligned with the Agile Manifesto and the principles would be referred to as Agile techniques (Rigby et al., 2016b). These practices were believed to deliver a higher value to the customers but are not a direct definition of agility (Dingsøy et al., 2012). Instead, they can be looked at as guidelines for delivering high-quality software in an Agile manner (Dingsøy et al., 2012). The Agile Principles are listed below (Beck et al., 2001).

*Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.*

*Welcome changing requirements, even late in development. Agile processes harness change for the customer’s competitive advantage.*

*Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.*

*Business people and developers must work together daily throughout the project.*

*Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*

*The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*

*Working software is the primary measure of progress.*

*Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*

*Continuous attention to technical excellence and good design enhances agility.*

*Simplicity—the art of maximizing the amount of work not done—is essential.*

*The best architectures, requirements, and designs emerge from self-organizing teams.*

*At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*

### **2.5.1 Scrum**

One of the Agile approaches is Scrum, which aims to develop innovative products and services (Rubin, 2012). Scrum's history began back in 1986 when Takeuchi and Nonaka wrote the famous article "*The New New Product Development Game*" (Takeuchi & Nonaka, 1986). In this article, the authors describe how well-known companies like Honda produced world-class results using a team-based approach. The authors highlighted the power of having empowered, self-organizing teams as well as well-described roles in the development process (Rubin, 2012). Takeuchi and Nonaka's article was the spark of what is today called scrum (Rubin, 2012).

Nine elements are essential for Agile-Scrum execution and are called "Power of Nine" (Cooper & Sommer, 2016a). There are three artefacts, three tools and three roles, Cooper and Sommer (2016a) list them up as follow:

#### **Artefacts:**

1. Time-boxed sprints
2. Daily scrums
3. Retrospective (review) meetings

#### **Tools:**

4. Product backlogs and sprint backlogs
5. The scrum board
6. Burndown charts

#### **Roles:**

7. Product owner
8. Scrum master
9. Development team

Cooper and Sommer (2016b) describe how the Agile roles give the employees more control over their work, increase their motivation and improve communication and knowledge sharing. The authors further explain that the Agile artefacts create the project heartbeat.

### **Time-Boxed Sprints**

Pinto (2016) describes that the project is divided into several time-boxed short sprints and the length of the sprints are decided before the project starts. These time-boxed iterations are usually between one to four weeks (Pinto, 2016). These sprints begin with a sprint planning session, where the development team clarify what will be achieved within this sprint (Cooper & Sommer, 2016b). The sprint consists of several activities, for example, sprint planning, daily scrums, retrospectives, and demos, to mention a few (Sutherland & Schwaber, 2013). Cooper and Sommer (2016a) explain that the objective is to deliver a product or a concept to the customer at the end of the sprint to receive

feedback for the next sprint. The sprint review is where the outcome of the sprint is presented to the customers and management. In practice it is not always possible to create a physical product in 2-4 weeks therefore a concept, VoC study or a rapid prototype can be a result of a sprint (Cooper & Sommer, 2016a).

### **Daily Scrum**

The daily scrums can also be referred to as daily standup meetings. These meetings are roughly 15 minutes and are held in the morning of each day (Pinto, 2016). During these meetings, the development team shares what they have done in the last 24 hours, what they will do in the next 24 hours, and the problems they are facing (Cooper & Sommer, 2016b). There are many benefits of having these daily stand-ups where the team shares their knowledge and communicates daily, which results in increased knowledge sharing and team motivation (Cooper & Sommer, 2016a).

### **Retrospective (Review) Meetings**

Each sprint or iteration ends with the project team having a retrospective meeting to go over the sprint's result and to set new goals for the next sprint (Pinto, 2016). Cooper and Sommer (2016a) illustrate that these meetings are to improve how the team functions. In the retrospective meetings the team members assess where they might improve their work and performance. This meeting demonstrates how the team works with continuous improvements, where they solve critical challenges together and the team becomes a high-performance team (Cooper & Sommer, 2016a). After the retrospective meeting, the sprint is over and the next cycle begins, following the same routine.

### **Product Backlogs and Sprint Backlogs**

The development team creates the sprint backlog which is the list of features that will be developed during the sprint (Cooper & Sommer, 2016a). The sprint backlog is extracted from the product backlog, which is a prioritized list of the features and the capabilities needed to develop a rewarding product (Pinto, 2016). It consists of all capabilities that might be needed in the completed product (Pinto, 2016). However, the product backlog continually changes in order to identify and capture what is appropriate for the product to be competitive (Pinto, 2016).

### **The Scrum Board**

The second tool is the scrum board or sprint board. In the beginning of a sprint the backlog is broken down into activities and shown on a scrum board (Cooper & Sommer, 2016a). The scrum board can be presented virtually or visually, with for example Post-it notes. The most common way to set up a scrum board is to use three columns: "to-do", "doing", and "done" (Cooper & Sommer, 2016a). This makes the process visual whereas each activity moves from "to-do" to "doing" and when that activity is finalized to "done". This also makes it easier for the management to keep track of the progress (Cooper & Sommer, 2016b).

### **Burndown Charts**

To visualize the progress of each sprint, a burn-down chart is used (Cooper & Sommer, 2016a). It shows the number of days in the sprint against activities finished. The chart should be a straight line and showing zero remaining activities at the end of the sprint (Cooper & Sommer, 2016a). By using the burn-down chart the team can instantly see if they are behind schedule by looking if the progress line is above or under the straight

line on the chart (Cooper & Sommer, 2016b). The objective is to have a steady flow and be able to plan the flow well (Cooper & Sommer, 2016a). At the beginning, the team might find it difficult to plan the sprint accurately but with time the team gains more knowledge and improves their ability to plan their sprint and their performance (Cooper & Sommer, 2016a).

### **Product Owner**

When it comes to the roles within scrum and their responsibilities, it differs some from the traditional product development (Cooper & Sommer, 2016b). It is the product owner who controls the product backlog, and the product owner is the person who represents the stakeholders (Pinto, 2016). The product owner acts as the “voice of the customer” and has to take the outsiders’ side to represent the customers’ needs (Pinto, 2016). The product owner creates user stories that identify the customers’ needs (Pinto, 2016). The user stories are a short explanation of what the end-user expects and needs from the product. The user stories are to understand the customers’ perspective, which facilitates to develop a product for the customers. The product owner is not involved in the daily activities rather the scrum master who is a process master (Cooper & Sommer, 2016b).

### **Scrum Master**

The scrum master facilitates the development team, making sure that the team has all the tools they need and that they use the Agile methods appropriately (Cooper & Sommer, 2016b), and acts as a servant leader (Holtzhausen & de Klerk, 2018). He/she removes any obstacles that the team may encounter and facilitates team meetings (Vedsmann et al., 2016). The scrum master is responsible for moving the project forward between the iterations (Pinto, 2016).

### **Development Team**

The development team, which usually consists of 3-9 team members (Cooper & Sommer, 2016b), works in short, timeboxed sprints (Pinto, 2016). The team is responsible for the sprint planning and for doing the actual work; development, testing and delivering the final outcome (Vedsmann et al., 2016). This structure gives the development team more control over their daily work and they make the day-to-day decision themselves (Cooper & Sommer, 2016b). This motivates the team members and gives them increased sense of project ownership and improves performance (Cooper & Sommer, 2016b). When a sprint is over, a review of the completed features is held (Pinto, 2016). The stakeholders can provide feedback to the development team, which helps the team and the product owner change the plan of how they work, if needed (Pinto, 2016).

## **2.5.2 Scaled Agile Framework (SAFe)**

Scaled Agile Framework (SAFe), which is a framework developed to fit large software development organizations that want to adopt Agile methods (Paasivaara, 2017). Knaster and Leffingwell (2020, p. 82-83) state that the goal with SAFe “is to help enterprises become thriving digital age businesses that deliver competitive systems and solutions to its customers in the shortest sustainable lead time“ According to Putta et al. (2018), SAFe is the most frequently used scaled Agile framework. The first version of SAFe (version 1.0) was published in 2011 (Knaster & Leffingwell, 2018), and has been continuously updated and improved since. Version 5 of SAFe was published in 2020 (Scaled Agile, 2019). However, there is an update to version 5 that is called SAFe

5.1 (Scaled Agile, n.d.-c). SAFe integrates the latest thinking from Lean, Agile, and DevOps into a set of principles and practices to deliver innovative products and services faster with more precision and with higher quality (Scaled Agile, n.d.-a).

The latest version of SAFe was built around seven core competencies of the Lean Enterprise to achieve a competitive advantage and sustain the advantage (Scaled Agile, n.d.-b). These seven competencies are crucial in order to understand and implement SAFe in an organization (Knaster & Leffingwell, 2020). The seven competencies are:

- Lean-Agile Leadership
- Team and Technical Agility
- Agile Product Delivery
- Enterprise Solution Delivery
- Lean Portfolio Management
- Organizational Agility
- Continuous Learning Culture

On SAFe’s official website, they state that if an organization is able to master these competencies, it will result in agility, which is needed to respond to changes within market conditions, customer needs, and new technologies (Scaled Agile, n.d.-b). SAFe can be divided into four configurations: Essential SAFe, Large Solution SAFe, Portfolio SAFe, and Full SAFe (Scaled Agile, n.d.-a). Having four configurations gives each company the option to adopt a more suitable framework and meets their specific business needs (Knaster & Leffingwell, 2020). These configurations suit both small numbers of teams to more complex systems (Knaster & Leffingwell, 2020). The full SAFe configuration consists of all the levels, see Figure 5.

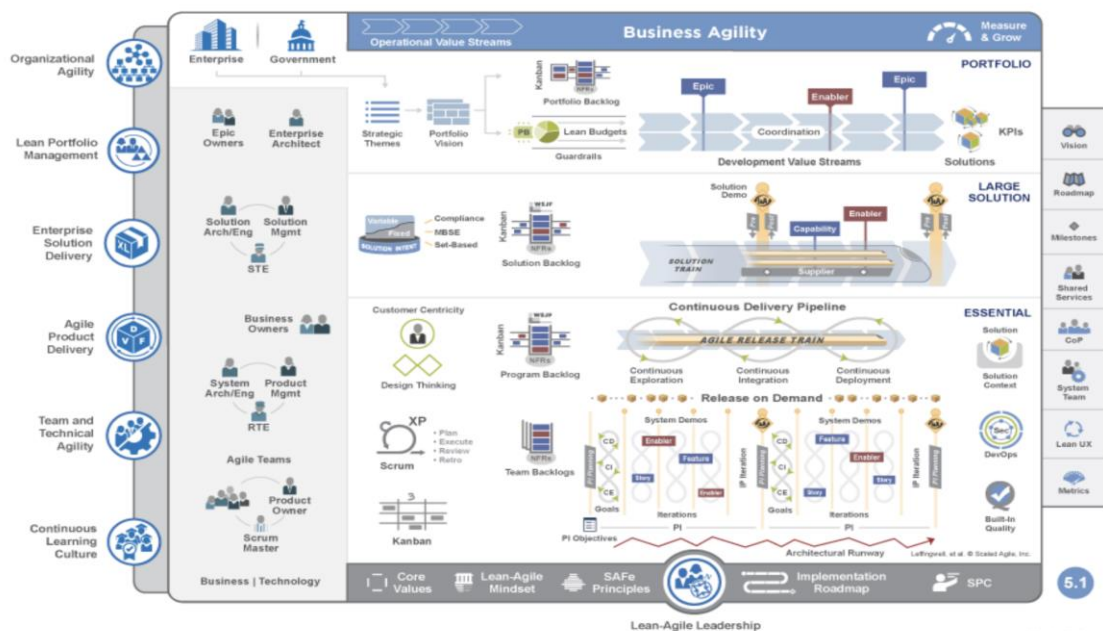


Figure 5: Full SAFe 5.1 configuration (Scaled Agile, n.d.-f).

### 2.5.3 Agile-Stage-Gate Hybrid Model

In this chapter, the Agile-Stage-Gate Hybrid Model is introduced and further explained. The chapter will present findings from combining the two methods within the software industry and then move on to further demonstrate the differences of implementing this into physical product development.

Cooper (2016) describes how businesses within the IT industry began to integrate Agile methods into their traditional Stage-Gate product development processes and it became a trend. According to Cooper and Sommer (2016b), the outcome of combining these two methods was positive and has resulted in:

- Faster response time to changed customer needs,
- The voice of the customer builds within the process and it is much more effective than with the traditional methods,
- Improved team communication,
- Shorter time to market.

However, Cooper and Sommer (2016b) illustrate that researchers were uncertain if this approach could be implemented for physical product development. The authors describe how IT product development is very different from hardware or physical new product development. Nonetheless, leading firms began to integrate Agile methods into their traditional Stage-Gate product development processes to produce physical products (Cooper & Sommer, 2016a). This method is called Agile-Stage-Gate Hybrid Model and has significant potential benefits for manufacturing companies (Cooper & Sommer, 2016a). However, integrating these two methods to make physical products demands adjustments to the Agile model (Cooper & Sommer, 2016a). Boehm and Turner (2005) bring up that many wonder how organizations can integrate Agile methods with traditional product development processes without killing agility. Boehm (2002) states that organizations must carefully blend an Agile way of working with traditional product development to achieve the best balance of Agile and plan-driven methods that fits the firm's position.

#### **Agile-Stage-Gate Hybrid Model in Software Development**

Cooper (2016) describes how software companies that worked with traditional development systems began to integrate Agile into their processes, creating a hybrid model. To investigate if this new approach is feasible, Karlström and Runeson (2005) performed a study at three large software companies: Ericsson, ABB, and Vodafone. The purpose of the research was to evaluate the advantages and disadvantages of combining Agile methods with the Stage-Gate model. The study's findings suggest that integrating these two methods does work and is compatible. Karlström and Runeson (2005) found several benefits and drawbacks with this approach. The benefits that Karlström and Runeson (2005) discovered are summarized by Cooper (2016) and Cooper and Sommer (2016a):

- ***Better internal team communication:*** The team felt more in control and, for example, using the burndown chart made it easier for the management to visualize the progress metrics.

- ***More efficient planning:*** Being able to adjust to customer feedback focusing on the significant product features, avoiding fixed plans that lead to longer lead times.
- ***Improved customer feedback:*** The Agile way of working emphasizes involving the customer in the process, and thus gets continuous feedback from them.
- ***Clearer resolution of documentation issues:*** Prioritization is resolved between documentation and code.
- ***Improved morale on the project team:*** The employees feel more motivated because of the improved communication and sense of control.

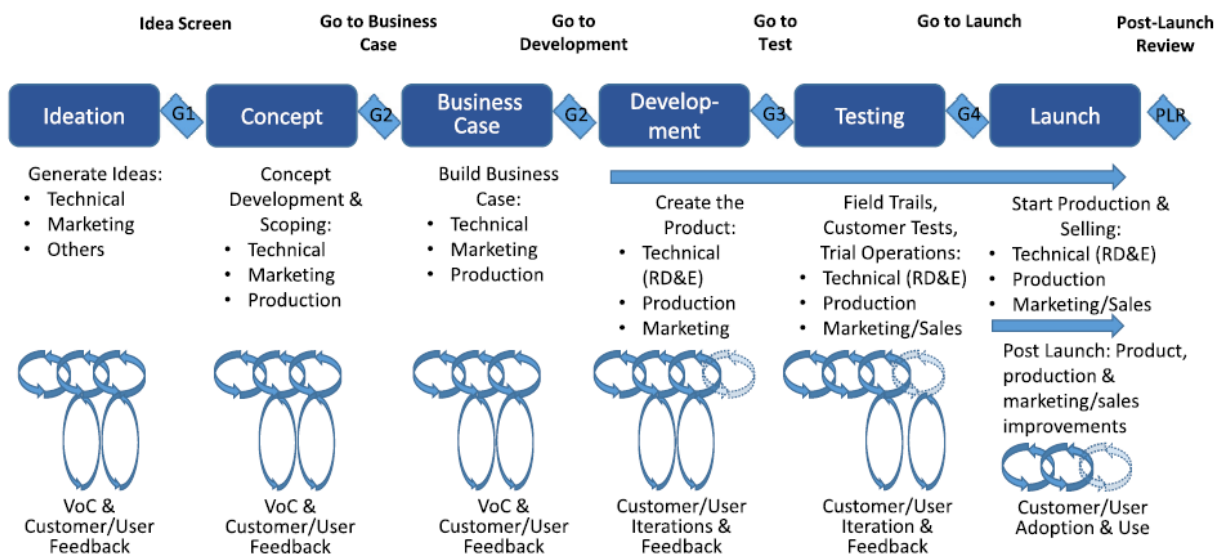
Karlström and Runeson (2005) also identified disadvantages, such as having a dedicated team focusing their full-time on one project could result in isolation from other parts of the organization. Another disadvantage that was identified is that managers might feel that they lose control and become resistant as long-term plans are ignored and the focus is on the current sprint. The managers might also feel threatened by the new situation, and therefore management training is needed.

Despite the challenges, Karlström and Runeson (2005) demonstrate that all three companies showed that it is possible to combine Agile software development with Stage-Gate project management. The payoffs are improved cost control, product functionality, and on-time delivery. According to the authors the challenges that they classified are general problems that emerge when implementing any new methods. To conclude, “Agile methods give the Stage-Gate model powerful tools for microplanning, day-to-day work control, and progress reporting” (Karlström and Runeson, 2005, p. 49).

### **Blending Agile and Stage-Gate in Traditional Physical Product Development**

According to Cao and Ramesh (2007), customer needs tend to change and evolve more frequently than before, and therefore the requirements become obsolete before project completion, and lead time reduction has become a large factor regarding competitive advantage. These elements pressure companies using traditional plan-based product development to seek new ways of working. Traditional models, such as Stage-Gate and Waterfall are said to be too linear and too planned to handle the fast-paced and quickly-changing world (Cooper & Sommer, 2016a). To deal with these new challenges the Stage-Gate model must become more adaptive, more Agile, and more accelerated (Vedsmann et al., 2016).

Cooper and Sommer (2016a) explain how Agile principles are integrated into the Stage-Gate process. The Scrum method is suggested to be the most attractive Agile approach among the organizations that are integrating Agile for physical product development (Sommer et al., 2015). The stages in the traditional process are kept and the sprints, which are 2-4 weeks long, are blended within the product development. At the end of each sprint, the customer feedback and desired product changes are evaluated for the next sprint, for clarification see Figure 6. Therefore, the Agile process is very fast and responsive. The process is not plan-based and can more easily adapt to changes in customer requirements (Cooper and Sommer, 2016a). The Agile-Stage-Gate hybrid model provides a framework for managing uncertainties and ambiguity in the front end (Vedsmund et al., 2016). The process becomes faster by using time-boxed sprints and emphasizes the outcome of developing tangible products increments as the measure of progress (Vedsmund et al., 2016). According to Vedsmund et al. (2016), this model is a promising approach to deal with the challenges of shortening the time to market.



**Figure 6:** The Agile-Stage-Gate hybrid model from Cooper & Sommer (2016a).

Cooper (2016) explained that the Stage-Gate model is a macroplanning process and Agile is a microplanning project management methodology. The author further demonstrates that combining these two methods, creating a hybrid model, balances the benefits and challenges of the two approaches and seems to yield dramatically positive results, gaining the best of both worlds. Cooper and Sommer (2016b) describe that when these two methods are combined, Agile is usually applied as the project management method within the stages in Stage-Gate. Most often, manufacturing firms use Agile methods in the development and testing phase (Cooper & Sommer, 2016b). However, the Agile way of working is applicable in all stages, but it requires some modifications to the process (Cooper & Sommer, 2016b). Moreover, the traditional roles might change, and project leaders get different and new responsibilities (Cooper & Sommer, 2016a).

### Required Modifications

Implementing the Agile way of working into a traditional Stage-Gate process within the hardware industry where the products are tangible creates new challenges that are

not known in the IT industry. Therefore, adjustments and modifications are required for physical product development. (Cooper & Sommer, 2016a)

Cooper (2016) explains that defining success and a done sprint, and the way tasks are allocated may be different in the hardware context. Defining a done sprint is important within the Agile mindset (Cooper & Sommer, 2016b). Creating a working product in 2-4 weeks in the hardware industry is not always possible, new solutions are needed to deal with that challenge (Cooper & Sommer, 2016b). The concept of a done sprint needs to be redefined and is something that can be demonstrated and shown to the customer to seek feedback (Cooper, 2016; Cooper & Sommer, 2016b). These tangible deliverables can vary between different firms. According to Vedsmann et al (2016) they can be for example:

- The results of market research,
- Computer-generated 3D drawings of the product concept,
- Detailed design drawings,
- Protocepts (a product version between a concept and a ready-to-trial prototype),
- Prototypes,
- Early working models.

According to Cooper and Sommer (2016b), having a dedicated, co-located project team can come as a challenge in physical product development, and adjustments need to be made. The authors further clarify that finding dedicated team members is almost impossible, but in an Agile way of working having a small and dedicated team is critical. Physical product development requires cross-functional teams, which means people from marketing, operations, and sales work on the project. Having employees from these departments working 100% on one project can be difficult for many firms. Compromises can be made by, for example, having these functions dedicated to one project during one sprint. The authors further emphasize the importance of having a dedicated team focusing on one project and that it is a huge payoff from the Scrum method and it seems that this fact alone improves the speed to market. (Cooper & Sommer, 2016b).

Cooper and Sommer (2016a) demonstrate that blending the Agile way of working into the Stage-Gate process does not mean that the up-front homework and early-stage voice-of-customer work is not needed. On the contrary, the authors state that understanding the customer requirements at the beginning of the process is still important to create the essential foundation for the project and to get the product right.

### **Benefits and Drawbacks in Physical Product Development**

A study was performed at five large Danish manufacturing firms that implemented Agile-Stage-Gate hybrid models that showed positive results for this Scrum hybrid (Sommer et al., 2015). These companies revealed many of the same results found in the IT world. Cooper (2016) summarizes the findings for the benefits as:

- Faster response to change due to design flexibility,
- Improved productivity, communication, and coordination among project team members,
- More focus on the project leading to improved prioritization and,
- Higher morale among team members

Cooper (2016) summarizes the findings for the drawbacks as:

- Difficult to find dedicated team members, which resulted in delays for the project,
- Problems in combining project teams with the rest of the organization,
- Company's reward system does not match the requirements of Scrum,
- Documentation and the system were still too bureaucratic.

Cooper and Sommer (2016b) name more advantages and disadvantages when implementing Agile into the Stage-Gate product development when developing physical products. The listed advantages are, for example, faster releases, higher quality, and customer focus whereas the listed drawbacks are, for example, poor knowledge management across functions, the IT system within the company is not suited for Scrum and project members, and management does not understand and follow the Scrum methods. However, Cooper (2016) claims that blending Agile-Scrum methods into Stage-Gate to create this new Agile-Stage-Gate hybrid model does in fact work and has great potential for better results and improved processes for firms within the physical product development.

#### **2.5.4 Reducing Product Development Lead Time With Agile Methodology**

Agile is one of the new NPD approaches that organizations have chosen to use to enhance their way of working. Organizations are also applying the Agile way of working to their existing processes with the aim to reduce product development lead time and improve the overall process. (Cooper, 2019)

When it comes to Scrum, the purpose is to reduce the product development time to market as well as helping the team to deal with volatile requirements (Maria et al., 2015). This could potentially be accomplished by applying the "Power of Nine", which would lead to having self-organized and empowered teams that can improve transparency and reduce product development time.

According to the provider for SAFe, one of the main benefits of implementing SAFe to an enterprise is the 50% faster time-to-market (Scaled Agile, n.d.-e). Pries-Heje and Kroh (2017) identified that SAFe can reduce the development risks, which might be one of the underlying reasons why implementing SAFe can reduce the time.

According to Cooper and Sommer (2016b) combining an Agile way of working to the Stage-Gate process resulting in a hybrid model has shown to reduce lead time both within the software industry and physical product development. By having sprints within the Stage-Gate process has enhanced the process and improved companies performance as stated above.

#### **2.5.5 Challenges Implementing Agile in Traditional Organizations**

Boehm and Turner (2005) demonstrate that managers come across many obstacles when implementing Agile into traditional organizations. The authors describe conflicts that may occur in the development process, business process, and between people. Nerur et al. (2005) point out similar problems that emerge and mention management and organizational issues, people-related issues, process-related issues, and technological issues. Some examples of these problems may be organizational culture,

reward systems, working effectively in a team, new skill sets might be needed, the processes are changing, shifting to shorter sprints, and selecting the right Agile method is challenging (Nerur et al., 2005). These researchers address these dilemmas and come up with suggestions on how to best handle these issues.

### **Development Process-Related Conflicts**

Boehm and Turner (2005) mention conflicts related to the change of a development process, and name problems such as legacy systems, requirements changes, and different life cycles. The authors suggest that firms do their homework and prepare for the change by looking into the differences of the processes and identify the mismatch between their current way of working and what adjustments are needed to successfully implement the Agile methods. Nerur et al. (2005) emphasize that choosing the appropriate Agile method for the organization is essential. Boehm and Turner (2005) also state that redefining traditional milestones and responsibilities might be needed when changing to Agile. Additionally, the authors emphasize that evaluating the risks that may occur, is an important element that must be performed.

### **Business Process-Related Conflicts**

Boehm and Turner (2005) specify business process conflicts that might occur when implementing Agile in a traditional organization, such as human resource issues, progress measurement, and process standard ratings. According to the authors, the firms must address the HR issues, develop management and architectural practices, and investigate what may be more suitable for the organization regarding these issues. In addition, Boehm and Turner (2005) suggest that firms create guidelines for the employees to better share the changes and how to deal with them.

### **Management and Organizational Issues**

Nerur et al. (2005) reveal management and organizational issues that have a large impact on the structure of the organization and change in behavior of people. The authors state that since the management and organization structure is quite different between Agile and traditional approaches, adjustments have to be made and firms must study the best way for themselves to achieve an Agile way of working.

### **People-Related Issues**

When it comes to changes, people-related issues are unavoidable, and people might be confused and feel threatened (Ford & Ford, 2009). The employee's role might change and now the working environment moves to work in dedicated teams (Nerur et al., 2005). Boehm and Turner (2005) identify conflicts regarding management attitude, logistical issues, and change management. The authors present suggestions on how to handle these issues and emphasize that communication is key and understanding how communication occurs is critical. Boehm and Turner (2005) further express the importance of emphasizing the value and educating the people, to successfully implement Agile into a traditional organization. Nerur, et al. (2005) support this view by mentioning that the tools and methods are not what makes product development successful, it is the people that must be educated and trained correctly to use the tools to succeed. To conclude, organizations must investigate their readiness and prepare carefully before implementing Agile into the organization and embrace the change (Nerur et al., 2005).

## **2.6 Change Management**

According to Kotter (2007), the most common goal when implementing a change within an organization is to adapt to a new and more challenging market environment. Kotter (2007) demonstrates that when leading a change, companies must be aware of the most common pitfalls. Additionally, the author illustrates that to achieve a successful change transformation, it is crucial to follow a change plan. Kotter (2007) indicates that there are eight steps to successfully implement a change within an organization, which are:

### **1. Establishing a Sense of Urgency**

The first step, establishing a sense of urgency, is one of the most crucial steps. This step is critical because if the people do not feel motivated or understand why they have to go through this new change, the change effort cannot start and is bound to fail. Leaders tend to underestimate the importance of this step as it may sound easy. However, driving people to follow a change can be more difficult than originally anticipated, that is why organizations must put great emphasis on this first step.

### **2. Forming a Powerful Guiding Coalition**

The second step, forming a powerful guiding coalition, involves having the head of the organization come together and develop a shared commitment to the change transformation. The guiding team may vary between 3-5 people or more, depending on the size of the company. In order to successfully manage this step, a strong leader has to lead the team and create trust and communication.

### **3. Creating a Vision**

The vision must be easy to communicate and appealing to customers. The vision must also be easily understood and help clarify the direction the company aims at moving to. If the change leader cannot communicate the vision to the people in five minutes or less, and the employees do not clearly understand and find it interesting, then this phase is not finished in the change process.

### **4. Communicating the Vision**

When it comes to implementing change, communicating the vision is an important factor. There are multiple ways to do this but to make it successful the executives must use all existing communication channels to share the vision. The executives try to change the boring newsletters into interesting and understandable letters that people want to read and learn about. There has to be a lot of communication so that everyone understands and feels motivated to change their way of working themselves.

### **5. Empowering Others to Act on the Vision**

The people have to be on board with the change, and with more people being involved with the change the more likely it is to be successful. Empowering others to act on the vision can be challenging, and therefore it is essential that the change leaders remove all obstacles that may be in the way. It may become difficult to remove all obstacles due to the company's capabilities and time. However, removing the obstacles that affect the change the most is crucial to maintain the credibility of the change effort.

### **6. Planning for and Creating Short-Term Wins**

Having short-term wins can be very useful in a change process as it creates pressure in the transformation. A large change will take a long time, so the importance of the

change may decrease with time. Therefore, having short-term wins helps to fulfill the urgency of the change process. It is essential to have something to celebrate as the process moves along.

### **7. Consolidating Improvements and Producing Still More Change**

Organizations must avoid declaring victory too soon. The change efforts that had been implemented will otherwise slowly disappear because the first big project has been implemented and then the company thinks the process is over and the change has been achieved. Change leaders should rather focus on solving even bigger problems, continue the change, and find more improvement factors.

### **8. Institutionalizing the New Approaches**

A common pitfall that managers must watch out for when implementing a change, is not anchoring changes in the corporation's culture. The change has not been successfully implemented until that way of working becomes the norm. There are two factors that are important; showing people how the new values and behavior has improved performance and taking sufficient time to ensure that the next generation of top management makes the new approach their own.

Hayes (2018) mentions similar steps to manage a change successfully. The seven critical activities in the change process according to Hayes (2018) are:

#### **1. Recognizing the Need for Change and Starting the Process**

A change begins with recognizing the external or internal events that create opportunities for change. The organization starts the change process and needs to establish a desire for change, deciding who will lead the change and build an effective relationship between the change agent and the employees that will be affected by the change.

#### **2. Diagnosing What Needs to Be Changed**

The second step is to evaluate the current state the organization is in today and where they want to be in the future. They need to diagnose what problems or opportunities they have and identify the future state, creating a vision.

#### **3. Planning and Preparing for Change**

Planning the change involves choosing what change strategy the firm will proceed with and planning how the change vision will be accomplished.

#### **4. Implementing Change and Reviewing Progress**

Implementing the change and reviewing the progress requires a focus on action. It is important to communicate the change, motivate the individuals and groups, and manage the stakeholder interests. The change progress should be monitored frequently.

#### **5. Sustaining the Change**

Even though a change has been implemented in the organization, it does not mean that the change will become the norm. Sustaining the change is a crucial step that means that the new ways of working have been successfully implemented in the firm and people's mindset and thinking have changed and become the norm. The overall organization has changed and improved the way of working and people have accepted the change.

## **6. Leading and Managing the People Issues**

Leading and managing the people issues is an important step that requires attention from the change agent and an understanding of their concerns. People are different and have different opinions. Therefore, people need to be motivated and influenced to achieve the desired result. When dealing with people issues the key capabilities are communication and trust.

## **7. Learning**

The last step is learning from past experience. This step is important to improve performance and promote continuous improvement.

### **SAFe Implementation Plan**

SAFe has an implementation roadmap that is based on Kotter's eight-step model for leading change. The implementation roadmap consists of twelve steps, where the focus is on training and educating the employees to be prepared for new ways of working. After the SAFe implementation, some of the roles and responsibilities might change. Therefore, it is important to educate people to inform them about this change. Transforming from a traditional way of working to SAFe is an organizational change that requires leadership and management support. With this new way of working, the mindset is bound to change and the company's culture will be affected by the change. The twelve steps are to guide the change and have a strategy in place to implement the new ways of working. These steps are illustrated here below and have shown to be effective in securing a successful transformation. (Scaled Agile, n.d.-d)

1. Reaching the Tipping Point
2. Train Lean-Agile Change Agents
3. Train Executives, Managers, and Leaders
4. Create a Lean-Agile Center of Excellence
5. Identify Value Streams and ARTs
6. Create the Implementation Plan
7. Prepare for ART Launch
8. Train Teams and Launch the ART
9. Coach ART Execution
10. Launch More ARTs and Value Streams
11. Extend to the Portfolio
12. Accelerate

### 3. Methodology

This chapter will introduce the research strategy and design chosen for the thesis and a description on how they are appropriate for this study. The research process will also be demonstrated, and the data collection and analysis phase will be further explained. Additionally, the quality criteria will be described to ensure the quality of the research. Lastly, the ethical aspects of the study will be considered.

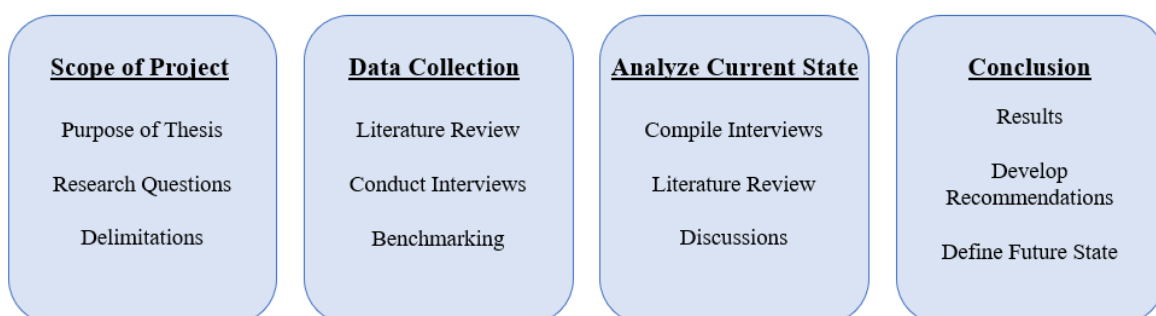
#### 3.1 Research Strategy

According to Bell et al. (2019), there are two types of research methods: quantitative and qualitative. Quantitative methods focus on numbers rather than words, while qualitative research most often emphasizes words rather than numbers in the data collection and analysis (Bell et al., 2019). For this thesis, a qualitative approach was used. The qualitative method was chosen to enable the researchers to gather the necessary information from the participants needed to conduct the study. This research method is used to see through the participants' eyes and understand the interviewees (Bell et al., 2019). Qualitative methods are suitable for a study like this as they are more flexible and give a broader view of the subject (Bell et al., 2019). Qualitative methods also allow a deeper understanding of the topic and give the participants more room to express their opinions (Bell et al., 2019).

#### 3.2 Research Design

The most appropriate research design for this thesis is a case study since case studies are typically used in business research and are often combined with qualitative research. A case study helps the researchers understand the subject, get more open-ended discussions regarding the chosen topic, and provides the researchers with flexibility. The purpose of this thesis is to get an understanding of where an Agile way of working can be applied and where it should not be applied at HCP. A case study provides the right tools for the researcher to understand the current situation to identify gaps between the future state and the current state. (Bell et al., 2019)

The research design can be seen in Figure 7, it gives an overview of how the study was performed, and each phase of the process is shortly described.



**Figure 7:** The research design.

### **3.3 Data Collection**

This section will describe the chosen methods for the collection of data. In this study, most of the data were collected through qualitative interviews. Additionally, a literature review was conducted on topics relevant to this study. The researchers also had access to Husqvarna Group's intranet to get a better overview of HCP's process and its associated Roles and Responsibilities (R&R). Some of the information from Husqvarna Group's intranet was also used to describe the company's background. Benchmarking was also performed at three different companies that have been implementing an Agile way of working over the last years. The data collection for the literature review will be presented in this section followed by a detailed description of the interview guidelines and organizational data. Lastly, the benchmarking will be explained.

#### **3.3.1 Literature Review**

A thorough literature review was conducted on the relevant topics that revolve around Agile product development and reducing time to market. This work provided a basis for the research and a framework for the study. The literature review was also carried out to get a deeper knowledge of the subject, and to better formulate the interview questions used in the semi-structured interviews.

To collect the necessary literature for the study, databases, such as Google Scholar and Chalmers Library, were used. Snowballing was also used where the researchers identified additional papers using references from previously identified papers. Additionally, suitable research papers and books from courses that the students had attended were used (such as Integrated Product Development, Change Management and Improvement Process, and Lean Management).

Keywords and search terms were used to find the literature that match the chosen topic: Agile, Agile Product Development, Agile-Stage-Gate Hybrid Model, Change Management, Lean Product Development, New Product Development, Reduce Time to Market, Scaled Agile Framework (SAFe), Scrum, Stage-Gate, Time to Market, and Waterfall Model.

#### **3.3.2 Interviews**

A series of semi-structured interviews were used in this study. A semi-structured interview utilizes a mix of structured and unstructured questions (Bell et al., 2019). This gives the interviewee the possibility to answer the questions as they like. Semi-structured interviews match well with the chosen research method (Bell et al., 2019). In total, 24 interviews were conducted with a variety of employees within HCP and one interview was conducted from Husqvarna Brand Division. Each interview lasted between 30-60 minutes.

The interviewees were identified with the help of the supervisors at HCP. The interviewees were selected based on their role at HCP with the aim of providing information regarding the NPD process and their way of working. Furthermore, additional interviewees were booked based on empirical gaps that the students experienced. Table 1 shows the list of interviewees. The interviewees' roles are presented and from which function the role belongs.

**Table 1:** List of Interviewees

<b>Role</b>	<b>Function</b>	<b>Number of interviewees</b>
Project Manager	Project Management Office	6
Project Coordinator	Project Management Office	3
Vice President	Project Management Office	2
Product Manager	Product Management	3
Product Management and Services	Product Management	1
Chief Product Engineer	R&D	2
Electronics and Software Manager	R&D	1
Software Manager	R&D	1
R&D Director	R&D	2
Test Manager	R&D	1
Design Engineer	R&D	1
Purchasing Director	Project Sourcing	1
Operations Director	Project Sourcing/Manufacturing	1
<b>Total interviewees</b>		<b>25</b>

Before each interview, the researchers wrote an interview guideline based on the interviewee's role in the company. The interview guidelines were therefore adjusted to each role, and as knowledge increased with each interview, the guidelines were modified to serve the research's need. In total, nine interview guidelines were created for the employees at HCP and one interview guideline for the benchmarking interviews, see Appendix 1-10. All the interviewees were single interviewees to be able to focus on one specific individual and understand their opinions on the topic. Due to the situation with COVID-19, all of the interviews were held through video calls.

The interviews were recorded and transcribed to make it easier to compile the findings. One of the researchers conducted the interview while the other one wrote and took notes. In addition to the semi-structured interviews, the researchers had weekly meetings with the HCP supervisors, Fredrik Sandinge and Erik Silfverberg, which gave valuable inputs and assistance throughout the journey of the study.

### **3.3.3 Organizational Data**

From Husqvarna Group's intranet, organization documents were collected and used to understand the company's processes and way of working. The information was used to understand HCP's PCP, NPD, and different R&R within the organization. The researchers also attended steering team meetings, which are held monthly, and pulse meetings, which are held weekly. This was to observe HCP's way of working, how they share their projects' status, and how they make decisions at each gate on how to move forward for every project.

### **3.3.4 Benchmarking**

Due to the limited knowledge regarding Agile transformation within HCP, benchmarking was performed to support existing theory with real examples from the industry on opportunities and challenges that come with an Agile transformation. Interviews were conducted with three external companies that have been implementing an Agile way of working over the last years. Each interview lasted between 60-90 minutes and gave the researchers some ideas on how an Agile way of working could improve HCP's performance regarding time, but also emphasized different pitfalls to

avoid. To ensure all the companies keep their anonymity, the researchers decided not to give too detailed information about the organizations. The researchers created an interview guideline that focused on how the transformation took place: before, during, and after the transformation, see Appendix 10.

### **3.4 Data Analysis**

The data was collected from the interviews by taking notes and compiling the answers to each question, which was later transferred to an Excel sheet. When performing the analysis of the interview data, the Affinity method was used. Kawakita (1991) presented the Affinity method, it is commonly used to organize interview data to identify connections and develop new ideas. An overall summary of the findings from each function was documented and translated into short statements. The statements were then clustered into categories that addressed the same problem. The researchers identified three main problems: *Challenges related to the early phases*, *Process-related challenges*, and *Communication challenges*. For each main problem, a series of sub-challenges were also identified. This will be further presented in chapter 5. *Empirical Findings*.

### **3.5 Quality Criteria in Qualitative Research**

Bell et al. (2019) describe that reliability and validity are important quality criteria that researchers must consider to establish and assess the quality of business research. However, Bell et al. (2019) state that some writers argue that quantitative and qualitative research cannot be evaluated with the same quality criteria due to the difference in the two research strategies. To assess the quality criteria for qualitative studies, Lincoln and Cuba (2013) propose using trustworthiness and authenticity. It is important to follow the quality criteria to establish trustworthiness and quality in the research. Trustworthiness is made out of four criteria: credibility, transferability, dependability, and confirmability. Credibility, transferability, dependability, and confirmability will be demonstrated according to Lincoln and Cuba (2013).

#### **3.5.1 Credibility**

Credibility is to make sure that the findings that the researchers collect are trustworthy and that they are collected with good practice. To ensure that credibility was fulfilled, twenty-five interviews were conducted with various interviewees from different functions that had different experiences.

#### **3.5.2 Transferability**

Transferability includes if the results of the study apply in other contexts. The interviews were performed internally to understand HCP's current situation, and benchmarking interviews were conducted to get knowledge on how an Agile way of working could improve performance. The results of the study are therefore most likely only transferable to organizations that work with similar processes, face comparable challenges, and are similar in size.

#### **3.5.3 Dependability**

Dependability involves the "auditing" approach in order to keep records of the research process. By, for example, having the records available and keeping the interview transcripts, it can be shown that an appropriate research procedure has been conducted and followed. To ensure the dependability of this thesis, the researchers have kept a

diary to write down what has been done and what decisions have been made. The researchers have also had weekly meetings with their supervisors at HCP and meetings with their supervisor from Chalmers, which can be seen as an external audit.

### **3.5.4 Confirmability**

Confirmability is to ensure that the researchers have acted with good intentions when executing the research. It means that the researchers should not let their values affect the research nor sway the findings to favor their beliefs. To address this criteria, the researchers have derived the findings as accurately as they could. Moreover, a continuous discussion with employees from HCP regarding the findings has assured that the findings are based on a common understanding and not on the researchers' values.

## **3.6 Ethical Aspects**

Bell et al. (2019) present four ethical principles that researchers must keep in mind when conducting research. These four ethical principles are avoidance of harm, informed consent, preventing deception, and protection of privacy through confidentiality (Bell et al., 2019). It is of high importance to adhere to ethical aspects when writing a research study. Each ethical principle will be explained in detail and how the researchers overcame the ethical challenges.

### **3.6.1 Avoidance of Harm**

According to Bell et al. (2019), researchers conducting a study must avoid harming the participating interviewees. This can include avoiding harming their reputation, job security, anonymity, etc. It is critical to assure confidentiality for the participants. Therefore, it is important to ask for permission to record the interview and secure anonymity if they wish. To avoid harm to the participants, the researchers asked if the interview could be recorded. Bell et al. (2019) point out that it can be easier to make the records anonymous and not allow individuals to be identified in quantitative research. However, it can become difficult to ensure confidentiality and anonymity for the participants or organizations in qualitative research, which the researchers experienced since the number of interviewees was limited. However, the researchers did their best to address this by excluding sensitive information regarding the interviewees' identity to assure their anonymity.

### **3.6.2 Informed Consent**

Before interviewing participants, researchers must ensure that the interviewee is given a thorough description of the study and its purpose, along with acceptable information for them to be able to give informed consent (Bell et al., 2019). To secure that this ethical aspect was fulfilled, the researchers began each interview by explaining the aim of the study to the interviewee. They made sure that the participants completely understood the purpose for them to be able to make an informed decision to be a part of the study or not. The researchers also sent out the interview guideline to participants a week in advance. This allowed participants to read through the questions before their interview was conducted, and therefore be better prepared for the questions to avoid giving out sensitive information.

### **3.6.3 Preventing Deception**

To prevent deception, researchers must explain the study in detail so that the participants understand the study's goal and do not perceive it as something other than what it is (Bell et al., 2019). To meet this ethical aspect, the researchers explained the thesis in detail and made sure that there was no deception, creating mutual respect between the researchers and the interviewees.

### **3.6.4 Protection of Privacy Through Confidentiality**

Bell et al. (2019) state that it is crucial to protect the participants' privacy. Privacy can be linked to informed consent because, in a sense, when the participants give their consent, they are surrendering their privacy. However, the participant may refuse to answer questions that they feel harm their privacy. To protect the interviewees' privacy, they had the option to refuse to answer any questions. This was done so that the participant felt safe and secure while performing the interview. One concern of the thesis regarding ethical aspects is to not publish any sensitive information about HCP's way of working or processes. To ensure this, the supervisors from HCP gave permission on which data was acceptable to publish.

## **4. Company's Background**

In this chapter, the company's background will be presented. Firstly, a brief overview of Husqvarna Group will be given followed by a description of the main division that this thesis will focus on HCP. Secondly, the PCP will be explained and demonstrated. Lastly, the Roles and Responsibilities (R&R) within the NPD process will be discussed.

### **4.1 Husqvarna Group**

Husqvarna Group is a Swedish company and a global leader in developing and manufacturing outdoor power products for forests and gardens, watering products, and offers services and products for the construction industry (Husqvarna Group, 2021a). The company was founded in 1689, and its product portfolio has evolved throughout the years (Husqvarna Group, 2021b). Husqvarna Group has 12.400 employees in 100 countries and has a turnover of ca 42 billion SEK per year (Husqvarna Group, 2021a). Husqvarna Group has a strong focus on innovation and quality performance.

Husqvarna Group consists of three main divisions: Husqvarna Brand Division, Gardena, and Husqvarna Construction Products (Husqvarna Group, 2021a). This thesis is conducted at Husqvarna Construction Products.

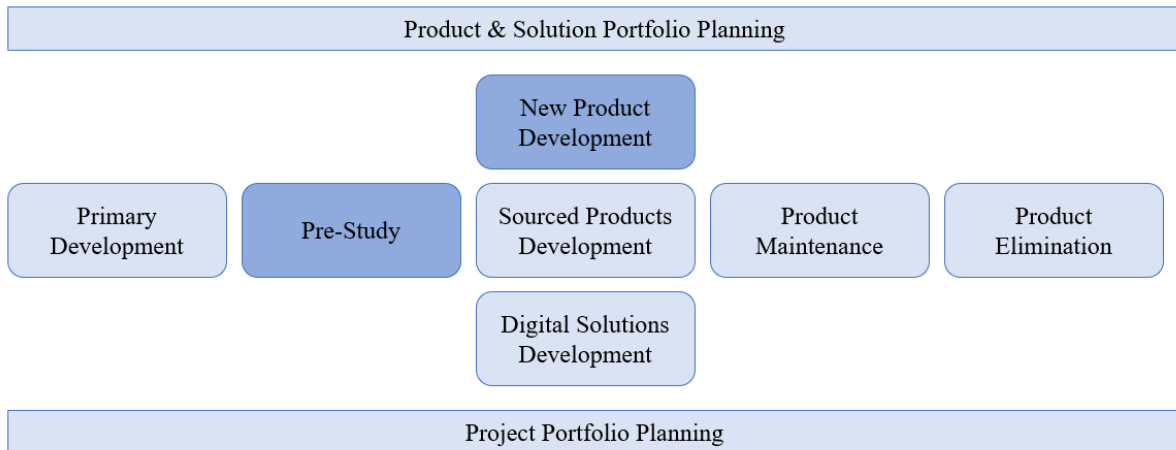
### **4.2 Husqvarna Construction Products (HCP)**

HCP is one of the leading companies in developing and producing machinery and diamond tools for the light construction and stone industries with products such as power cutters, drilling motors, and wall saws (Husqvarna Group, 2021a). HCP has around a 14% share of Husqvarna Group's net sales annually and around 2700 employees (Husqvarna Group, 2021a).

HCP consists of six subdivisions, and four of them are located in Jonsered: Concrete Sawing and Drilling, Concrete Light Demolition, Concrete Surfaces and Floor, and Aftermarket and Connectivity. The other two are located in Ath, Belgium: Diamond Tools and Stone. HCP shares nine factories with the rest of Husqvarna Group, where the products are manufactured. The factories are spread out over the world to be closer to the market and the customers. Most of the high-volume products produced at HCP are however manufactured at the Husqvarna Group's factory located in Huskvarna, Sweden.

### **4.3 Husqvarna's Product Creation Process (PCP)**

Husqvarna Group has one overall process for developing products called the Product Creation Process (PCP). The PCP is a structured process to guide and manage the project's lifecycle for the product. It has several processes for all parts of the product lifecycle, from primary development to product elimination. All divisions at Husqvarna Group are advised to use the PCP for their NPD processes and as an overview of the project portfolio planning. The PCP also has formal R&R that will be defined below. This thesis focuses on the NPD process, which is a part of the PCP. Additionally, while conducting this study, it was found that the early stages of the PCP are also valuable and interesting to look further into, and therefore both the pre-study and the NPD will be described below. The PCP is illustrated in Figure 8.



**Figure 8:** HCP's PCP with the research scope highlighted in dark blue.

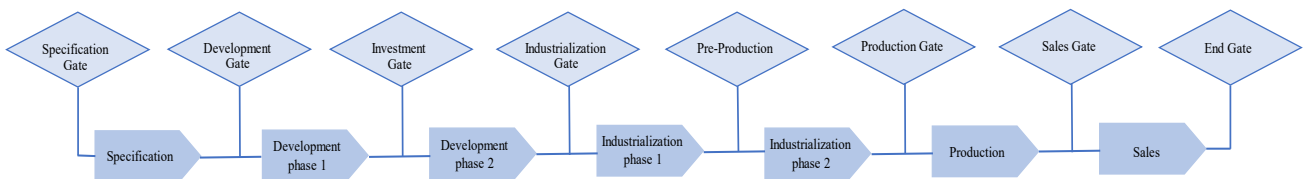
### 4.3.1 Pre-Study

The pre-study is a part of the PCP and is the last step before going into the NPD process. In the pre-study, the product management presents a project proposal for a new project. The purpose is to get approval from the management to continue on a product idea and start a project. In this step, the customer requirements are translated into functional specifications for the product. This step consists of several activities that need to be evaluated and analyzed: overall group strategies, product portfolio plans, market and competitor situation, trends and technologies, and financial impact are all part of the pre-study.

### 4.3.2 The New Product Development Process (NPD)

Husqvarna Group uses a Stage-Gate model for its NPD process. The process consists of seven different stages and eight gates, see Figure 9. There are deliverables that need to be finalized in each stage to be able to move on to the next stage. The project team for each product gives recommendations if the project is ready to move on to the next stage. There is an appointed steering team for each category that evaluates if the project has fulfilled all the criteria for each gate and they decide if the project can pass the gate. A normal project within HCP can last between 2-4 years depending on the product and the project scope.

To be able to start an NPD project and enter the specification stage, a project proposal and all other criteria defined in the specification gate must be evaluated and approved. At the beginning of the project, a cross-functional project team is formed according to the requirements for the project.



**Figure 9:** HCP's NPD process.

### **Specification Stage**

The specification stage is where the requirements from the project owner are evaluated and defined. Product specification and product concept are developed and fulfilled towards requirements. Relevant attributes are evaluated by all stakeholders.

### **Development Stage**

In the development stage, an industrial- and engineering design for the selected concept is developed. The design is verified and frozen, and purchase orders are ready to be released. Prototypes are manufactured and measured according to engineering specifications, and trial tests are done to validate the product. Feasibility must be ensured through simultaneous product- and process engineering and with the involvement of relevant stakeholders. Additionally, project funding is approved.

### **Industrialization Stage**

The industrialization stage is where purchase orders are issued, and engineering pilots (EP) are built and evaluated to verify and validate the product. In this phase, the supplier's quality assurance is performed, and Production Parts Approval Process (PPAP) and certification must be approved. When this has been verified and approved, the manufacturing pilot (MP) is built, and the start of production can be authorized.

### **Production Stage**

In the production stage, the products are produced according to the production planning. Production is ramped up and products are distributed to warehouses. In this stage, the product must be approved in the Sales Start Gate to start selling. Additionally, market launch activities have to be finalized.

### **Sales Stage**

In the sales stage, it is assured that the project meets all specified targets before ending the project. The project is evaluated, closed, and handed over to the production operations. The product is available for sale at this stage.

### **4.3.3 Roles and Responsibilities (R&R)**

The following section will provide the reader with a short description of the roles that are defined in the PCP, along with a brief description of their responsibilities. The NPD process involves nine functions, and each function has its roles and responsibilities. By understanding the different roles and their responsibilities, it will be easier to understand the NPD process at HCP. These descriptions are based on information from Husqvarna Group's intranet as well as statements from the interviews.

### **Project Management Office (PMO)**

The PMO defines the expectations for the project management and coordinates the projects within the NPD. The PMO is responsible for controlling the projects and organizing the project managers (PMs) at HCP. The project coordinators also work for the PMO, but more precisely they support the PMs. The project coordinators are in charge of following up on costs and articles within the projects and providing this information to the PM. The PMs are responsible for driving the project(s) and making sure the project is executed in an efficient way to fulfill the targets. Some of the tasks that the PMO is responsible for are: form the project teams, define the responsibilities for the different roles within the team, communicate with various stakeholders, ensure resource alignment with the line organization, inform the steering group about the

progress, set a budget and maintain it, and fulfill the requirements for the gate passages. The PM works as a mediator between the various functions. The PMO for HCP is located in Jonsered for four of the six business segments.

### **Research and Development (R&D)**

R&D is in charge of the research and development within the NPD projects. The R&D function consists of various segments, for example, R&D lead, electronic/software, mechanic, and simulation. The R&D lead has the ultimate responsibility for technical decisions that involve the design of the new product. The R&D lead also has the responsibility to ensure that the R&D deliverables are met within the set time plan and identify and communicate the required resource demand to the PM. Additionally, the R&D lead is responsible for the R&D project team and for driving the technical progress of the project. The R&D team and the PM form the core of the NPD project team.

### **Product Manager**

The product manager is in charge of the product portfolio and represents the market and customer perspective in the NPD process. Some of the key responsibilities of the product manager are to conduct market research, identify market and user requirements, and create a business case for the product. The product manager has a tight collaboration with both the PM and the R&D department to ensure that the customer requirements are translated from the soft market requirements to harder and more tangible technical user requirements.

### **Supplier Quality Assurance (SQA)**

The SQA function ensures that the supplier can fulfill the needed quality requirements. APQP (Advanced Part Quality Planning) is a method for part quality planning which HCP has adapted to fit their requirements. The main focus is to deliver the Production Part Approval Process (PPAP), which is the process that confirms that the supplier can fulfill HCP's quoted requirements. The process confirms that the set requirements are understood as well as fulfilled by the chosen supplier. The PPAP also indicates that the supplier's manufacturing processes can produce the parts. Sourcing places the order on the PPAP on the PM's behalf, but the SQA is in charge of educating and supporting the suppliers to ensure that the PPAP is approved on time.

### **Compliance Function**

The compliance function investigates the market to understand the compliance requirements to assure that HCP's products follow the market regulations. This is to guarantee that the products can enter the market once they have been manufactured. Compliance informs R&D regarding the requirements that affect both engineering and design constraints, which results in a compliance plan. Compliance can be further divided into areas, such as chemical-, electrical-, and emission-compliance. Their main responsibilities are to collect the compliance specifications, conduct a compliance plan, but also to participate in setting the industry standards. They are in close collaboration with the PM as well as the R&D.

### **Manufacturing**

The manufacturing function is responsible for the industrialization of the new products and has to ensure that the production capacity exists. Manufacturing is also responsible for delivering product builds throughout the NPD projects, and they provide the R&D

with feedback on design-for-assembly. Another responsibility that manufacturing has is to set the manufacturing demands for the product as well as specify the assembly costs for the projects. They are also in charge of procuring new machinery and equipment or adapting the existing to the new requirements. Manufacturing is responsible for providing the EP and MP builds.

Within the NPD projects, the manufacturing function is represented by an industrialization lead. The industrialization lead's responsibility is to coordinate the development team and the industrialization team. Most of HCP's products are produced at Husqvarna's plant located in Huskvarna.

### **Project Sourcing**

The project sourcing function is responsible for driving and securing the sourcing activities within the project. They collaborate with SQA to ensure that the quality of the suppliers is met. Project sourcing also collaborates with R&D when it comes to selecting the suppliers and calculating the should-costs for the quotation requests. Their main responsibilities are to select the supplier for the product, participate in the bill of materials (BOMs), secure that the sourcing resources are available, and establish and control the sourcing schedule.

### **Global Design (GD)**

GD is responsible for the product design and to assure it complies with the Husqvarna brand. This includes setting the brand design direction, ensuring that the product has the right "feel, fit, and finish", aligning with the brand design, and securing the design and patent. The GD function is located in Stockholm, Sweden, and serves all divisions of Husqvarna Group.

### **Product Quality**

The Product Quality function helps the NPD projects to ensure that the specified product quality is fulfilled. Some of the product quality function's responsibilities are related to knowledge management and customer satisfaction, which involves documenting lessons learned and conducting customer validation tests. The product quality lacks representation in HCP's PCP, and it is the PM's responsibility to assure the deliverables connected to the product quality function at HCP. In some circumstances, these deliverables are delegated to other functions.

## 5. Empirical Findings

In this chapter, the empirical findings will be presented. Three main problem categories from the current pre-study and NPD processes were identified from the interviews conducted: *Challenges related to the early phases*, *Process-related challenges*, and *Communication challenges*. These challenges will be further discussed in the chapter, followed by presenting the knowledge within the organization regarding an Agile way of working. Lastly, the findings from the benchmarking will be introduced where the change process will be presented, along with the benefits of applying an Agile way of working into an organization and the pitfalls to avoid. All the findings listed in this chapter are from the interviews and the interviewees' experience.

### 5.1 Challenges Related to the Early Phases

One of the main challenges that the interviewees mentioned was putting more time and effort into the early homework. This implies that people should emphasize doing more work and knowing more in the early phases before going into an NPD project. According to the interviewees, it is important to thoroughly investigate all aspects of the pre-study before the NPD to reduce the project's risks.

#### 5.1.1 Early Homework (Frontloading)

One interviewee stated, *"It is important to do the early work well from the beginning"*. Many participants agreed with this statement and emphasized that doing more work in the earlier stages could lead to a shorter time to market. Checking the available technology and cost from the beginning of the project will decrease uncertainties and reduce the complexity before going into the NPD. This could eventually avoid late scope changes. One interviewee mentioned that the project team struggles the most in the early phases of the project, referring to the specification phase and development phase in HCP's NPD. The interviewee also said, *"We often keep on circling and meeting technical challenges, which seems to take forever to handle"*. This is connected to the previous statement since if it would be possible to research and check the available technology in more detail before going into the specification stage, the project team would not have these problems and could be quicker in fixing them.

Another finding from the interviewees was that the software department is involved late in the project. Including the software department earlier in the process, even before the PCP, and specifying the software features earlier could speed up the process. One interviewee stated, *"The process of making code should start prior to starting the project to get a head start to figure out what to test when making new technology and have time to make new rigs"*. Software development is increasing at HCP, which adds more complexity to the NPD process.

The interviewees emphasized that it is better and easier to make changes early in the process compared to later on. Therefore, the project team should aim to find the problems and have shorter development cycles at the beginning of the project, to be able to accomplish that. However, the project team lacks the complete picture from the start, so the process has to be able to incorporate changes because the project scope will never include everything from the start. One interviewee even stated, *"Don't guess when you don't have the facts since it is a big risk"*. Additionally, the team must ensure the concept is good before running at full speed in the NPD.

It is important to have a good design in the beginning so the suppliers can make the components needed for the product. It is critical to release the correct drawings early, at a good level from the start to avoid problems later in the process. One interviewee stated, *“If we do not have this maturity, there are a lot of questions back and forth with the suppliers, and we have to improve and fix”*. Another interviewee said that lead times are long, and therefore it is important to avoid redesigns.

According to one of the interviewees having structure and the needed knowledge in the organization is critical. Improving the structure in the earlier phases could be beneficial for HCP. However, some of the interviewees stated that it is not possible to investigate forever, and sometimes the concept, the design, etc., is never good enough.

### **5.1.2 Customer Involvement**

One interviewee stated that it is crucial to capture the customer requirements early on to avoid late changes. HCP tries to involve the customer at the beginning of the project to get the correct specification from the start. One interviewee stated, *“It is important to interact with the customer early to understand what they like and don’t like”*. Key customers are a part of the specification phase, and larger projects tend to have more customer involvement at HCP.

One participant also mentioned, *“It is good to send out prototypes early to get feedback”*. However, more often, HCP does not involve the customer until EP builds, and during that phase, it can be too late to incorporate the changes in the product. They do involve the customer in field testing, which occurs in later stages. Usually, at this point, HCP is testing the end result of the product, and by then, it is too late to make changes. One interviewee said, *“The industrialization stage takes a long time due to not getting things correct from the beginning”*, and this results in the EP and MP builds being highly challenging.

One interviewee stated, *“It is important to test prototypes to verify if we have the right concept”*, and by testing the prototype, HCP can figure out if they have something wrong. Another interviewee expressed that testing the prototype early does reduce lead time. In the prototype stage, HCP can make changes to the product. However, as mentioned before, it seems that HCP does not involve the customer when developing the product. One participant revealed that it can be difficult to involve the customer due to the risk of leaking confidential information.

One participant explained that, for a recent project, they did involve the customer when they had a prototype ready. Involving the customer early allows for changes. When they usually have prototypes, they are still in the development stage 1, and therefore, it is possible to make changes to the specification, at that point, based on the feedback. The project team made the customer sign an NDA. The interviewee declared, *“When it comes to confidentiality, I believe I could tell you with 80-90% certainty what the competitors are working on”*. By involving the customer early, the project team experienced benefits in the form of valuable feedback from the customer, more than just the theoretical input. It also gave the team more confidence that they were doing the right thing.

### 5.1.3 Resource Allocation

Some interviewees mentioned that HCP should spend more time on resource allocation in the earlier phases. They described that, usually, products are selected to move forward within the PCP based on the budget. The focus is not on whether HCP has the available resources to deliver all the products that have been decided to develop. Not allocating the resources from the start of the projects can create bottlenecks later on in the projects.

Occasionally, the employees with the most knowledge are fire-fighting in order to deliver the product on time. This leads to employees that have less experience doing the work in the earlier stages, which can affect the quality of the early work and results in redesigns and challenges later in the project. It is better to have more experienced people at the beginning of the project to do a proper investigation. One participant revealed, *“By having the right people at the beginning of a project it will facilitate doing the early homework well”*. Therefore, HCP tries to avoid having only new employees on a new project.

### 5.1.4 Prioritization

Product selection is one of the most crucial elements and most challenging parts of product development at HCP. One interviewee stated, *“The most challenging thing is not that you do things right, it is that you do the right things”*. When it comes to reducing time to market, product selection is an essential part of product development at HCP, and choosing the right product is crucial. However, HCP does not have a structured way to prioritize product selection. HCP has Product Management Meetings (PMM) where the product managers bring their product ideas, and they make decisions on which are the most promising ideas to bring up in the Strategic Product Planning Meeting (SPPM). During the SPPM, they make a priority list of the desired products to have in HCP’s product portfolio. Project planning is also a critical part, and HCP lacks processes in this area. Product selection is based on a combination of:

- Market analysis,
- Knowing what the competitor is doing,
- What technology is starting to be available on the market,
- Profit analysis, and
- Expected revenue.

Furthermore, there is no structured way in how to prioritize the requirements for the product. Requirements are usually prioritized based on the employees’ judgment and the requirements’ strategic fit to the product portfolio. HCP has already begun to create a more structured way of working in the pre-study phase. However, not all the product managers are working with this new structured way, and therefore it needs to be shared across HCP. HCP has started to emphasize being more prepared, and this involves evaluating to which degree the project will be regarding these aspects:

- Technology availability,
- Time,
- Product cost, and
- Project cost.

With this new efficient way of working, HCP focuses on reducing uncertainty for the project scope and wants to have more in-depth project proposals where they have

investigated the cost and performance needed before starting a new project. A product manager stated that this new structured way of working is already showing benefits.

## **5.2 Process-Related Challenges**

The second main challenge that was identified is process-related challenges. Problems regarding the PCP will be further explained in this section, followed by describing the process flexibility. Next, the testing phase and the quality assurance process will be introduced, and what challenges emerge in those processes. Lastly, a need for a more structured way of working will be presented.

### **5.2.1 The PCP**

The PCP has been created for the most complex products. Therefore, the process does not suit all the products that HCP develops because they have a variety of low- and high-volume products in their product portfolio. It becomes a challenge to work according to the process, specifically for the products in the low-volume range. However, some participants stated that people should not just follow the PCP. Instead, the project team should identify the value-adding activities and prioritize them since it is acceptable to deviate from the process. Although, the people working with the process find it difficult to make the deviations and do not know how to do it. Some interviewees wondered, “*Who makes the decisions?*” and are not sure whom to ask for advice.

The interviewees emphasized that HCP needs to be better at adapting the process and actively prioritize tasks to select and deselect the tasks required for a specific project. This is also needed in the pre-study phase, where the project team needs to adapt the process because they need to investigate particular aspects of different products. One interviewee stated, “*The PCP is a reference, so if you do everything in the PCP, it will take time*”. However, another participant mentioned, “*The process will not get us a good product. You need good people to get good products*”, which is also important to remember in product development.

### **5.2.2 Flexibility in the PCP**

Many interviewees highlighted that the PCP is not flexible and does not easily allow one to take one step back and then two steps forward in the process. When the project team discovers late changes, there are limited possibilities to change without delaying the project. As of today, changes take a lot of time and effort. One interviewee said, “*It is not thanks to the process that we can handle these changes*”. Another dilemma that was identified is that problems tend to pile up in the industrialization stage, making it difficult to fix them. A participant mentioned, “*I think it is also important to be flexible to changes later on in the process and have quick reactions*”.

### **5.2.3 Testing Phase**

HCP’s ambition is to test during the whole life cycle of the project in the NPD. They try to build prototypes early to be able to test early. However, HCP does not always manage to test the whole product early, and as one of the interviewees stated, “*Late testing causes late changes*”. The testing phase is labor-intensive, which adds to the complexity of testing the product’s features. Late changes caused by a failure during a test or the machine not working as it should cause HCP to have to make a redesign. Testing the software often becomes exceedingly challenging as well. If someone makes

a change to one function in the software, sometimes it affects other functions, and then the code might not work anymore. One interviewee expressed, *“If it would be possible to make simulations that could save resources. By creating simulations to test updated software, the testing team could save time and effort in the testing phase”*.

One participant had another idea regarding testing the product. The participant said that testing small parts of the product in the beginning could speed up the overall process. Another interviewee mentioned that using components that have been used before could also shorten time to market. The interviewee demonstrated that a modular platform could be beneficial where HCP has parts that can fit multiple products. This could reduce the lead time since HCP would not have to design and develop components for all different products.

#### **5.2.4 Quality Assurance Process**

Another factor that many interviewees expressed was time-consuming is the quality assurance as the PCP is highly quality-oriented. The quality assurance involves proving the quality of components from suppliers, which is called the PPAP. Getting all the tooling approved takes a long time. The PPAP seems to not fit low-volume products, and it is too complicated. It is not clear enough who is responsible and makes the decisions regarding PPAP. One interviewee stated, *“The PPAP is not helping in the way it should”*. The process of obtaining the certification is also time-consuming. However, one interviewee stated, *“If we take care of our problems earlier in the project, we would not have these PPAP problems later on”*. This leads back to doing the early homework well from the beginning.

#### **5.2.5 Structured Way of Working**

The interviewees from several standpoints expressed a lack of a structured way of working. In this subchapter, the lack of a structured way of working will be explained from the view of the supporting functions, software development, and meetings at HCP.

The supporting functions seem to lack processes and a structured way of working. One interviewee stated, *“We do not have any process to follow, and everyone goes their way”*. This leads to the participant having the same discussions about the exact solutions to many different people repeatedly. In return, the interviewee has to fire-fight a lot in his daily work. This takes up a lot of time for the participant, who stated, *“I take a lot of time to go through these discussions and decide what we should do”*. HCP needs to make time to choose a process or procedures to follow, for these decisions or problems, so that people can follow the same process, which would make this more efficient and structured. One interviewee stated, *“Some processes we need to adjust, to be able to make quicker decisions”*. However, the most crucial factor is the way of working and people's minds; as one interviewee stated, *“We need to have a process to follow, and people need to be more flexible to handle these things”*.

The software department explained that they had developed their own model to work in the PCP, which is similar to an Agile-Stage-Gate hybrid model. However, some participants stated that HCP lacks structure and methodology regarding how to work with software since other functions lack understanding of software development. One interviewee stated that it would be beneficial to have more milestones for software to be more efficient and structured.

A recurring theme in the interviews was that many participants experienced that HCP is a “meeting organization” and have long discussions before making a decision. One participant stated, “*Communication and discussion tend to take too much time. There are too many meetings and too many people attending the meetings*”. The participants experienced that these endless discussions did not add value to their work, instead took time from their workday. Some participants stated that by having more structure regarding the meetings, it would be possible to decide who needs to participate in the meeting.

### **5.3 Communication Challenges**

The third main problem that was identified is communication challenges. One of the aspects that adds to the importance of communication is the increased software and electronics in HCP’s products since this added complexity requires a greater understanding.

#### **5.3.1 Resources**

Software and electronics are increasing within HCP, and the designs are becoming more complex. Testing the software takes a long time, and electronic hardware is complicated and labor-intensive. Furthermore, software development is time-consuming, and the software department is constrained on resources. Therefore, HCP needs more resources for software and electronics to test, design, and develop. As the interviewees stated, software and electronics are becoming a more significant element of the products, and it is crucial to expand HCP’s capacity in this area. With this increased technology, the uncertainty and complexity increase, which can create misunderstandings between different functions and roles, and other communication challenges.

#### **5.3.2 Knowledge Sharing**

It is vital that the employees receive information that HCP sends out. One interviewee stated that it was difficult to find information on HCP intranet and it is constantly changing which makes it even more challenging to find the necessary information. If no one reads the material, it will only be unnecessary work, and no new learnings can be drawn from it. One of the employees pointed out, “*We need to send out information in a way, so people connect to it*”. Therefore, it is important to have effective communication to be able to share knowledge and create understanding at HCP. Another interviewee stated, “*Communication can be increased, and you can learn from each other*,” highlighting that the right communication can impact the learnings at HCP. There is always a risk that the knowledge only stays at one function instead of being spread to the whole organization. Some interviewees expressed that by having a system for knowledge sharing, the employees will not have to invent the wheel each time. Some participants stated that they lacked understanding or perceived that others lacked understanding of software and electronics, which could be avoided by improving knowledge sharing. This is crucial since they felt that the lack of knowledge had a negative impact on the project and eventually caused problems.

#### **5.3.3 Collaboration Between Functions**

The communication between different functions needs to be improved since some participants perceived that they lacked understanding of other functions. One participant stated, “*There is too little interaction between software and mechanics*”,

which illustrates the need for collaboration between the different functions. Another participant stated, *“The understanding of electronics and software is sometimes lacking in the other departments, so if you want to make a product together, it sort of takes two to tango”*. One participant expressed the importance of getting everyone in line regarding what should be done in the project since that could eventually save time and effort. It is essential to improve communication to get a better insight into the other functions, and it is also necessary to make great products. As one of the participants expressed, *“We develop products, and that is a team effort. Everyone is a part of making the product. If we do it together, it can be a lot better rather than a group of people who are not talking to anyone and trying to figure out how to make the parts”*.

Another finding was that software often is involved too late in the projects. One of the interviewees stated, *“One thing that has been a typical problem and might have delayed the project, even more, is that software has often been involved too late in the product creation”*. It is critical to involve all the parties that can add value to the process. Some interviewees stated that it is more crucial to involve software early when the risk is high, or the technology is new, compared to when technology has been used before. Involving the software earlier when the technology is new could also improve the speed of the project and time to market.

Another improvement area that was identified was the collaboration between the design team and the product manager. The design team sometimes lacks knowledge regarding the customer requirements, which makes the design process more challenging. Having a tighter collaboration between the design team and the product manager could potentially make the design process faster. The designers must understand what the customers want to make good designs. The product manager has a lot of knowledge regarding the customer requirements, which would help and could therefore facilitate the design process.

One of the participants expressed the need for widening the competence regarding testing. The participant stated that it would be preferable to have a smaller mixed group responsible for testing than a single person. This illustrates the benefits of collaboration since people can learn from each other and facilitate problem-solving.

## **5.4 Agile Knowledge Within the Organization**

Most of the interviewees had limited knowledge about Agile methodology. Some expressed that it was difficult to get a clear description of what an Agile way of working included and how it worked. Many interviewees had heard that Agile is a method that is used for software development and were concerned about how an Agile way of working could be implemented within hardware and mechanics. One interviewee stated, *“I have problems seeing how an Agile way of working could be applied in hardware”*.

Some functions are using Agile practices to enhance their work. In HCP factories, daily stand-up meetings are used that are around 15 minutes long. During these meetings, the team shares what they have been doing, what they will do, and what problems they have encountered. One interviewee stated that the meetings have made everyone more prepared and improved knowledge sharing within the team. The meetings have enabled the team to make quicker decisions, and they have improved the overall efficiency.

Parts of the R&D department use incremental planning meetings that are eight weeks long. In these meetings, the team focuses on value-adding activities and prioritization. This way of working has given the team a more holistic picture of the project and improved knowledge sharing between team members, which has resulted in increased transparency. The software department is using JIRA as a tool to prioritize their activities and organize their work. This tool has advanced their way of working.

Many participants believe that an Agile way of working could be beneficial to use within HCP, especially in the earlier phases, e.g., in the pre-study, specification stage, and concept development. One interviewee stated, *“Agile-inspired way of working could be applicable and beneficial for HCP”*. Another interviewee thinks that the usefulness of using Agile methods could depend on the complexity of the product, and HCP could have different approaches for different products. The participant expressed that HCP should implement Agile selectively and could use Agile methods as tools in the toolbox. That way, for more complex products, an Agile way of working could be suitable to apply.

One interviewee described their understanding of an Agile way of working as *“You do not freeze the complete time plan from the beginning since you don’t know the full scope and should therefore not lock the specification at the beginning when you don’t know everything. You divide it into a number of steps and take it step by step and make decisions as you go. It is important that you develop as you learn”*. This is an interesting description, which sums up shortly how an Agile way of working could be applied within HCP.

One interviewee stated that HCP needs to implement certain Agile ideas into their existing processes. Another participant thinks it could be valuable to apply an Agile way of working at HCP since it is essential to work together. They furthermore stated, *“Teams could have more decision power to make quicker decisions”*. Enabling teams to make quicker decisions could lead to reduced lead time since decision-making takes a long time in the current product development process. To conclude, one interviewee stated, *“A way to get a new result is to impose new behaviors otherwise, you only repeat yourself. Don’t expect a different result if you do not change your behavior”*. Therefore, it is important to be open-minded to changes if one wants different results.

## **5.5 Benchmarking**

Benchmarking interviews were performed at three different companies, with one representative at each organization. All the companies have been implementing Agile methods during the last four years and are located in Sweden. The main findings from those interviews will be presented in this chapter. First, the change process within the organizations will be described, followed by introducing the benefits of applying an Agile way of working. Lastly, pitfalls to avoid when implementing an Agile way of working will be presented.

### **5.5.1 The Change Process**

The main drive for the companies to decide to apply an Agile way of working into their organizations was the need to change and adapt their current way of working to not be left behind by competitors or lose market shares. The companies needed to become faster and adjust to a different environment since software development is increasing within their service and product development. One interviewee stated that the company

needed to learn how to do things quickly and simplify the work. According to one of the interviewees at the benchmarking companies, an Agile way of working is often associated with being fast and making the work easier.

The benchmarking companies emphasized that when a company decides to change its way of working, it is important to have the proper knowledge and an implementation plan. It also requires a person or a team of people, depending on the size of the company, to lead the change. A change of this magnitude will create conflicts and problems, so it is essential to have patient change leaders that act as servant leaders. One of the firms hired people who had already been a part of a similar transformation to lead the change and guide them in this journey. That company followed an implementation plan similar to Kotter's eight steps.

According to the benchmarking companies, organizations need to focus on training and keep on training new personnel. It is of high importance that organizations adapt Agile to their way of working. One of the organizations had the capabilities of having their own internal courses and could, therefore, train scrum masters and product owners in their way of working. One of the interviewees at the benchmarking companies emphasized that when implementing a change, it is key to share the vision with the whole company. One of the firms used visual management tools to share the change and used screens to show their status and improvements. The company managed to share the vision since they emphasized the why and other people started sharing the vision. The company made structural changes, e.g. adapted HR, focused on value flow and it created changes in people's behavior. That firm has its own way of working that has been continuously updated during its transformation journey.

As stated before, a change of this size will create conflicts, and people-related issues often follow these kinds of transformations. There are different ways of dealing with these people-related issues, and the companies did not all follow the same process regarding that matter. One of the companies focused on people who accepted the change and did not put too much effort into the laggards. The laggards either left the company or eventually accepted the change. Another approach that one of the benchmarking companies took, was to have sessions where people can share their concerns. From these sessions, one can get some valuable points and discuss improvements with the people at the firm. One of the companies created surveys to monitor how people were feeling regarding the change.

### **5.5.2 Benefits from Applying an Agile Way of Working**

The benchmarking companies shared their Agile practices and tools that they have started to use to enhance their way of working. However, not all companies used the same practices or tools. Listed below are all the Agile practices that the companies mentioned:

- Incremental planning meetings
- Scrum board
- Product Backlog management
- Sprints
- Business Value Review
- Value stream mapping
- JIRA software

All three organizations have an incremental planning meeting every twelve weeks and divide the work into two weeks sprints. The product backlog made it easier for people to prioritize their tasks which facilitated resource allocation, for example, testing. It also allowed people to know what the goal was and what each individual was supposed to do.

When asked how an Agile way of working can be applied in hardware development one of the organizations stated that using CAD modeling to create shorter loops has given the firm great benefits. The business value review has two purposes. Firstly, it gives the management team a learning opportunity to learn what they are doing on a very deep level. Secondly, it gives the team exposure to the top management. One interviewee stated that the JIRA software is a great planning tool to plan software development and the firm used it for that purpose.

An Agile way of working has led to the following improvements in the organizations:

- More knowledge sharing where people started sharing their learnings to each other
- The Agile tools improved the visual management
- The collaboration between functions increased
- The employees got more control and decision power and become empowered teams
- People started to communicate more
- Employees experienced more joy and motivation
- Increased transparency between team members by using Agile artefacts

People that had similar roles started talking to each other and learning from each other how the best practices were being done and the collaboration grew within the organization. An Agile way of working helped one of the firms to have the difficult discussions early. Everyone knows when the other team is planning to do something, and in that way, it improves transparency between the employees at one of the benchmarking companies. One of the interviewees stated that one of the most important factors was getting the overall picture.

### **5.5.3 Pitfalls to Avoid When Implementing an Agile Way of Working**

Implementing a new way of working in an organization is challenging. Therefore, avoiding pitfalls that firms have experienced is an important factor of this study. At one of the organizations, only one function initiated the change and implemented an Agile way of working at their function alone, which was the R&D department. This created conflicts between different functions, and not everyone fully agreed on the change. The interviewee mentioned that not everyone was educated and got sufficient training. One employee joined the company after the transformation process had already been initiated and for that reason received no training in the Agile way of working. More discussions and interaction would have been beneficial since people were working differently and in silos. The interviewee would have wanted the organization to implement an Agile way of working for the entire company. The mindset of the ones that were working with Agile practices changed, and they thought more in increments and sprints. However, since the other functions were not involved, it created obstacles, and the interviewee felt that this new way of working had increased the lead time. The people within the firm felt like they were less flexible in this new set-up.

One organization explained that the downside of the incremental planning meetings is that the team plans for twelve weeks, which is a long time. At the beginning of the increments, the team has a better understanding of what needs to be done compared to their understanding of what needs to be done at week ten. Therefore, it is easier to plan for the first weeks. One interviewee stated that one of the biggest problems when beginning the transformation was starting to focus on the teams and transform them. That only built up frustration because outside the teams there is a whole different world, similar to what happened at the other firm.

When asked if there was anything the organization would have done differently when applying an Agile way of working, one interviewee stated that they might have focused more on asking people questions before and during the transformation regarding how they felt about the change. One interviewee expressed that when implementing an Agile way of working, the organization should have more collaboration and include all functions when doing the prioritization since that was something the participant felt was lacking at their firm when that company applied an Agile way of working. The benchmarking companies emphasized that it is crucial to discuss how the firm is planning on initiating the change and how it will fit together. However, all the companies agreed that an Agile way of working could be beneficial if applied within HCP for the larger part of the organization.

#### **5.5.4 Reducing Product Development Lead Time**

The benchmarking companies could not answer whether the Agile way of working has reduced the product development lead time since they are all still in their transformation process to their new way of working. The organizations have not been able to measure if it has shortened the time to market. However, all the companies shared benefits from applying Agile practices and tools.

## **6. Discussion**

This chapter includes a discussion regarding the empirical findings in relation to literature and benchmarking. The twelve challenges identified during the study at HCP will be addressed and discussed. To conclude, the research questions will be answered.

### **6.1 Challenges Related to the Early Phases**

In this section, the early phases challenges will be addressed.

#### **6.1.1 Early Homework (Frontloading)**

Most of the interviewees at HCP emphasized how important it is to do the early work well from the beginning. According to Cooper (1995), one of the most critical factors when reducing time to market is putting more time and effort into the early homework. This is a common challenge in NPD processes and has shown to be of high importance when reducing lead time in product development. Therefore, HCP should focus on putting time and effort into the early phases, doing the up-front homework, and having a structured way of working. This includes involving the software department when there is new technology that needs to be analyzed, which will reduce uncertainty and complexity later on. The software department could research the technology availability earlier to avoid endless loops of changing and fixing the software. Having a structured way of working and focusing on the up-front homework will lead to reduced product development lead time. However, HCP can not investigate forever in the early phases and in that way Agile encourages the project team to have a final delivery to the stakeholders at the end of each sprint. Furthermore, HCP needs to define a “done sprint”, meaning that there should be instructions on what counts as a finished design or concept.

#### **6.1.2 Customer Involvement**

According to Cooper (1995), another key factor to achieve a shorter time to market is customer focus. The traditional development processes are not known for emphasizing customer involvement, and customer feedback is provided late in the development process (Petersen et al., 2009). Therefore, new NPD approaches have been introduced over the past years to improve customer involvement and enhance customer feedback (Cooper, 2019). Involving the customer in the early phases and getting feedback on prototypes will save time later on. Cooper (2016) described how the Agile way of working has improved customer involvement and that it has shown to be more effective than the traditional methods. When using Agile, it is easier and faster to make changes early in the project since the process is more frequently involving the stakeholders. Having an Agile way of working creates shorter loops where the project team can have earlier prototypes and receive customer feedback earlier and faster in the process.

HCP finds it difficult to involve the customer due to the risk of leaking confidential information. However, HCP had a project that did include the customer early in the project, and the project team received valuable feedback. Therefore, HCP should share their learnings and the benefits of involving the customer since it had a positive impact on the project.

### **6.1.3 Resource Allocation**

HCP is struggling with allocating resources at the beginning of the projects, which can cause delays later on in the project. Therefore, focusing on resource allocation in the earlier stages can avoid bottlenecks and redesigns. HCP should try to allocate the most knowledgeable and experienced resources at the beginning of the project to do things right from the start, which could lead to reduced time to market. According to one of the benchmarking interviews, the product backlog can be a useful artefact to facilitate resource allocation. Using the product backlog to prioritize the project team's tasks made it easier to delegate activities between the team members and understanding the needed competencies.

One interviewee said, *“Most of the time it is either resource conflicts that cause delays in the project or it is technical concerns that we didn't foresee”*. Having the necessary capabilities and competencies at the beginning of the project is essential. This connects both to doing the early homework right from the beginning to avoid having these technical problems in the projects and allocate the resources efficiently from the start.

### **6.1.4 Prioritization**

HCP is lacking processes when it comes to project planning and product selection. According to Pinto (2016), a product backlog is a prioritization list of the features and capabilities needed to build a rewarding product. The author further demonstrated that the product backlog can change to capture what is appropriated for the product to be competitive. The product backlog could be a helpful artefact to prioritize at HCP. According to the benchmarking companies, product backlog management has improved the organization's prioritization and made it easier to prioritize the tasks.

The product backlog could be beneficial on two different levels, both when it comes to the detailed requirements regarding a specific product and to get the overall picture for the product selection. Creating a prioritization system based on the factors that HCP utilized in their product selection and building processes around the project planning is an important step to reduce lead time. The product backlog could be helpful in creating this prioritization system and be used to prioritize the products at a high level at HCP and to prioritize the requirements and features for a specific product. Since HCP is lacking processes in their product selection, building a prioritization system and using a product backlog in that process, would be valuable to create a structured way of working at HCP product selection.

## **6.2 Process-Related Challenges**

In this section, the process-related challenges will be addressed.

### **6.2.1 The PCP**

The PCP at HCP has been created for the most complex products. Some interviewees expressed that they found it difficult to deviate from the process and deselect the non-value-adding activities. According to the benchmarking companies, a product backlog has proven to enhance the organization's way of working and prioritizing the work. Therefore, adopting a product backlog at HCP could be valuable since prioritizing the activities for each project would become easier. Incremental planning meetings have also shown significant benefits in product development both within HCP and the benchmarking companies. The benchmarking companies had twelve weeks increments,

and one of the firms stated that it was seen as a pitfall to have these long planning periods. However, HCP has eight-week increments, which could be more suitable to apply because the planning period is shorter. Therefore, the project team has more knowledge when planning the increments.

According to Cooper and Sommer (2016ba), blending an Agile way of working to the Stage-Gate process, creating an Agile-Stage-Gate hybrid model, has resulted in an improved way of working and shorter time to market within physical product development. Applying an Agile way of working within the PCP at HCP could result in an improved way of working and reduced product development lead time. This new way of working could make it easier to adapt the process for the low volume products.

### **6.2.2 Flexibility in the PCP**

According to the interviewees at HCP, the PCP is not flexible to adapt to changes. Beck et al. (2001) demonstrate that one core value within the Agile Manifesto is “responding to change”. Cooper and Sommer (2016b) established that by using an Agile-Stage-Gate hybrid model in physical product development, the companies responded faster to the changing customer requirements. Cooper (2016) illustrated that due to design flexibility, the organization could easily and quickly adapt the process when using an Agile way of working.

### **6.2.3 Testing Phase**

By having earlier prototypes and short development loops, the testing team can test the product more frequently and detect problems earlier. At HCP, the testing phase is labor-intensive, and it is challenging to test the software. HCP could incorporate simulations to test updated software, which would save time and effort in the testing phase.

Modular platform development could also be valuable at HCP since it would reduce building parts for each product. HCP could design and develop products for multiple fit products for their product portfolio, which would reduce lead time.

### **6.2.4 Quality Assurance Process**

The quality assurance process within HCP is cumbersome and complicated, according to the interviewees. However, one interviewee stated that if the project teams would do the up-front homework right from the beginning, HCP would not have these PPAP problems, which causes delays in the project. This shows how important it is to do the early homework well from the start. HCP could consider restructuring the PPAP for low-volume products since the process is not suitable for those products.

A clearer description of the Roles and Responsibilities (R&R) is needed at HCP since the interviewees mentioned that it was unclear who makes the decisions when it comes to the PPAP. HCP needs to improve their knowledge sharing for their R&Rs and have it easily accessible on their intranet. This will be further discussed in chapter 6.3.2 *Knowledge sharing*.

### **6.2.5 Structured Way of Working**

HCP lacks processes for the supporting functions. Therefore, HCP needs to create procedures and a structured way of working when there is a decision to be made or a problem that needs to be solved. Having an employee have the same discussions repeatedly is non-value adding, and therefore, it would be valuable for the long term to

create a standardized way of working. Both the literature and benchmarking emphasize that the product backlog would clarify the prioritization, and therefore, be beneficial for HCP in creating a structured way of working. HCP needs to develop processes for the ones that are lacking. Having a standardized way of working could improve the speed if the processes are stable and reliable.

From the interviews, the researchers found that many of the project managers lacked an overview of the software development. Some interviewees also expressed that the software development lacked milestones, which obstruct the collaboration between the functions. According to Cooper (2016), the Stage-Gate model is a macroplanning process, while Agile is a microplanning project management method. Therefore, combining these methods could lead to a more holistic perspective and improved understanding between the different functions.

Many of the interviewees have experienced that they have endless discussions before making a decision and that the teams lack decision power. According to some of the participants, HCP is a “meeting organization”. This has resulted in many people attending the meetings without adding any value to the discussions. Applying an Agile way of working could minimize the endless discussions and the number of participants in the meetings since the Agile roles give the employees more control over their own work (Cooper & Sommer, 2016b). The benchmarking interviews stated that one of the benefits of applying an Agile way of working was that the teams were more empowered. By empowering the teams, they could make quicker decisions, which would lead to faster response and shorter time to market.

## **6.3 Communication Challenges**

In this section, the communication challenges will be addressed.

### **6.3.1 Resources**

Since the amount of software and electronics is increasing at HCP’s products, the uncertainties and complexity in the NPD increase as well. HCP has to adjust to better deal with these uncertainties to stay competitive and profitable. The main drivers for the benchmarking companies to adapt an Agile way of working were to not be left behind by the competition or lose market shares. They also needed to become faster and adapt to a different environment since software development had increased. The Agile way of working provides a framework to better manage these uncertainties and ambiguity (Vedsmund et al., 2016). Because of these challenges, Cooper (2019) states that companies have had to adapt to new ways of working, and Agile product development is one of them.

### **6.3.2 Knowledge Sharing**

HCP has islands within the company that use Agile practices, and they have experienced benefits in the form of improved collaboration and more efficient knowledge sharing. However, these practices and knowledge have not been shared across HCP, which creates an opportunity for HCP to spread these Agile practices to improve their current way of working. From the benchmarking interviews, the researchers found out that one of the areas that improved after the implementation of Agile practices was knowledge sharing. This has also been found in previous studies, for example, Cooper and Sommer (2016b) found that the Agile roles can improve both

communication and knowledge sharing. Therefore, an Agile way of working could improve knowledge sharing at HCP.

It is essential to improve HCP's intranet to share the knowledge more efficiently. It is difficult to find information regarding R&R, and many of the interviewees stated that it is difficult to find the correct information at times since the intranet consistently changed. From the benchmarking companies, the researchers were able to identify that visual management was improved when applying an Agile way of working. One of the benchmarking companies mentioned that the company used screens to share the progress of the implementation of Agile to emphasize why they were changing. According to Kotter's eight steps, it is essential to emphasize why the change is needed to achieve a successful transformation. Therefore, HCP should utilize more screens and the intranet to spread information across the company more efficiently to spread the urgency of why they are implementing Agile practices.

### **6.3.3 Collaboration Between Functions**

Efficient communication and knowledge sharing in the organization can create a better understanding between the different functions. Insufficient communication can lead to misunderstandings, and perhaps missed opportunities. It is important to improve collaboration between the different functions to prevent problems from happening later in the project.

Some of the interviewees expressed how they believed an Agile way of working would have a positive impact on the work environment and that it would result in better products. The positive impact that Agile can have on the work environment has been shown before in research by Cooper and Sommer (2016b). They found that having more control over the daily work increased the motivation among the employees (Cooper & Sommer, 2016b). From the benchmarking companies, the researchers found that the employees experienced more joy and felt more motivated after implementing an Agile way of working.

Another benefit found in the benchmarking interviews was the increased collaboration. This finding is important for HCP since many of the employees have experienced a lack of collaboration between different functions. One of the participants expressed, "*It is like in any team sport, it is best to have a good team that likes to work together. Working together creates a team spirit and makes everything a lot more fun, and if it is fun to work you do a better job*". The benchmarking companies and the function at HCP that has implemented incremental planning meetings have experienced increased collaboration and improved communication. Both research and findings from the interviews point to the direction that an Agile way of working could increase collaboration and make the work environment better.

## **6.4 Answering the Research Questions**

This section will address the research questions and answer based on the empirical findings, literature, and benchmarking.

#### **6.4.1 RQ1: Can an Agile way of working reduce product development lead time in an organization that is characterized by traditional development processes?**

According to the literature, an Agile way of working can reduce product development lead time if it is implemented efficiently and effectively. Cooper and Sommer (2016a) describe the nine elements for Agile-Scrum and emphasize how it can provide valuable tools and practices that have proven to increase performance and reduce product development lead time. By having short development sprints, the process becomes faster and more flexible to changes. Therefore, an Agile way of working is quick and responsive.

The SAFe method incorporates Agile, Lean, and DevOps practices and principles that have proven to deliver innovative, high-quality products and have resulted in a shorter time to market. SAFe is based on Lean and several studies show that Lean product development achieves a faster product development lead time (Yang & Cai, 2009). However, limited studies were found that prove how SAFe reduces product development lead time since it is a relatively new approach in NPD.

According to Cooper and Sommer (2016b), the Agile-Stage-Gate hybrid model has shown great benefits and it can reduce product development lead time within both software development and physical product development. Included in the study were organizations that previously worked according to traditional development processes but had transformed to an Agile way of working. The authors demonstrated that the companies experienced some positive outcomes, for example, faster releases, higher quality products, and improved customer focus. This shows that applying an Agile way of working can be beneficial to reduce product development lead time but also have a positive impact on other areas. Both literature and the benchmarking companies show improvement areas in the form of improved communication between team members, increased flexibility and improved customer involvement.

Scrum aims to reduce the volatile requirements for the development team (Maria et al., 2015), and reducing the risks might be one way to increase the speed of the product development process. A similar scenario was seen at HCP, where they reduced risks by involving the customer in the product development process. This tight collaboration and continuous feedback loop gave the project team the confidence needed to run the NPD project at full speed. However, the project has not been completed and, therefore, it is difficult to conclude if this project will result in a shorter time to market. After all, the collaboration with the customer has shown to increase the project team's confidence since they can verify with the customer that the concept is valid.

Since the benchmarking companies are still in the transformation process towards an Agile way of working, it was not possible to draw any conclusions if an Agile way of working has reduced the time to market. Some employees at HCP are concerned about how an Agile way of working could be implemented within hardware and mechanics. However, one of the benchmarking companies stated that an Agile way of working is a relevant method to apply in physical product development. This has also been seen in Cooper and Sommer (2016a) studies about the Agile-Stage-Gate hybrid model.

The twelve challenges identified at HCP will be further discussed regarding if an Agile way of working can reduce product development lead time in chapter 7. *Recommendations for HCP*. The three main challenges will be addressed in regards to which practices from the Agile-Scrum method can be valuable in reducing product development lead time. The recommendations will be built around an Agile way of working with regards to literature and information from the benchmarking.

#### **6.4.2 RQ2: What challenges may emerge when implementing an Agile way of working into an organization that is transforming its product development processes?**

When implementing a change of this magnitude, there are challenges and pitfalls to avoid to secure a successful transformation. Bohem and Turner (2005) and Nerur et al. (2005) point out challenges that may emerge when implementing an Agile way of working into traditional product development processes and how to handle these issues. The conflicts that the authors demonstrate are:

- Development process-related conflicts
- Business process-related conflicts
- Management and organizational issues
- People-related issues

The authors explain that the organization needs to prepare for the change and identify the gap between the current state and the ideal state for companies in general. Therefore, the firm must analyze what adjustments need to be made to successfully implement an Agile way of working and find the appropriate Agile method for the organization. The company might also have to redefine roles and responsibilities within the firm. Bohem and Turner (2005) suggest creating guidelines to share the vision and the change with the employees at the company. Educating and training the people within the organization about the Agile way of working is crucial. Nerur et al. (2005) emphasize that organizations must prepare the change carefully before implementing an Agile way of working into the company and embrace the change. One of the identified pitfalls in the benchmarking was the lack of sufficient training regarding the Agile methodology. Not having the relevant training will create conflicts in applying an Agile way of working.

Kotter (2007) and Hayes (2018) address common pitfalls when implementing a large change into organizations. Kotter (2007) emphasized how important it is to follow an implementation plan and has created a plan that includes eight steps to successfully implement a change. One of the benchmarking companies followed a change plan similar to Kotter's eight steps and expressed how it helped the change team to emphasize the "why" and share the vision. Hayes (2018) has similar steps as Kotter (2007) to manage a change. Both literature and the benchmarking companies emphasized that following a change plan similar to Kotter's or Hayes' plan, the change leaders avoid falling into the pitfalls that are commonly known in change management theory.

From both literature and the benchmarking companies, the researchers found out how a change of this size can create conflicts and people-related issues. It is common that some of the employees do not accept the change and try to fight against it since they feel threatened by the change (Ford & Ford, 2009). Therefore, it is crucial for the

momentum of the change that these people are handled efficiently. The researchers discovered that the benchmarking companies had dealt with the people who were negative towards the change in different ways. Despite dealing with the people who had difficulties accepting the change, the companies understood the importance of communicating why the change was needed. Boehm and Turner (2005) also emphasize that communication is key when dealing with people-related issues.

One of the benchmarking companies addressed that the firm only implemented an Agile way of working at one function in the organization. This created conflicts between different functions and roles within the company. Not everyone got the appropriate training and education regarding the Agile way of working, which resulted in many of the employees having a negative attitude towards the change. The participant from the benchmarking company revealed that it would have been better to implement an Agile way of working for the entire company. Implementing the change in only one function created silos and increased the product development lead time. Therefore, it is crucial to learn from this pitfall and prepare the change in detail to avoid having a longer time to market when the goal is to reduce the product development lead time. Implementing an Agile way of working efficiently and effectively and being aware of the risks that may emerge is critical. Involving everyone in the change and sharing the vision is important, and together the organization can achieve a successful improved way of working.

## **7. Recommendations for HCP**

In this chapter, the recommendations for HCP will be presented. Based on the literature review, benchmarking interviews, and the empirical findings, a list of recommendations has been made to handle the challenges addressed in the empirical findings. The recommendations are built around an Agile way of working to reduce product development lead time and improve the PCP at HCP. However, the researchers identified other challenges that were out of the scope of the Agile way of working to solve but are worth mentioning. The researchers want to address these challenges and give recommendations to reduce lead time at HCP.

### **7.1 Recommendations to Address Challenges Related to the Early Phases**

The following section will present the recommendations for the challenges that were identified in the early phases. The four different challenge areas that were classified were: early homework, customer involvement, resource allocation, and prioritization. The recommendations are built around an Agile way of working to reduce product development lead time and address the challenges in the early phases.

#### **Product Backlog**

HCP is recommended to use a product backlog, a priority list of features and requirements, to address the challenges in the early phases. The researchers suggest HCP to create two types of product backlogs, one to capture the overall picture for the product selection and one for each specific product to dive more into detail regarding the specific requirements. Having a product backlog for the product selection would give HCP a more holistic perspective over the tasks needed to be accomplished and help with the prioritization. A product backlog regarding a specific product would facilitate resource allocation since HCP would be able to distinguish which project has the highest priority. Utilizing a product backlog would also enhance the project proposal since the backlog is a prioritization list of the features needed to create a rewarding product.

#### **Collaboration in the Early Phases**

HCP has created a new structured way of working in the pre-study phase in their product creation process to work more efficiently. HCP is advised to extend this way of working across the organization. It would also be beneficial to enhance the use of a product backlog in this new way of working in the pre-study to facilitate the prioritization of both the technical and market-oriented requirements.

The necessary functions need to be involved early in the project to have the difficult discussion and get an overview of the challenges that might emerge. The software department needs to be included when identifying the available technology and the required capabilities. Having the essential resources and doing the up-front homework well from the beginning will reduce the lead time.

#### **Sprints**

HCP is recommended to use sprints in their development process. The project team can create rapid prototypes and get customer feedback more frequently and faster. Having quicker feedback loops in the specification and the two development phases would be beneficial. Thereby, identifying the problems earlier in the process makes it easier to

make changes and fix the problems in the early phases, leading to a shorter time to market.

The sprints at HCP could be between 2-4 weeks long. When using sprints, it is essential to define a “done sprint”. In physical product development, the project team needs to define what is expected to be delivered in each sprint.

It has become easier to have quick design loops in physical product development since the technology around 3D printing has increased. Therefore, sprints in physical product development should not be seen as an obstacle for an Agile way of working at HCP.

### **Customer Involvement**

HCP is suggested to involve the customer more in their project to get customer feedback on prototypes. That has shown benefits since the project team can verify if they have a desired concept. The project team also becomes more confident about the product, making it possible to run the project at high speed.

## **7.2 Recommendations to Address Process-Related Challenges**

The following section will present the recommendations for the process-related challenges that were identified. The five different challenge areas that were classified were: the PCP, flexibility in the PCP, testing phase, the quality assurance process, and a structured way of working. The recommendations are built around an Agile way of working to reduce product development lead time and address the process-related challenges.

### **Product Backlog and Sprint Backlog**

Regarding the process-related challenges, a product backlog would make it easier for the team to deselect non-value adding activities. The PCP involves tasks that could be excluded regarding the low-volume products since these tasks were created for the most complex products at HCP. A sprint backlog would help HCP to prioritize the activities that need to be completed during a sprint. It would give the team focus by seeing what needs to be accomplished during a sprint since they know what is prioritized and what is not as important.

### **Sprints**

Having sprints makes it easier to adapt to changes which could reduce lead time. By frequently testing the product during a sprint, HCP would detect problems earlier, and it would take less effort and time to make changes to the product. In the testing phase, HCP could benefit from having simulations when testing software updates. This way, the NPD process at HCP would become more flexible, and it would not be as challenging to deviate from the process.

### **Agile Teams**

HCP is suggested to have Agile teams. These teams consist of employees from different functions that work together as a cross-functional team. Having Agile teams means a product manager acts as the product owner, and a scrum master or a project leader facilitates the development team. The development teams might vary in size since the projects at HCP are diverse and require different amounts of people. The development team should be a self-organized team where the team members are given more power

and control over their activities. This provides the team with more decision power, which can lead to quicker decision-making and faster response.

### **More Processes and a Structured Way of Working**

HCP is advised to create more and better processes for the supporting functions. A standardized procedure to follow is needed to become more efficient and effective. Additionally, to utilize the supporting functions at HCP in an Agile way of working, they could be included during one sprint when they are needed, and dedicate their whole time to that project during that sprint.

By doing the early homework correctly from the beginning, the project team should not run into PPAP problems. However, HCP is recommended to restructure the PPAP, especially for low-volume products. HCP is suggested to define who is responsible for the decisions involving the PPAP. This could be solved by giving the teams more decision power since it would clarify who is in charge of the decisions and improve the speed of the project.

## **7.3 Recommendations to Address Communication Challenges**

The following section will present the recommendations for the communication challenges that were identified. The three different challenge areas that were classified were: resources, knowledge sharing, and collaboration between functions. The recommendations are built around an Agile way of working to reduce product development lead time and address the communication challenges.

### **Self-Organized Teams**

HCP is recommended to have cross-functional teams that are self-organized. Having this structure in the teams will improve collaboration between functions, which is important since HCP lacks understanding between functions. By working together, it will be easier to share knowledge and solve problems faster.

Self-organized teams will improve knowledge sharing since people from different functions will start to communicate and share ideas. They will also learn from each other and enhance their knowledge. Self-organized teams also empower people in the team so they can control their work. This could reduce non-value adding meetings and the number of participants attending the meetings since one person could represent the whole team.

### **Agile Artefacts and Tools**

Agile-Scrum artefacts and tools that can advance knowledge sharing at HCP are daily scrums, retrospective (review) meetings, scrum board, and burndown chart. These tools are known to improve the transparency between team members and aid visualization. Using these tools to visualize the project's progress and having short meetings every day have shown to be effective and resulted in an efficient way of working. The teams work better together, and team members help each other overcome any obstacles they might face during the project.

### **Clarify R&R and Agile roles**

HCP is suggested to clarify their R&R and have the description easily accessible for the employees. Since the researchers suggest that HCP moves towards an Agile way of working, descriptions of the Agile roles and their responsibilities should be shared

across the organization. These descriptions need to be adapted to HCP's needs to give the employees a better understanding of what is expected from them in their daily tasks. HCP might want to redefine specific roles when transforming from a traditional approach to an Agile way of working. Furthermore, HCP should consider investing in more software and electronic resources.

## **7.4 An Agile Way of Working at HCP**

The researchers have found the Agile-Stage-Gate hybrid model to be the most appropriate and applicable model to implement at HCP. The Agile method that is suitable to apply with the Stage-Gate process is the Scrum approach. The suggested tools and artefacts to reduce time to market have been addressed before. See Appendix 11 for demonstration of the Agile-Stage-Gate hybrid model at HCP.

The researchers do not recommend SAFe at this stage for HCP since a limited number of studies support how the SAFe approach reduces lead time. The SAFe methodology is a relatively new Agile framework and is suitable for large organizations. Since the knowledge regarding an Agile way of working is minimal at HCP, it was thought to be a too drastic change at this point. However, it could be beneficial for HCP to move towards a SAFe approach later in their Agile journey when the employees have more knowledge and understanding of the Agile way of working and when there are more empirical findings supporting the SAFe approach for physical product development. The Agile-Stage-Gate hybrid model would be an appropriate first step for HCP in their Agile journey.

When blending an Agile way of working into physical product development, modifications and adjustments must be made. HCP needs to adapt their processes and way of working to apply an Agile way of working to their current processes.

## **7.5 Implementation Plan**

This study has emphasized how important it is to follow an implementation plan to implement a change within an organization successfully. Creating urgency and emphasizing the "why" is important to start the transformation process. Having a change leader to lead and guide the change is essential. Creating a vision and getting everyone on board the change is crucial. The researchers recommend HCP to follow Kotter's eight steps to successfully transform the organization from the traditional product development to an Agile way of working.

HCP is recommended to educate their employees regarding the Agile way of working; this can include training and certifications. Educating the employees will improve the work environment and facilitate the transformation process by removing obstacles that may occur. To handle people-related issues, HCP could have a platform where people can address their concerns and get answers regarding their questions about the change. One way of monitoring the employees' feelings is by creating surveys. Communication and trust between the employees and the change leader are key in the transformation process.

One of the benchmarking companies explained the drawbacks of planning for increments of twelve weeks. The researchers, therefore, suggest that HCP sticks with having the eight weeks time frame since it has been shown to be effective. HCP should

share the improvement that they have experienced from applying incremental planning meetings to inspire and get the employees at HCP involved in the change. By sharing the success, it can make it easier for others at HCP to believe in the change and the Agile way of working.

Implementing an Agile way of working into an organization is a continuous improvement journey that will take time. Therefore, HCP must be patient with everyone involved in the transformation. HCP should not expect to see results immediately and change their focus to quick fixes since this transformation is a long-term commitment. The change will not be sustained within the company until it has become the norm and the employees have accepted the change.

## 8. Conclusion

In this chapter, the conclusion of the research will be presented. The two research questions that were introduced in chapter 1.2 will be summarized in a structured way. Next, the research method will be discussed. Lastly, the researchers will give suggestions on possible future work and discuss how the thesis contributes to research.

### 8.1 Addressing the Research Questions

The purpose of the research was to explore if an Agile way of working can reduce the product development lead time. The study was conducted to respond to the many changes in the construction industry due to the increase of software and electronics integrated into the products. Since the Agile methodology is typically used for software development, it is logical to investigate if an Agile way of working could reduce time to market in physical product development. By performing a qualitative study at HCP's NPD process, the researchers conclude that an Agile way of working could reduce the product development lead time in an organization characterized by traditional development processes. The researchers were also able to identify various challenges that might emerge when implementing an Agile way of working.

#### **RQ1: Can an Agile way of working reduce product development lead time in an organization characterized by traditional development processes?**

The literature supports the statement that an Agile way of working could reduce product development lead time if implemented efficiently. The nine elements in Agile-Scrum have illustrated to increase performance and reduce product development lead time. Scrum aims to reduce the volatile requirements, and by reducing the risks, the team can run the project at high speed. A similar situation has been seen at HCP when they involved the customer in the NPD process. This resulted in the team having higher confidence that they were developing a product that satisfied the customers' needs. The Agile-Stage-Gate hybrid model has shown substantial benefits in shorter product development lead time when it comes to software development and physical product development. Research has also shown that companies applying the Agile-Stage-Gate hybrid model experienced faster releases, higher quality, and improved customer focus. However, a limited number of studies show that the SAFe method reduces the product development lead time since it is a relatively new approach in NPD. The benchmarking companies are still in the process of transforming to an Agile way of working. Therefore, it is not possible to draw any conclusions from their implementation if an Agile way of working has reduced the time to market.

The purpose of the study was to investigate if the Agile methodology could reduce product development lead time. However, the research has shown that an Agile way of working can contribute beyond shortening the time to market. The researchers identified benefits of applying an Agile way of working in the form of improved flexibility, increased customer involvement and early feedback loops. From the benchmarking companies and literature, the researchers also established increased collaboration and knowledge sharing between team members, improved transparency, and the employees experienced more joy and motivation.

## **RQ2: What challenges may emerge when implementing an Agile way of working into an organization that is transforming its product development processes?**

Transforming from a traditional way of working to a more Agile way of working is a massive transition for a company. Therefore, there are several challenges and pitfalls to avoid to secure a successful transformation. One of the common pitfalls is not educating the employees enough regarding the new way of working, which leads to frustration and resistance towards the change. It is crucial to educate employees about their new way of working. Some of the literature emphasizes the people-related issues that can occur, which the benchmarking companies experienced as well. The benchmarking companies expressed how a change of this size created conflicts among the employees. The companies experienced that some of the employees had problems accepting the change. This is a normal reaction since it is common to be threatened by the unknown. In such circumstances, it is important to emphasize why the change is necessary, which is the first step in Kotter's eight steps. It is crucial for the momentum of the change that a large portion of the employees accepts the transition to secure successful implementation. However, there are different ways of dealing with people who resist the change. The benchmarking companies had different strategies for dealing with people resisting. One of them ignored the employees who did not accept the change, and another had discussions with the ones who had trouble accepting it. Despite dealing with the resisting people in different ways, the benchmarking companies followed an implementation plan, which facilitated the transition to an Agile way of working.

## **8.2 Reflection on the Research Method**

This research was conducted using a qualitative approach. It was considered essential to use qualitative data to receive new ideas into the topic. A case study was suggested to be the most appropriate research design since the study is performed at one company. Most of the interviews were conducted at HCP to capture the organization's challenges in their NPD process that negatively affect time to market. Some standard questions were included in all interviews regarding the difficulties in the NPD process and how it affected time to market. These questions formed the bases of the interview guides to ensure that the main purpose of the interviews was the same. However, the interview guides were adjusted for each interviewee and their role, to get the correct data needed to analyze the organization's challenges and how much knowledge was within the firm about an Agile way of working. The participants received the interview guideline one week in advance, making it possible to prepare answers to the questions.

The researchers conducted twenty-five internal interviews, which could be considered sufficient for a master thesis of this size and timeline. The supervisors at HCP suggested which people to interview. In the project's progress, additional employees that were thought to have interesting ideas on the subject were added to the interviewee list. The people interviewed were from various functions but not from all of the functions at HCP. Having interviewees from all the functions could have been beneficial to gain a broader perspective. However, the functions that were included in the study are more connected to the NPD process, which was the main topic to be researched. Therefore, the researchers do not think that would have changed the NPD process's main challenges and recommendations in regards to reducing time to market.

To be able to base the recommendations on more than theory, the researchers conducted three interviews at three different external companies to benchmark how their Agile

journey has been. This made it possible to analyze both the potential benefits and pitfalls of implementing a change of this size and get a real-life perspective of it. By not only basing the recommendations on theory, the researchers believe the improvement areas are more relevant and more favorable for HCP. However, the researchers only interviewed one participant from each benchmarking company. It could have strengthened the data, and the results, to interview more than one person at each benchmarking company. Due to time restrictions, it was not possible to interview more participants.

All the interviews were conducted via online meetings due to the COVID-19 outbreak. This could be considered a drawback since the interviews were not conducted face to face, and the human interaction was partially missing. However, it could have also made the participants feel more comfortable and secure since the interviewees were sitting alone. Most of the interviews were recorded, making it easier for the researchers to transcribe and analyze the data collected from the interviews. The researcher chose to conduct semi-structured interviews. It was considered the most suitable approach to focus on the right subject to make sure to receive the necessary data to answer the research questions. Furthermore, it gave the participant the option to answer the questions more openly.

The data for the theoretical framework was collected through Chalmers Library, Google Scholar, and articles from relevant courses that the researchers had attended. The literature search was done in a structured and efficient manner. However, it cannot be determined if all the relevant and existing literature was found on the topic. The data analysis was performed with an Affinity method which is beneficial in analyzing qualitative data.

### **8.3 Contribution and Future Work**

This study aims to contribute to research about if an Agile way of working can reduce product development lead time in an organization characterized by traditional development processes and what challenges may emerge when implementing an Agile way of working. The researchers addressed several NPD approaches and Agile methods, but the focus was on if these methods can reduce product development lead time. Since an Agile way of working is mainly associated with software development, the research emphasized whether an Agile way of working can reduce product development lead time in physical product development. HCP is producing physical products, and therefore, the research focused on physical product development and reducing time to market.

When transforming an organization's product development processes, many challenges may emerge. Therefore, it was beneficial to analyze what pitfalls to avoid when implementing an Agile way of working at HCP. Investigating the challenges is a critical factor from a change management perspective. Additionally, it can add to existing research on NPD processes since change management is sometimes neglected in NPD literature. Change management was seen as an important element in transforming organizations' NPD processes, and therefore the researchers wanted to address that subject.

The purpose of this study was to analyze if an Agile way of working could be a helpful approach to reduce product development lead time and what challenges may emerge;

the researchers have addressed that above. HCP is in their early steps in their Agile journey, and therefore, it is difficult to anticipate how many Agile teams the organization should have. Possible future work for HCP is to investigate:

- How many teams should HCP have?
- How many people should be on each team?
- How many projects can each team work on at a time?
- How would the teams work together for complex products?

These identified research areas would be beneficial for HCP to explore further to move towards an Agile way of working. By examining these questions, HCP would know what capabilities they have and what competencies are needed for the future.

There is limited research existing about the SAFe methodology and how that approach reduces lead time within physical product development. Future research on that topic is needed, and more empirical findings are required for physical product development. Also, more studies on how the Agile-Stage-Gate hybrid model reduces lead time and experience on applying that approach is a possible future work. This study could be used as a foundation for future research to determine if an Agile-Stage-Gate hybrid model can reduce lead time.

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# Appendix 1

## Interview Topic Guide - Project Manager and Project Coordinators

### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

### 3) Questions to understand the product development process

- Can you describe your most recent project?
  - Can you explain how the project was regarding time, cost, and quality?
- How many projects do you run at a time?
- How large is the project team?
- What data do you report at the steering meetings?
- How do you measure if you have fulfilled all the requirements to be able to move to the next stage?
- How do you make the decisions at each gate to move on to the next stage?
  - Who makes that decision?
- What sub-process in the NPD do you believe takes the most time?
- Is there something in the process that you would like to change that could possibly reduce time to market?
- Where in the process does the project usually face difficulties?
  - What causes these problems?

### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?

### 5) Close the interview

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time

## Appendix 2

### Interview Topic Guide - Product Management

#### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

#### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

#### 3) Questions to understand the customer involvement within the pre-study

- How do you collect the data from the market and users to be able to create the customer requirements for a specific product?
- Do you prioritize the requirements/features?
  - If so, how do you prioritize the requirements?
  - How do you know what requirements are the most important once?
- Can you describe the new set-up for the pre-study?
  - What benefits have you gained from that change?
  - Does the process of pre-study depend on the product or do they look the same?
    - For example, do the tools or data you use to capture the customers' needs differ depending on the product

#### 4) Questions to understand the customer involvement and the new product development process

- Can you describe your most recent project?
- How many projects are you involved in at a time?
- How do you measure if you have fulfilled all the customer requirements?
- Do you experience that the customer requirements change once it reaches the NPD?
  - In your opinion, how adapted is the process to these changes as of today?
- How do you involve the customer in the NPD?
- Is there frequent communication with the customer during the development of the product?
- What sub-process in the NPD do you believe takes the most time?
- Is there something in the process that you would like to change that could possibly reduce time to market?

**5) Questions regarding Agile:**

- What is your knowledge regarding Agile?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?

**6) Close the interview**

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

## Appendix 3

### Interview Topic Guide - Operations Director

#### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

#### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

#### 3) Questions to understand the current situation

- How many production plants does Husqvarna own?
- How do you make the “make or buy” decisions?
  - Who makes that decision?
- How do you choose the location for the production plant?
- How do you prioritize time, cost, and quality?
  - Is there an overall strategy for the company when it comes to time, cost, quality, and sustainability?
- How many projects are you involved in at a time?
- How large is the team?
- What activity takes a long time for your position?
- Is there something in the process that you would like to change that could possibly reduce the time?
- Can you describe the challenges that emerge when it comes to operations?

#### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?

#### 5) Close the interview

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

# Appendix 4

## Interview Topic Guide - Purchasing Director

### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

### 3) Questions to understand the current situation

- Can you describe the purchasing process?
- How do you make the “make or buy” decisions?
  - Who makes that decision?
- How do you choose a supplier?
- How do you prioritize time, cost, and quality?
  - Is there an overall strategy for the company when it comes to these factors?
- How many suppliers does Husqvarna have?
- Do you have many suppliers to choose from?
- Do you prioritize collaboration over cost?
- Do you try to establish a relationship with a supplier for the future?
- Do you have a close collaboration with your suppliers?
- How many projects are you involved in at a time?
- How large is the purchasing team?
- What process in purchasing takes a long time?
- Is there something in the process that you would like to change that could possibly reduce the time?
- Can you describe the challenges that emerge when it comes to purchasing?

### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?

### 5) Close the interview

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

# Appendix 5

## Interview Topic Guide – Chief Product Engineer

### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

### 3) Questions to understand the customer involvement and the new product development process

- How many projects are you involved in at a time?
- How large is your team?
- How do you measure if you have fulfilled all the customer requirements?
- Do you experience that the customer requirements change once it reaches the NPD?
  - In your opinion, how adapted is the process to these changes as of today?
- How do you involve the customer in the NPD?
  - Is there frequent communication with the customer during the development of the product?
- What sub-process in the NPD do you believe takes the most time?
- Is there something in the process that you would like to change that could possibly reduce time to market?
- Where in the process does the project usually face difficulties?
  - What causes these problems?
- How do you make decisions when it comes to the technical part of the product?

### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
  - Can you reflect on your experience using an agile way of working?
  - What are the benefits and drawbacks?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?
- Do you have any certifications/training regarding the agile way of working?
- Has agile improved your way of working?
  - In what areas?

- Do you think the agile way of working reduces lead time?
  - Have you experienced any reduction in lead time?
- What is your thought of applying the agile way of working within mechanical and hardware development?
  - How could that be applicable?
- Do you believe the agile way of working could be implemented within Husqvarna Construction Products and be beneficial?

**5) Close the interview**

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

# Appendix 6

## Interview Topic Guide - Design Engineer Mechanics

### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

### 3) Questions to understand the current situation

- Can you describe the design process?
- How many projects are you working on at a time?
- How large is the project team you work with?
- What process takes the longest time that involves design?
- Are there any time-thieves in the process?
  - What causes them?
- How adapted to changes is the process as of today?
- In your opinion how could the process be more adapted to changes?
- Is there something in the process that you would like to change that could possibly reduce the time?
- Who gives you the input for the customer requirements?
- Do you feel like you get the right knowledge from that person to be able to make a good design?
- How do you incorporate the customer requirements into a tangible design?
- Where in the process does the designing usually face difficulties?
  - What causes these problems?
- What resources does your team need?
  - Do you get it at the right time or do you have to wait for it?

### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?
- What are your thoughts on having design sprints?
  - How would that work?
  - How could it be applied?
  - Could that avoid redesigns too late in the process?
  - Do you believe that could reduce the overall lead time?

- Do you believe the agile way of working could be implemented within Husqvarna Construction Products and be beneficial?

**5) Close the interview**

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

# Appendix 7

## Interview Topic Guide - Test Manager

### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

### 3) Questions to understand the current situation

- Can you describe the testing process?
- How many projects are you working on at a time?
- How large is the project team you work with?
- What process takes the longest time that involves testing?
- Is there something in the process that you would like to change that could possibly reduce time?
- Where in the process does the testing usually face difficulties?
  - What causes these problems?
- What resources does your team need?
  - Do you get it at the right time or do you have to wait for it?
- Do you have the resources to test in parallel?
  - How would that be carried out?

### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?
- What are your thoughts on beginning testing prototypes?
  - How would that work?
  - How could it be applied?
  - What status would the prototype have to be in to be able to test it?
  - Do you believe that could reduce the overall lead time?
- Do you believe the agile way of working could be implemented within Husqvarna Construction Products and be beneficial?

**5) Close the interview**

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

## Appendix 8

### Interview Topic Guide - Software Manager and Software and Electronics Manager

#### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

#### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

#### 3) Questions to understand the current situation

- Can you describe your most recent project?
  - Can you explain how the project was regarding time, cost, and quality?
- How many projects are you working on at a time?
- How large is the project team you work with?
- In what sub-process do you get involved within a project?
- What sub-process in the NPD do you believe takes the most time?
- Is there something in the process that you would like to change that could possibly reduce time to market?
- Where in the process does the project usually face difficulties?
  - What causes these problems?

#### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
- Would you consider yourself working Agile or are you more Hybrid working between Agile and waterfall?
- Do you have any certifications/training regarding the agile way of working?
- Are you using any Agile practices now?
  - If yes, what practices or tools are you using?
  - How has it affected your way of working?
- Can you describe your way of working today?
  - How are you working with agile within the waterfall process?
- Has agile improved your way of working?
  - In what areas?
- Do you think the agile way of working reduces lead time?
  - Have you experienced any reduction in lead time?
- What is your thought of applying the agile way of working within mechanical and hardware development?
  - How could that be applicable?

- Do you believe the agile way of working could be implemented within Husqvarna Construction Products and be beneficial?

**5) Close the interview**

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

# Appendix 9

## Interview Topic Guide - R&D and Vice President

### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask for the interviewee's permission to record the interview.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

### 2) Opening questions:

- What is your role within the company?
- Can you describe your responsibilities?

### 3) Questions to understand the product development process

- How are you involved in the projects?
- How many projects are you involved in at a time? (rephrase)
- How do you make the decisions at each gate to move on to the next stage?
  - How do you evaluate if the project has fulfilled all the requirements to be able to move to the next stage?
  - Is it based on your gut feeling?
- How do you select which product to go forward with?
  - Do you consider the lead time?
- How do you know you are selecting a product that the customer wants?
  - What kind of products?
- What sub-process in the NPD do you believe takes the longest time, where is there most waste?
- Is there something in the process that you would like to change that could possibly reduce time to market?
- Can you describe the challenges that emerge in the NPD?
  - What causes these problems?
- In your opinion, how adapted is the process to changes as of today?

### 4) Questions regarding Agile:

- What is your knowledge regarding Agile?
  - Can you reflect on the agile way of working?
  - What are the benefits and drawbacks?
- Are you using any Agile practices now?
  - If yes, what practices or tools and how has it affected your way of working?
- Do you have any certifications/training regarding the agile way of working?
- Do you think the agile way of working reduces lead time?
  - Have you experienced any reduction in lead time?

- What is your thought of applying the agile way of working within mechanical and hardware development?
  - How could that be applicable?
- Where do you think the agile way of working would be most beneficial in the NPD?
- Do you believe the agile way of working could be implemented within Husqvarna Construction Products and be beneficial?

**5) Close the interview**

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

# Appendix 10

## Interview Topic Guide - Benchmarking

### 1) Introduction:

- Start by introducing us.
- Explain the topic of the research and the purpose of the interview.
- Ask the interviewee if we have permission to use their company's name in the thesis.
- Inform the interviewee that their identity will not be included in the study.
- Shortly introduce the interview agenda.

### 2) Opening questions:

- Can you describe your role within the company?
- Were you involved in the transformation process?
  - What were your responsibilities?

### 3) Questions before the Agile transformation:

- Why did you transform to an agile way of working?
  - What was the driving force for this change?
  - What wasn't working with the existing way of working?
- What was your knowledge regarding Agile before the transformation?
- Did you have any certifications/training regarding the agile way of working?
- Can you describe the transformation?
  - Who initiated the change? - Top-down or Bottom-up?
  - What went well?

### 4) Questions during the Agile transformation:

- How did the employees react during the change?
  - Had people trouble accepting the change?
  - If so, how did you deal with it?
- Did you follow an implementation plan?
- Who was responsible for implementing the change and monitoring it?
  - Did you use a change agent?
  - Was it internal or external (consultant)?

### 5) Questions after the Agile transformation:

- Can you describe your way of working today?
  - What Agile practice do you use today?
  - How has it affected your way of working?
- Did your mindset change once you started an agile way of working?
  - Did it improve your way of working?
  - In what areas?
- What consequences did you experience from the transition?
  - Positive?

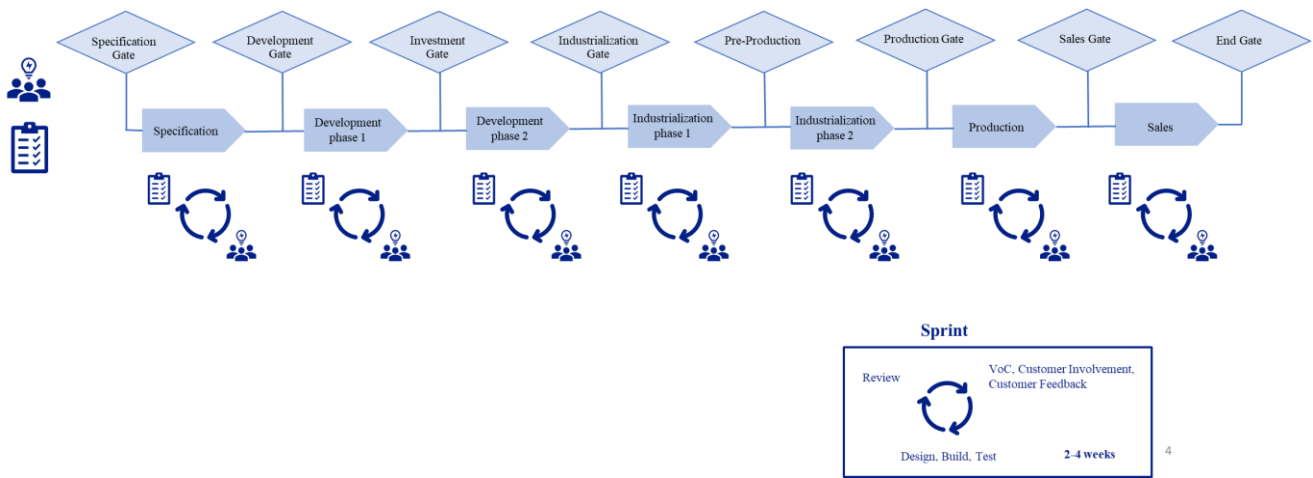
- Drawbacks?
- Have you experienced a reduction in lead time?
  - How does it reduce the lead time?
  - What is it in the working procedure that makes this possible?
- How adapted is the process to changes after the transformation?
- What were the challenges of applying the agile way of working within mechanical and hardware development?
  - How did you adapt the agile way of working to make it applicable for your development?
- If you had to do this transformation today, what would you have done differently?

#### **5) Close the interview**

- Ask the interviewee for permission to contact them for a follow-up interview, if needed.
- Thank the interviewee for his/her time.

# Appendix 11

## Agile-Stage-Gate Hybrid Model at HCP



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