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Improving the Product Elimination Process

A case study at Husqvarna Construction

Master's thesis in the Management and Economics of Innovation Programme

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SUMMARY

Shorter product life cycles and the faster development of new products have increased the frequency of product eliminations. However, product elimination tends to be neglected both in theory and in practice. Not paying the elimination process the necessary attention can result in unnecessary costs and process inefficiencies.

This study aims at further examining the area of product elimination, focusing on the area of the elimination of products that get replaced by a new product version. Hereby, the study focuses on the actual removal of the product from the product portfolio rather than the decision-making process of which product to eliminate. The company Husqvarna Construction is used as a single case company and builds the empirical research basis. By investigating the current product elimination process of the company and creating an improved version of the process, the study adds on the body of knowledge regarding the product elimination process and aims at providing Husqvarna Construction with a more cost-efficient and transparent process

The empirical study and analysis revealed improvement potentials of the current product elimination process at the company. Those were divided into several categories: communication, frozen order volumes, system updates, overstock, tools/equipment, spare parts management and measurements. To improve the current elimination process, a new process was created, taking into account the identified improvement potentials. The most important improvements include: more coordination between the New Product Development process and the elimination process, increase of cross-functional communication, standardized definition of responsibilities and increased attention to early overstock and spare parts reduction.

The study concludes that an improved elimination process that has standardized activities and responsibilities can help Husqvarna Construction to reduce costs and increase the process transparency. Additionally, the study raises awareness of the topic of product elimination, connects it to process management and highlights the importance of focusing more attention on the topic of product elimination.

Keywords: Product elimination, Product development, Process management, Process improvement

Table of Contents

ABBREVIATIONS

NPD = New Product Development

PCP = Product Creation Process

S&OP = Sales and Operations Planning

R&D = Research and Development

PMO = Project Management Office

EoP = End of Production

EoS = End of Sales

SSG = Sales Start Gate

BPMN = Business Process Management Notation

MP = Manufacturing Pilot

EP = Engineering Pilot

BOM = Bill of Material

1 Introduction

For most companies the constant development of new products is essential to maintain competitiveness and to secure future success (Grosbois, Kumar, & Kumar, 2010). With an increasing number of new products being developed, old products are getting replaced more often and need to be removed from the product portfolio. However, compared to the recognition that new product development has received throughout academia and management, product elimination has received rather sporadic attention (Muir & Reynolds, 2011). That stands in contrast with the findings of scholars that firms that apply a "structured product elimination program have advantages in improving sales, reducing the level of inventories, freeing up executive time for more profitable products and making important scarce resources, such as raw materials, available for more promising projects" (Hise, 1975). Additionally, research has shown that an improperly handled elimination process can have a severe impact on economic and psychological costs to the customer and can thereby reduce customer satisfaction and loyalty (Homburg, Fürst, & Prigge, 2009).

The case company, Husqvarna Construction, believes that the product elimination process currently in place has the potential to be improved in order to guarantee smooth product generation transition, increase its transparency, optimize its inventory and reduce the resulting scrap costs. In order to do so, this thesis aims to first understand how the company currently conducts product elimination, to then analyze existing improvement potential and to finally come up with an improved version of the process.

1.1 The Husqvarna Group

The thesis is conducted through a case study on the product elimination process of the company Husqvarna Group, one of the leading companies offering forest and garden products and services, as well as services and tools for the construction and stone industries (Husqvarna Group, 2020a). Founded in 1689, the firm's product portfolio evolved throughout the ages, from rifles, to sewing machines and motorcycles, and most recently to outdoor power products (Husqvnara Group, 2020b)

The Husqvarna Group is composed of three main divisions: Husqvarna Construction, Gardena, and Husqvarna Division. The thesis is conducted in the Husqvarna Construction division. While Gardena and Husqvarna Division manufacture garden and forest products (Husqvarna Group, 2020a), Husqvarna Construction produces machinery and diamond tools for the construction and stone industries, such as Power Cutters, Drill Motors, and Remote Demolition robots (Husqvarna Group, 2020c).

1.2 Organizational Structure

To be able to understand the process and which stakeholders are involved in the process, the structure of the organization that operates the process need to be understood. Generally, Husqvarna Construction is divided into six categories: Concrete Sawing & Drilling – Equipment, Concrete Sawing & Drilling – Tools, Concrete Surfaces & Floors, Light Demolition, Stone and Aftermarket & Connectivity. Besides the divisions, Husqvarna Construction is running its global Sales & Service operations (Fig. 1).

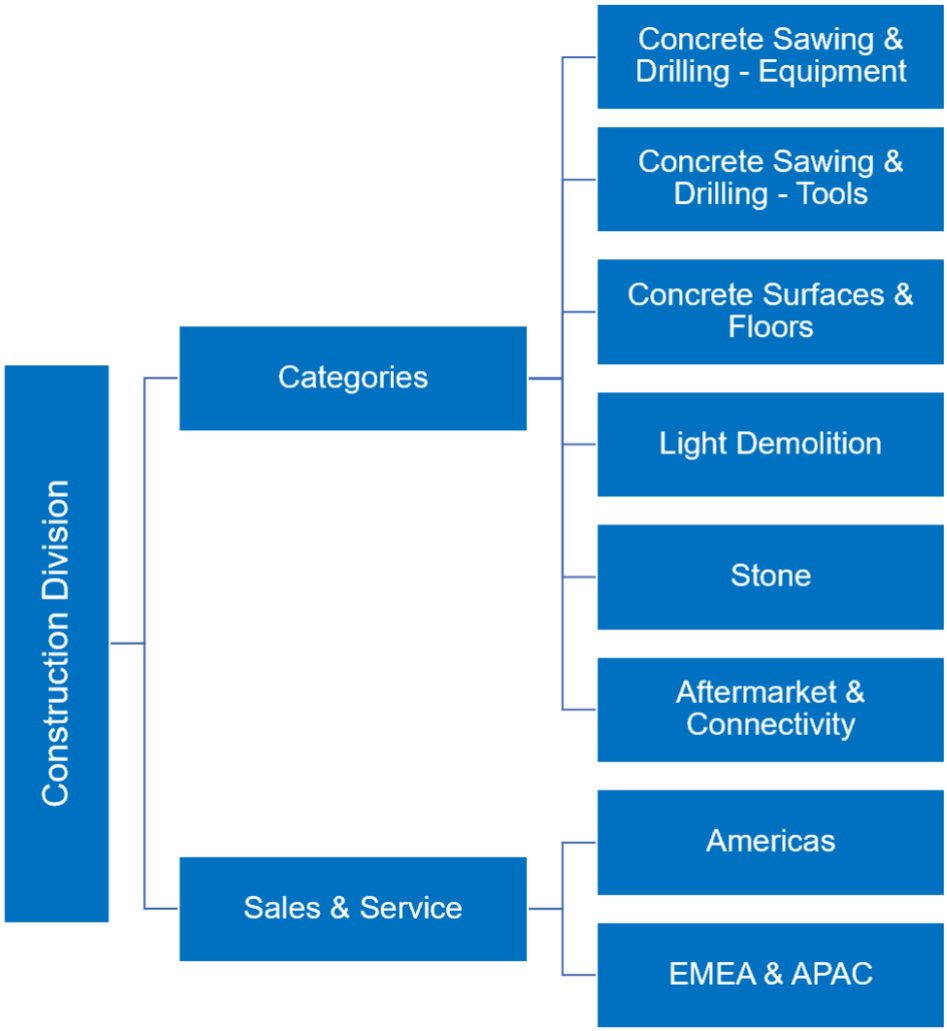

Figure 1: Organizational Structure of Husqvarna Construction

Since this thesis focuses on Concrete Sawing & Drilling – Equipment, only the organizational structure of that category will be looked at in depth. The category is divided into eight functional silos (Fig. 2). The functions Product Management Power Cutters & Drill Motors, Product Management Floor, Wall, Wire, Tile & Masonry Saw, R&D and Operations are consisting of sub-functions.

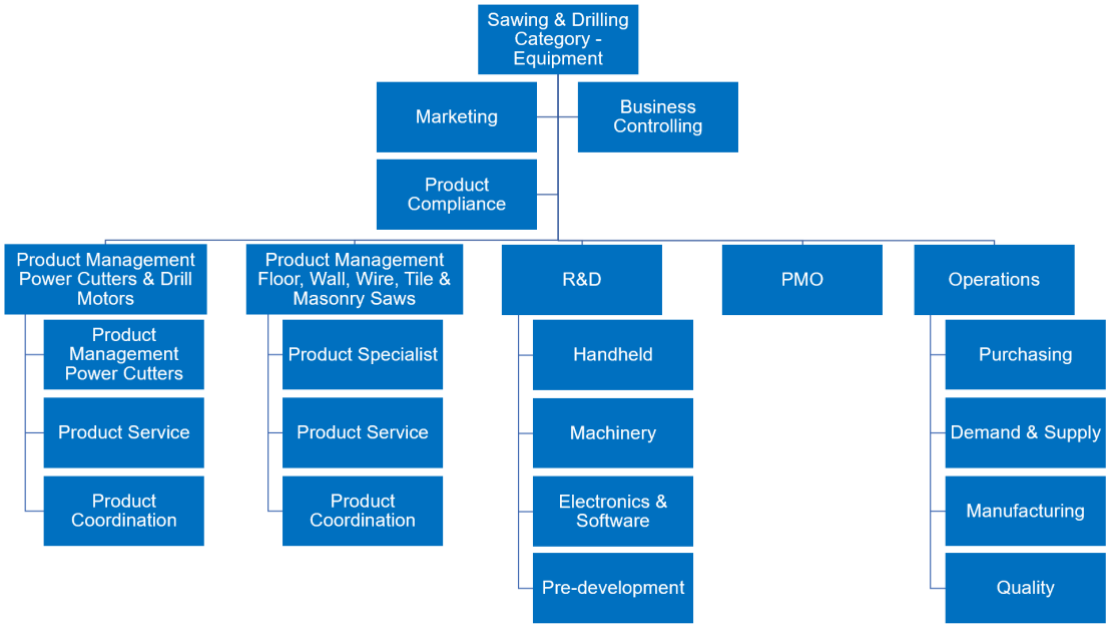

Figure 2: Organizational Structure Sawing & Drilling Equipment Category

All functions within the Sawing & Drilling – Equipment Category except for Manufacturing are located in Jonsered, Sweden. Manufacturing operations of the category are taking place in Huskvarna (Sweden), Åsbro (Sweden), Olathe (US) and Xiamen (China).

1.3 Product Elimination at Husqvarna Construction

As part of the product life cycle, the decline phase constitutes the last step that every single product undertakes at Husqvarna, and product elimination is the action taken to terminate a products' life cycle by eliminating it from Husqvarna Construction's product portfolio.

At the moment, Husqvarna Construction is not using a standardized elimination process. Currently, the division undertakes these processes as projects and since no standards or guidelines on how to execute the projects exist, the elimination process is executed differently every time. Therefore, the division has the need to analyze how the elimination projects are run, to formalize the process, and to improve it.

Product eliminations at Husqvarna Construction are usually run when a new product will replace an incumbent one, or when it is decided to completely delete a product from the portfolio without replacing it. Therefore, elimination within the division can be run as part of two different workstreams: as connected to the New Product Development (NPD) process of the replacement product, or as part of the annual Elimination Cycle. Elimination as part of the NPD process is undertaken in case of a replacement of the incumbent product, characterized by substantial investments and modifications, supported by a formal variation in the name (e.g. from K760 to K770). The Elimination Cycle is

performed on a seasonal basis, following a specific time plan. This workstream aims at keeping the product portfolio ‘healthy’, eliminating all of those parts and products that are not profitable anymore or have not been moving in the last years and thereby increase the stock level. Depending on the workstream, the product elimination process undergoes a set of activities. Those activities, however, are not as well defined yet as the company wishes.

1.4 Aim

The aim of the thesis project is to formalize and improve the product elimination process at Husqvarna Construction in order to optimize for smooth product generation transition, lowest possible scrap cost and maximal transparency. The project focuses on the elimination process of products that get replaced as part of an NPD process and consecutively need to be eliminated from the product portfolio. To identify weaknesses in the current process and create an improved version, internal stakeholders who are involved in product elimination are interviewed. The elimination processes of the other divisions at Husqvarna Group will be benchmarked against each other in order to unveil the weaknesses of the current elimination process at Husqvarna Construction.

The intended outcome of the project is a mapping of the replacement-related product elimination process under consideration of the feedback gathered from stakeholders. It will contain a preferred timeline, guidelines, a process description and training material on how to implement the process.

The thesis aims at answering the following Research Questions:

- *What are the improvement potentials with the replacement-related product elimination process at Husqvarna Construction?*

- *How can the replacement-related product elimination process at Husqvarna Construction be improved?*

1.5 Limitations

The thesis project focuses on the product removal part of the product elimination process. The first part of the product elimination process in which the decision is made on what products to eliminate has to be understood and taken into account but is not to be improved. Moreover, testing the improved elimination process is not in the scope of the thesis.
Considering the two different workstreams elimination can be part of, namely NPD and the Elimination Cycle, the thesis only works with upgrading the elimination processes connected to the NPD process.

The thesis focuses on the product elimination process of the Husqvarna Construction division only. Within this division, the categories (1) Concrete Sawing & Drilling, (2) Concrete Light Demolition and (3) Concrete Surfaces & Floor are to be prioritized.

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2 Theoretical Framework

2.1 Theoretical Framework Guidelines

In order to accumulate the knowledge on product elimination and process management that can be found in existing literature, an extensive literature review was conducted. Literature reviews are essential for: (a) identifying what has been written on a subject or topic; (b) determining the extent to which a specific research area reveals any interpretable trends or patterns; (c) aggregating empirical findings related to a narrow research question to support evidence-based practice; (d) generating new frameworks and theories; and (e) identifying topics or questions requiring more investigation (Paré, Trudel, Jaana, & Kitsiou, 2015).

As stated by Brewerton & Millward, the literature review should be approached systematically, starting with a broad perspective, narrowing down as the focus of interest becomes clearer (Brewerton & Millward, 2001). As a starting point, the themes 'product elimination' and 'process management' were used. Those themes were used for more general research and consecutively narrowed down to more specific key words. Using the Citation pearl growing technique (Rowley & Slack, 2004), documents found were screened for suitable terms to retrieve other documents and to identify additional key words. Key words used within the areas of product elimination, process management, and NPD are listed in figure 3.

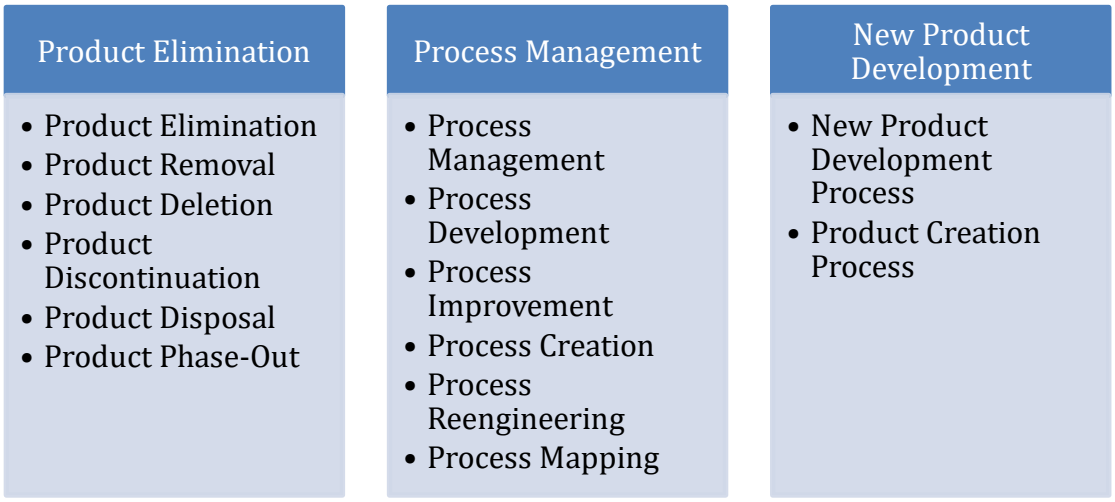

Fig. 3 Themes and Key words

For each key word, the first 200 results found in the Online Chalmers Library and less extensively in Google Scholar were screened and results with titles that seemed relevant were opened and their abstract was read. The results found and used in this thesis included academic journals, books and master theses.

2.2 Product Elimination Process

This section provides a brief summary of the product elimination process, research conducted on it over time and the different stages within the product elimination process.

Product Elimination is described as the process of reducing product portfolio complexity by deleting products from the portfolio (Zhu, Shar, & Sarkis, 2018). Scholars have highlighted that firms employing a structured product elimination program have advantages in improving sales, reducing the level of inventories, freeing up executive time for more profitable products and making important and scarce resources, such as raw materials, available for more promising projects (Hise, 1975). Avlonitis, Hart, & Tzokas (2000) highlight that research demonstrated that deletion or replacement of a product presents managerial challenges to the firm of equal importance to the creation or adoption of a new product. However, if not planned and implemented properly, it can also bring disadvantages to firms, for example losing certain market segments and revenues, customer dissatisfaction, poorer operational activities or loss of competitiveness (Zhu, Shar, & Sarkis, 2018).

2.2.1 The Elements of Product Elimination

Scholars have divided the elimination process in different stages. Banville & Pletcher (1974) define a three-stage procedure including (1) the designation of candidates for evaluation, (2) the evaluation of decision-making and (3) the implementation of the decision. More recently, Avlonitis, Hart, & Tzokas (2000) and Avlonitis (1983) suggest a four-stage model (Figure 4). The first stage, the **recognition of the product to be deleted**, is performed by examining the performance of the product against previously agreed criteria that signal the initiation of the product deletion process. Those criteria can be market share, market growth rate, profit margin or other relevant factors. Depending on a variety of situational, product-specific, and contextual environmental conditions, the recognition phase can be more or less extensive. The second stage is the **analysis and revitalization**. In this stage, alternative courses of corrective actions are considered by management to restore the viability of a product, e.g. by improving the quality, increasing the price and developing or entering new markets. Situational factors may have an influence on this stage too. For example, situational characteristics such as time pressure and perceptions of the problem as a threat or opportunity do have an influence on the analysis stage of the elimination process. The third stage is the **evaluation and decision formulation.** At this stage, management has to decide whether it is in the best interest of the company to delete or retain the product. That decision can be based on a number of factors, such as the effect of the deletion on the recovery of overheads, on ‘full-line’ policy and capacity utilization, as well as more strategic factors, such as not giving away important market share to competitors. The fourth stage, the **implementation** stage, includes the actual removal of the product from the portfolio. Depending on the removal strategy, different methods such as ‘drop immediately’, ‘milk’ or ‘sell out’ can be applied.

There are variables that influence the different stages of product deletion. Those variables include (1) situational and product-specific variables and (2) organizational and environmental conditions. Situational variables describe the nature of the 'problem' situation or precipitating circumstances that evoked the product deletion. These circumstances can affect the way in which a deletion proceeds. However, detail on how process dimensions such as length or content are affected is rare. Product-related variables are related to (1) the importance of the involved products regarding the firm's resources allocated to the product and its share on the firm's sales, (2) the way the product was removed, e.g. whether it was replaced by another one or completely dropped, and (3) the strategic considerations underlying the decision to remove the product, e.g. whether the removal was part of the overall product/market strategy of the firm.

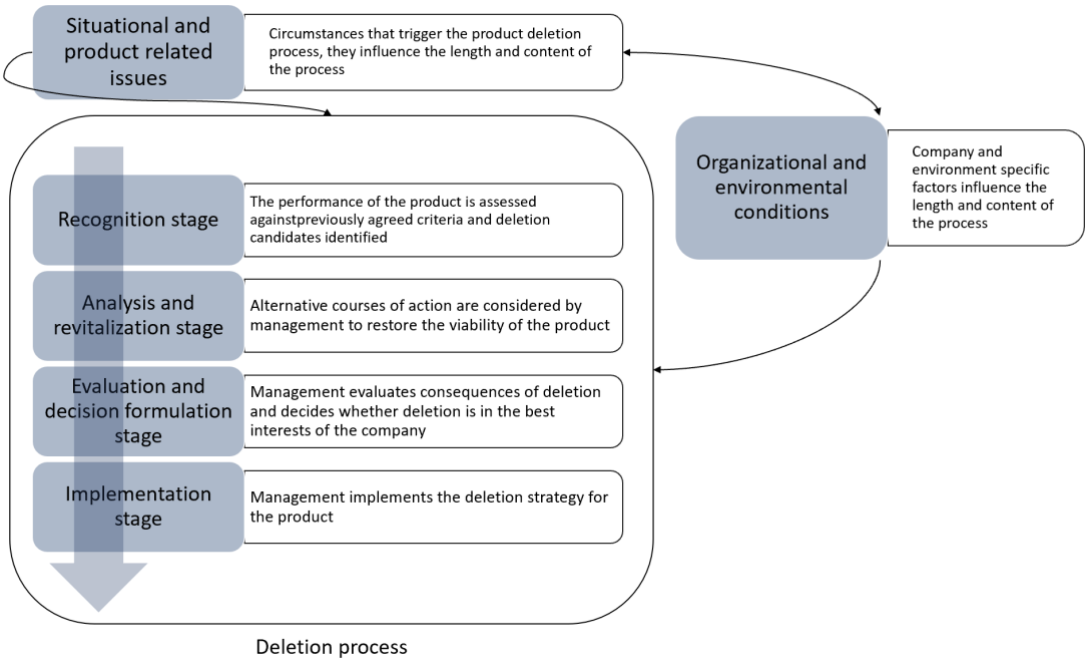

Figure 4: Elements of product elimination (Avlonitis, 1983)

The second set of variables that can affect product elimination are company-specific and market environment variables (organizational and environmental conditions). They relate to the overall context within which the product deletion decision is taken and implemented. Research has shown that variables such as size of the firm, operations technology, customer dependence, market competition and technological change, among others, moderate the product deletion process of the firm. To date, however, the extent to which the product- and situation-specific variables might interact with organizational and environmental conditions during the product deletion process has been largely neglected.

2.2.2 Terminologies related to product elimination

It is important to clearly distinguish between the different terminologies that are connected to elimination. Taking the four-step model of Avlonitis (1983) into

account, it can be said that the whole four-step process is to be called ‘product elimination process’. The first three stages of the model will be summarized as the ‘decision-making process’ in this study, whereas the implementation phase is called ‘removal process’.

2.2.3 The Decision-Making Process

The decision-making process consists of recognition of the product to be eliminated, the analysis of the product to find out why the products does not meet objectives, and the evaluation and decision formulation (Avlonitis et al., 2000; Avlonitis, 1983). The reason why companies decide to eliminate products can have different reasons. Zhu, Shar, & Sarkis (2018) state that the most common factors that influence that decision are the products impact on available resources, the products financial performance, or the firm’s strategy. Further, Banville & Pletcher (1974)state four main reasons under which a product may be evaluated for possible elimination, those being (1) declining demand on an industry-wide basis, (2) coercion by external forces, (3) incompatibility of distribution, and (4) poor product performance despite a generally viable market. Additionally, they developed a statistical model that permits a systematic analysis of candidates for elimination and concluded that the variables “unit sales, sales trend, dollar sales, profitability, gross margin trend and costs compared to competition” are most important to consider when identifying weak products.

Avlonitis et al. (2000) mentions seven “clusters of reasons why to eliminate a product”. Those include:

1. **“Product Deletions due to Coercion from External Forces”**. Products in this group are typically eliminated due to uncontrollable stimuli or outside forces, such as government policies, regulations, third party decisions or change in exchange rates.

2. **“Product Deletions that are Part of a Variety Reduction Policy”**. This group contains products that are eliminated as part of a strategic managerial decision to reduce the product variety offered. Those products mostly have been around for a long time and reached the decline stage of their lifecycle. This scenario is particularly common in companies which operate in highly competitive markets, employ large batch and mass production technologies and experience a low degree of technological change.

3. **“Deletion of Slow-Moving Products”**. Products in this group are low-volume, slow-moving products that show poor sales performance and don’t create any long-term benefit for the company anymore.

4. **“Product Deletions Aiming to Releasing Resources”**. These products get eliminated in order to make way for new strategic

developments. If products are mature and use a large portion of a company's resources, but don't generate enough sales volume to justify the heavy investments, they are considered for elimination. This scenario prevails in companies that have a low degree of technological change and low customer dependence. That reduces the magnitude of negative customer reactions towards the product's elimination.

5. **"Deletions of Unsuccessful New Products"**. This group consists of products that are not living up to profitability expectations and measures. Additionally, taking corrective actions to improve the products sales and market growth rate don't show positive results. This scenario is common for companies with high customer dependence, making elimination necessary when customers don't buy a product.

6. **"The Early Replacement of a Problematic Product"**. These products are new to the marketplace but show unexpected technical problems or poor quality. Since those quality problems may affect the company's image, management may decide to eliminate the product or to replace it with a new version, if no corrective actions are possible.

7. **"Replacement of "Bread and Butter Products"**. Products in this group are well established and account for a large portion of the company's sales turnover and resources but face competitive pressure and declining market and sales. Those products mostly get 'milked' and later replaced with a new and improved product. This scenario prevails in large companies that produce large batches and apply mass production technologies but are also exposed to technological change and intensive market competition.

When companies make the decision to eliminate a product, it is also important to consider that those decisions are often heavily influenced by the environment within which the company operates, and the role played by the product within that environment. Therefore, the decision-making process is dynamic and political and cannot always clearly to related to one of the seven clusters of why to eliminate a product. (Avlonitis, 1983)

2.2.4 The Product Removal Process

The product removal process is the stage in which the product gets phased out of the product portfolio and thereby constitutes the last step within the product elimination process. Dependent on the reason behind the elimination and the environment the elimination takes place in, different strategies can be applied when removing the product from the portfolio. Generally, product removal can

be applied in two different situations. Firstly, when a product gets eliminated from the product portfolio and does not get replaced by another product. The second alternative is when a product gets eliminated from the portfolio and gets replaced by a new or improved version. Whereas option one is relatively easy to execute, there are several different ways of running a product removal when replacing a product. Those different strategies will be introduced here.

2.2.4.1 Product Replacement

Saunders & Jobber (1994) introduce different product replacement strategies that can be used by companies depending on their competitive environments. They claim that it is important to synchronize product launch and product deletion. That often happens related to seasonal patterns within the market, such as before trade shows or pre-high season. Generally, Saunders & Jobber (1994) distinguish between four replacement strategies: (1) re-launch with moderate changes, (2) repositioning where little changed products are marketed differently, (3) inconspicuous substitution where a much-changed product is clothed in the market position of its predecessor, (4) conspicuous substitution where the products and its market change substantially. Moreover, when implementing product replacement there are different tools that can be used (Table 1).

Low season switch	A product gets replaced during low season, when the company has more time to focus on the replacement
High season launch	A product gets replaced before the high season, to have the new product on the market at that time
Roll-in/roll-out	Replacement of a product in one country after another
Downgrading	The old product gets downgraded and sold for a cheaper price
Splitting	Old products get sold through other platforms that the replacing new product
Sell-off	Resources on hand for the old product get sold off in order to speed up the replacement
Specials	Old products are sold with extras or benefits
Fudging	A product gets renewed continuously

Table 1: Phasing tools

In order to find out which replacement strategy to apply, Katana, Eriksson, Hilletofth, & Eriksson (2017) reveal a number of important decisions to consider. Firstly, the production volumes of the new and the old product as well as of the spare parts during rollover have to be considered. In second place, production capacity during rollover plays an important role when making the decision. Additionally, the timing of when the new product is needed and the inventory levels of the new and old products during rollover and the future demand of old products after the rollover are essential aspects when managing the trade-off between introducing and eliminating.

2.2.4.2 Solo Rollover vs. Dual Rollover strategy

When replacing a product, product introduction and elimination must be considered simultaneously. This process is called product rollover (Lim & Tang, 2006). Generally, there are two potential rollover strategies, solo rollover and dual rollover. Solo rollover implies that the old product is already sold out when the new product is introduced. Dual rollover aims at providing both the current and the new product simultaneously for a while, in order to phase out the new product after phasing in the new one (Katana et al., 2017). When executed flawlessly, solo rollover comes along with lower rollover costs but is also associated with a high risk of profit losses and customer dissatisfaction when the old product is taken out of production too early before the new product is launched (Lim & Tang, 2006). Additionally, solo rollover carries the risk of having an excess of obsolete products and inventory carrying costs if production of the old product continues for too long or if the production of the new products starts too early (Hill & Sawaya, 2004). It is therefore preferred when market risk is low (Lim & Tang, 2006). Moreover, to reduce the beforementioned risks, it is essential to plan the product rollover in advance. Product rollover planning can be carried out in the early changes in the new product development process (Katana et al., 2017). Dual rollover is associated with other risks, such as cannibalisation when the old product simply takes over the demand for the new one or when customers delay their purchase of the old product in hope of buying it at a lower price when stocks of the old product are cleared (Katana et al., 2017).

2.3 New Product Development

When eliminating a product from the portfolio and simultaneously replacing it by a new version, the product elimination process is closely tied to the NPD process of the replacing product. Therefore, it is important to understand how NPD processes are build up and how they function.

New Product Development Process

New product development is the process of bringing an original product idea to the market. The majority of manufacturing companies, around 70-85% of companies in the U.S., use a Stage-Gate model when developing a new product (Cooper & Sommer, 2016). A Stage-Gate new product development model is a conceptual and operational model that can be used as a guide for a new product's process, from ideas and through all steps until it becomes a new product (Cooper, 2001). It gives an overview of the new product process and can be used as a help to direct, manage and accelerate the product development process and thereby improve process effectiveness and efficiency.

The Stage-Gate process typically consists of a certain amount of stages and gates between the stages. Before a new stage can be entered, the requirements of the previous gate have to be fulfilled and approved. All stages

are cross-functional, meaning that there are no stages where solely one department is involved, because critical activities during a development process may fall into several different functional areas (Cooper, 1998). Cooper (2001) defines a model with five stages and five gates. The model can be divided into discovery, scoping, building the business case, development, testing and validation and launch (see figure 5).

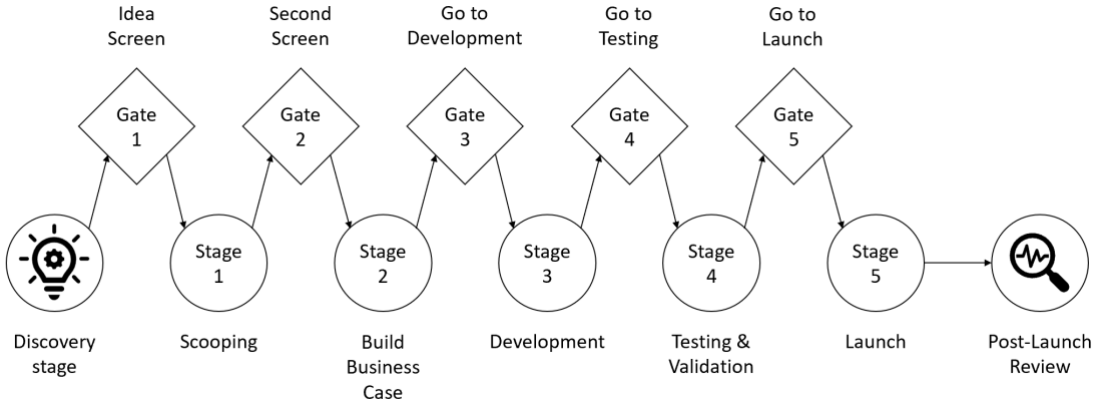

Figure 5: Example of the Stage-Gate process (Cooper, 2001)

- Discovery Stage

In the discovery stage ideas are generated and opportunities are discovered. This activity is critical since it activates the whole process. It is important for a company to generate many ideas in order to have sufficient input to start the process. Due to the importance of creating new ideas, many companies have formalized processes for that stage, which could include activities such as working with users to identify needs and opportunities in the marketplace. (Cooper, 2001)

- Gate 1: Idea Screen

At the first gate, the decision whether the idea is worth to be investigated and followed up on is taken. Criteria that is evaluated includes technical feasibility, alignment with the company's strategy and the project's market opportunities. Often checklists are used at this gate to identify if an idea fulfills all criteria needed to proceed to the next stage. (Cooper, 2001)

- Stage 1: Scoping

The first stage is a quick a relatively inexpensive investigation of generated ideas to see if the project is feasible. The purpose of the stage is to estimate the size, potential and acceptance on the affected market but to also create a preliminary technical assessment of the project. Mostly marketing and a technical group are involved in this stage. (Cooper, 2001)

- Gate 2: Second Screen

At the second gate the project is re-evaluated with a stricter consideration to the criteria. Also, information collected during the first stage that resulted in

additional criteria is considered at this point. As at gate 1, often a checklist is used to evaluate if all criteria are met. (Cooper, 2001)

- Stage 2: Build Business Case

Building the Business Case is the first stage in the Stage-Gate process where the project becomes an actual business case, which needs to be done before any heavy spending. The stage consists of a detailed project investigation considering both market and technical aspects. The result of the stage is a detailed product and project description with an additional project plan. The business case stage requires considerably more effort than the previous stages and also input from a variety of sources. Therefore, the stage needs to be handled by a cross-functional team. (Cooper, 1998; Cooper 2001)

- Gate 3: Go to Development:

The third gate requires a final review of the project before allowing financial commitments to be carried out. The financial analysis at this stage is of high importance since spending is substantial after this stage. The business case review evaluates the activities conducted during stage two and if the project is approved to continue the time plan for development, operations and marketing are revised and approved. In addition, a cross-functional team should be designated at this gate. (Cooper, 2001)

- Stage 3: Development

During the development stage iterative technical development is run, together with a market analysis and customer feedback analysis. A financial analysis for the project is updated with accurate information and production and commercialization design are developed. The output of the development stage is a lab-tested prototype of the product.

- Gate 4: Go to Testing

The fourth gate controls the development of the project by reviewing the project in terms of expected outcome and progress considering both technical and financial aspects. The product is checked in order to fulfil the specifications regarding time-plan for development, marketing and operations set up at gate 3.

- Stage 4: Testing and Validation

During the testing and validation stage the project is validated by testing the new products quality and performance, as well as its market acceptance and financial aspects. Pilot production can be performed in order to find bugs in the production. The tests and validations are the basis for a revised financial analysis. (Cooper, 2001)

- Gate 5: Go to Launch

If the product is approved at the fifth gate, it will be implemented as a new product. This gate focuses on the results of the tests run in the testing and

validation stage. Criteria for passing the gate is positive financial prospects in terms of both return and revenue.

- Stage 6: Launch

In the final stage, the project gets implemented, meaning that that full production is started, and a marketing plan is implemented.

- Post Implementation Review

The last activity of the Stage-Gate process evaluates the implemented product and its performance. Conclusions for future lessons are to be drawn.

2.4 Business Process Management

Most companies are consisting of organizational units, which are called functional areas. Each of these functional areas are specialized on a particular kind of work, such as Human Resources, Finance, Production or Purchasing (Damij & Damij, 2014). The problem of working with functional areas is that often creates boundaries between the functions that end up being silos of isolation and hinder the communication and coordination between the different areas (Rummler & Brache, 1991). Business processes are meant to be of cross-functional nature instead of separate activities (Damij & Damij, 2014). Figure 6 illustrates how a business process works cross-functionally.

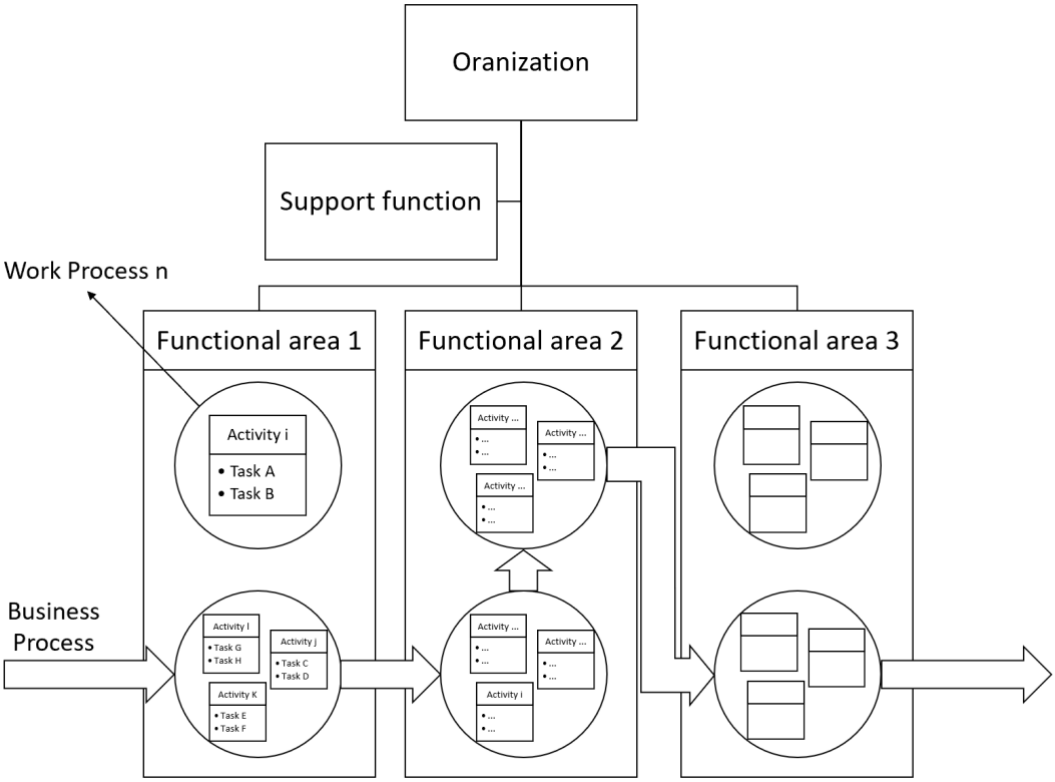

Figure 6: A business process in the vertical organization (Damij & Damij, 2014)

The research and advisory firm Gartner describe a business process as “the discipline of managing processes (rather than tasks) as the means for improving business performance outcomes and operational agility.” They further describe that business processes span organizational boundaries and link together people, information flows, systems and other assets to create and deliver value to customer and constituents (Gartner, n.d.). Becker, Kugeler, & Rosemann (2003) define a business process as a process that is directed by the business objectives of a company and by the business environment of the firm. The authors further say that the essential features of a business process are its interfaces to the different business partners of the company. Thereby it stays in contrast to working in functional silos (Becker et al., 2003).

Scholars have discussed the effects of integrating functional parts of the company on organizational performance. (Wheelwhright, 1985) found that cross-functional integration increases organizational performance among manufacturing companies in the U.S. and Pagell (2004) discussed the empirical evidence that strengthens the importance of cross-functional integration. Ittner & Larcker (1997) said that empirical research has vastly supported the existance of relationships between process design, customer satisfaction and profitability. Khan (2004) adds that additional benefits of implementing business process management are increased speed, process integrity and organizational agility.

2.5 Business Process Improvement

Business process improvement is about turning the existing process into a better one without erasing the fundamentals. A process can be improved by lowering cost or increase quality and performance of the process (Damij & Damij, 2014).

Business process improvement can be divided into several phases: documenting, analysis, implementation and management (Figure 7; Harrington, Esseling, & van Nimwegen, 1997). In the documentation phase, information about the process is collected so that it can be described and visualized. To collect that information interviews or surveys are recommended. In order to avoid misunderstandings and mistakes, the gathered information should be presented to the ones involved in the process to gain their approval of its validity. In the analysis phase the collected information is synthesized in order to draw conclusions and identify where improvement potential exists. Employees who are involved within the process need to be heard out since their experience may contribute to finding opportunities of improvement. In the implementation phase the design of the improved process is created and communicated to the different departments involved. Together with employees or managers modifications can be made to the process to make it fit the real situation better. Once it has been agreed on a final version of the process, an implementation team can be allocated to replace the old process. The management phase consists of keeping the process up to date and adapt it to environmental changes. Incremental improvement should be part of the

process owner's work. As a last step, the process undergoes constant screening for continuous improvement. (Harrington et al., 1997).

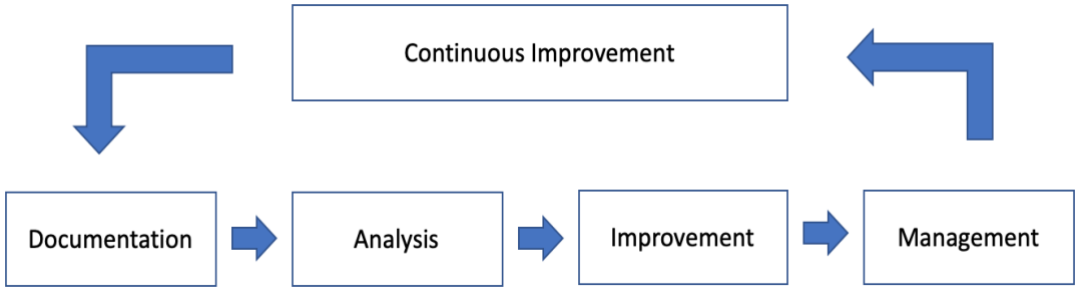

Figure 7: The business process improvement model (Harrington et al., 1997)

In addition to the business improvement model, Becker et al. (2003) claim that the first step of improving a process is to "as-is model" the process by giving an overview of the current situation and thereby creating knowledge of the current status that can be used to develop a migration strategy for the new process. The model builds the basis for identifying shortcomings and potential improvements. The first step of "as-is modelling" is to determine which level of detail and which techniques are to be used to create the models. Hereby, detailed as-is modelling can only be justified if it is expected that a large part of the as-is model can be transferred to the to-be model. In a second step, relevant sources of information will be identified. Lastly, those sources will be exploited and the as-is model will be created.

Ponsignon, Maull, & Smart (2013) created an archetype of improvement principles which can be applied when redesigning operational processes. Depending on the requirements of the organization and the environment it operates in different process improvement principles can be chosen. The four distinctive operational archetypes encapsulate different configurations of process design attributes. The four archetypes are displayed in Figure 8. The first archetype is employee-focused, meaning that employees are given decision-making authority to help them build ownership and accountability and to facilitate good morale in the workplace. The second archetype focuses on costs, suggesting that the organization relies on specialists who have limited decision-making authority to ensure that employees comply with work procedures and operational guidelines. This suggests that respondents operate in a rigid, relatively inflexible and focused work environment. As many tasks as possible are to be automated. A third archetype is a hybrid between the two first archetypes. It proposes that employees are empowered, and customer contact is maintained, but at the same time an increasing number of tasks is automated and control tasks are kept in house. A fourth archetype that is introduced suggests a workstream-focused approach, meaning that the operational system is adapted each time depending on the specific situation.

Generally, no matter what archetype is applied, Ponsignon et al. (2013) suggest that when improving a process, it is important to remove non-value adding tasks and to re-sequence tasks whenever applicable. Thereby both efficiency and customer service can be improved. That reasonates with Reijners & Liam Mansar (2005) associate the removal of non-value adding tasks with

improvements in process speed and efficiency, as well as with elimination of waste.

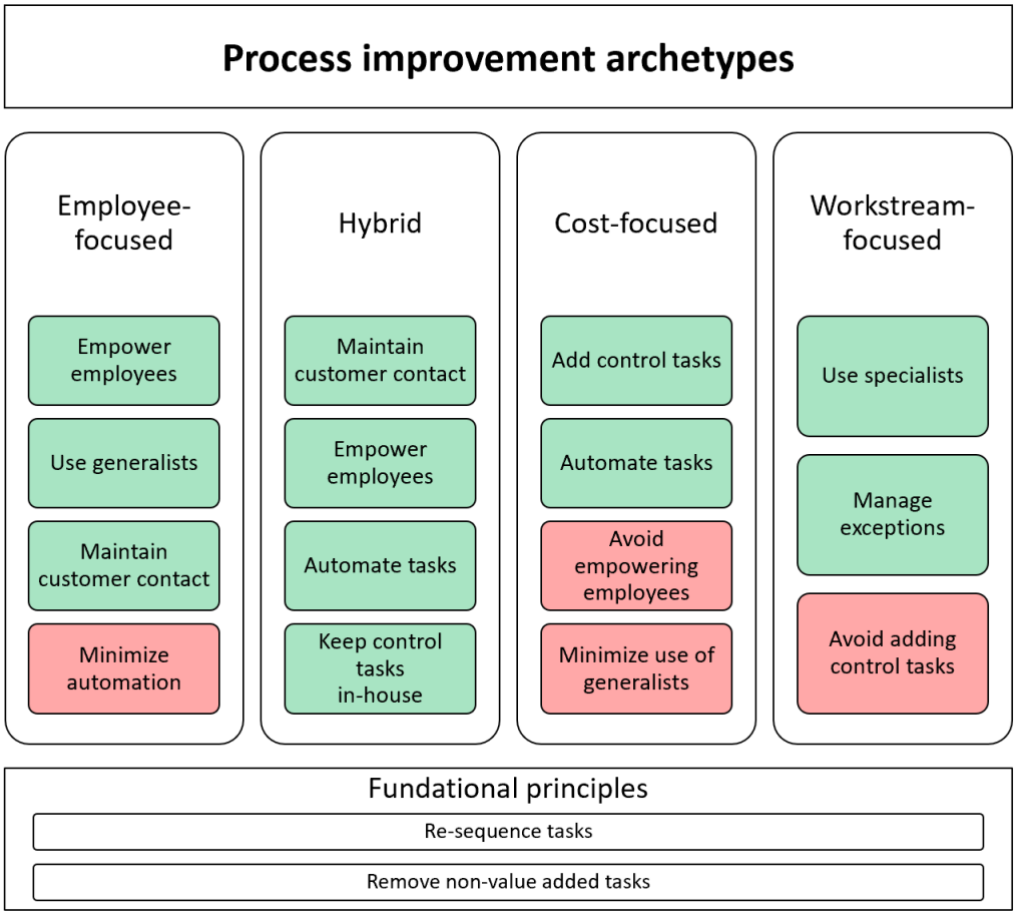

Fig. 8: Typologies of process improvement (Ponsignon et al. 2013)

3 Methodology

This chapter introduces general research methodologies, gives an overview over different research methods and explains why certain methodologies and methods have been chosen to be applied in this thesis. The purpose of this chapter is to ensure that the scientific approach adopted fits the context of the project and strengthens its' validity and reliability.

3.1 Research Approach

The research approach lays the foundation for the research project and is therefore of high importance. Thus, it is essential to understand the differences between the philosophies underlying scientific research.

3.1.1 Positivism and Constructionism

Easterby-Smith, Thorpe, & Jackson (2015) state that understanding the philosophical issues that underlie the research design helps to clarify what kind of evidence is required, how it can be gathered and interpreted and recognize which designs will work and which will not. They distinguish between the contrasting views of positivism and social constructionism. Positivism is defined as the idea that "the social world exists externally, and that its' properties can be measured through objective methods rather than being inferred subjectively through sensation, reflection or intuition". It says that the researcher either has to start with a hypothesis and then seek data to confirm or disconfirm, or that the researcher poses several hypotheses and seeks data that will allow the selection of the correct one. In contrast to that, social constructionism is defined as the idea of rather determining aspects of the social reality by people instead of using objective and external facts to do so. Here, the researcher starts from the assumption that verifiable observations are potentially subject to very different interpretations, and that the job should be to illuminate different truths and to establish how various claims for truth and reality become constructed in everyday life (Esterby-Smith et al., 2015). For the purpose of this thesis, a constructionist approach was chosen since the product elimination process at Husqvarna Construction is improved based on empirics, meaning that observations are made, and interviews are conducted. Also, different stakeholders of the process can have different opinions about how the process works or should work and thereby perceive different realities. To fully understand the process and its improvement potential, if therefore is important to be aware of how different people perceive it.

3.1.2 Qualitative and Quantitative Research

The underlying philosophical concepts of positivism and constructionism can be connected to research approaches applied when using those concepts. The

constructionism position with its aims of invention and sense-making understanding through discourse and experiences entails a qualitative research approach, whereas a positivism position that aims at discovery and verification or falsification through experiments goes along with a quantitative research approach (Easterby-Smith et al., 2015). Alongside with the constructionist approach used in this thesis, a qualitative research approach will be used, since sense-making understanding and discourse around how the process should work is essential.

Defining the two approaches, it can be said that qualitative data is “pieces of information gathered in a non-numeric form” (Easterby-Smith et al., 2015). It typically includes what research participants have done or said and is created in an interactive, interpretative process, emphasizing an explorative nature and involving open-ended rather than pre-coded questions and responses. The aim of qualitative research is to understand the respondent’s perspective, what their viewpoint is and why they hold this viewpoint. Methods and tools used in qualitative research include for example interviews, transcripts, written notes, observations and images, videos or documents. Quantitative data is data compiled in numbers. To give it value and legitimacy it is typically collected in high quantity and statistical methods are used to identify patterns in the numerical data and make sense of those patterns. It is for example collected through surveys or taken from databases and analyzed as secondary data. (Easterby-Smith et al., 2015)

3.1.3 Deductive and Inductive Research Approach

A deductive research approach involves moving from the general to the particular, meaning that a theory is taken, and hypotheses are derived from that theory by testing the hypotheses and revising the theory (Locke, 2007). A strength of using a deductive approach is that the research will be less affected by subjective perceptions of the persons performing it (Patel & Davidson, 2003). However, the approach also has a lack of adapting and addressing to the empirical circumstances encountered, what can lead to missing new discoveries (Polsa, 2013). An inductive research approach, on the other hand, entails moving from the particular to the general, as when empirical observations are made and those observations are used to form concepts and theories (Locke, 2007). Since the goal of this thesis is to improve Husqvarna Construction’s elimination process, it is important that the process is well adjusted to the empirical circumstances at the company. Therefore, mostly an inductive approach is used, transforming the observations made into a fitting concept for an improved process. Whereas the inductive approach is not as limited by theories as the deductive one, it has the disadvantage that results can’t always be generalized, since they are based on a certain empirical situation (Patel & Davidson, 2003).

3.2 Research Design

Before collecting data, a research method has to be defined to explain and justify how to gather data. In order to obtain internal consistency among the

elements of the research, and thereby achieve methodological fit, the method must be aligned with research question, prior work and theoretical contribution (Edmondson & McManus, 2007). In the following section different research methods will be introduced and it will be explained why certain methods were chosen for this study.

3.2.1 Research Methods

When conducting research, there are different methods that can be applied, such as experimental methods, quasi-experimental methods, survey research methods, narrative methods, case method, and grounded theory (Easterby-Smith et. al., 2015).

- The aim of **experimental methods**, as part of the positivist approach, is to validate a hypothesis through experiments in which the researcher has complete control over the variables. An experiment consists of an experimental group, in which an independent variable is manipulated, and a controlled group, which operates without manipulation. One of the groups' characteristics is that they are randomly assigned. Results are then obtained by comparison of the dependent variables between the two different groups. (Abbott & McKinney, 2013)
- **Quasi-experimental methods** are similar to the experimental methods. However, they differ in the group generation process, since in quasi-experimental methods the population is assigned to groups following specified criteria instead of being randomly assigned. Therefore, the results will also be based on these criteria. (Cook, Campbell, & Snadish, 2002)
- **Surveys** are composed by a series of written questions answered in interviews or questionnaires (Abbott and McKinney, 2012). Wording, sample's representation of the population and questions' order are relevant for these methods (Abbott and McKinney, 2012). As the other methods previously described, surveys belong to a positivist and quantitative approach. Based on the aim of the research, there are different types of surveys available, such as factual, inferential and exploratory surveys (Easterby-Smith et. al., 2015).
- **Narrative methods** belong to the constructionist ideology. These methods provide information about behaviors and organizational life through observations and interviews in form of stories regarding specific events (Easterby-Smith et. al., 2015).
- A **case study** is a research that aims at discerning the dynamics within a specific event and its context (Eisenhardt, 1989). Case studies commonly use a combination of data originated from interviews, observations, and archives (Eisenhardt, 1989). They can be designed with constructionist or positivist perspective (Easterby-Smith et. al., 2015), collecting and combining either or both quantitative and qualitative data (Eisenhardt, 1989).

3.2.2 Case Study Research

The most suitable method identified for this research is the case study. According to Yin (1981) “the classic case study consists of an in-depth inquiry into a specific and complex phenomenon (the ‘case’), set within its real-world context”. Moreover, Yin (1981) states that peculiar characteristics of case studies are their aims of explaining and investigating contemporary events in real-life context, especially when the interactions between the phenomenon and the context are not clear. Since the point of interest in this study is to get an in-depth understanding of the elimination process, the stakeholders involved in it and how they interact, a case study provides the right framework. Additionally, case studies mostly take place within a single organization and is conducted through direct observation and/or personal contacts (Easterby-Smit et. al., 2015).

Considering the other research methods introduced, experimental methods and quasi-experimental methods rely on complete control over the variables (Abbott and McKinney, 2012). Considering the context and purpose of this study, it would not be feasible to implement these methods.

Surveys seek answers from a large number of people (Easterby-Smith et. al., 2015). Moreover, flexibility and qualitative data will be needed in order for the research to be useful. Therefore, the use of surveys alone will not be sufficient to provide enough and relevant data.
Narrative methods, providing only qualitative data relatively to behaviors and relations, do not fit the research purpose.

3.3 Data Collection

The data collection methods and the techniques used for collecting data will be investigated in this section. Data was collected mostly through qualitative interviews, but in addition to that also archival record reviews in the company database were used.

3.3.1 Qualitative Interviews

Qualitative interviews are directed conversations evolving around questions and answers about a certain topic (Lofland & Lofland, 1984). By elucidating subjectively lived experiences and viewpoints, interviews provide opportunities for mutual discovery, understanding, reflection and explanation (Tracy, 2013). For the purpose of this thesis, interviews with stakeholders involved in the product elimination process at Husqvarna Construction, as well as with stakeholders involved in the elimination process at Gardena and Husqvarna Division were the main source for empirical data regarding the process.

3.3.1.1 Interviewee Selection

The initial selection of interviewees was done based on input from the company supervisor. After having conducted first interviews, more interviewees were picked following experiences from the conducted interviews and from input given by the interviewees. Additionally, as the research moved forward, interviews were booked based on empirical gaps identified during data compilation. Table 2 lists the interviewees by function.

Function	Number of interviewees
Project Management	3
Product Management + Service Management	3
Manufacturing	5
S&OP	3
Sourcing	3
Spare Part Management	3
R&D	2
Master Data Management	1
Controlling	1
Process Management at other Divisions	3
Division Management	1

Table 2: Interviewees categorized by function.

Since the product elimination process involves a variety of functions it was of high priority to target people within each function contributing to product elimination. It was also of high importance to interview numerous representatives with similar responsibility from the functions that have a large contribution to the elimination process. This was emphasized to avoid personal opinions to be understood as company procedures. The complete list and dates of the interviews conducted can be found in the appendix (Appendix 1).

3.3.1.2 Interview Structure

When performing qualitative interviews, the interviewer follows a guideline that can be of various extent depending on the type of interview that is performed. The interview structure can be divided into three types: structured, unstructured and semi-structured (Alvesson, 2011).

- **Structured interviews** are strictly controlled by an interview protocol that states what questions are asked and in what order. Throughout the interview, the defined protocol should be followed closely without exploring other areas of interest. The advantage of the structure is easy quantification of data. However, it also constrains interviewees from thinking outside the given framework and does not allow for discussion. (Alvesson, 2011; Brewerton & Millward, 2001)

- **Unstructured interviews** mostly only consist of some bullet points of topics of interest that the interviewer wants to cover. There is no defined interview protocol and the interviewees are free to partly define and develop relevant topics. The structure gives deep insights from each individual but makes it difficult to compare and quantify the collected. data (Alvesson, 2011)
- **Semi-structured interviews** are a blend of structured and unstructured interviews. The interviewer has a list of rather specific topics that have to be covered but the interviewee has large freedom in how to answer the questions. If topics of interest occur during the interview, they can be discussed even when not being part of the topic list. (Byrman & Bellmann, 2003)

When performing qualitative interviews, typically unstructured or semi-structured techniques are used. For the given purpose those techniques were considered as well-fitting since the aim of the interviews was to develop an understanding of the respondent's task within the product elimination process and to get a feeling what works well and what does not work well for them. For interviews early in the research process, unstructured interviews were conducted in order to get a broad understanding for the process and to get a feeling for what topics are important when working with product elimination. Later, once a good overview over the stakeholders and their tasks existed, semi-structured interviews with a more detailed topic guide were used to investigate more specific topics. However, the questions were not formulated too narrowly, so that interviewees still had the opportunity to come up with issues that were missed when writing the interview guide.

3.3.1.3 Interview Size

It can be distinguished between using a single interviewee or a group of interviewees. Group interviews can be used to conduct discussion-based interviews or to encourage brainstorming (Alvesson, 2011).

For the purpose of this study, mostly interviews with single interviewees were held. That had the advantage of being able to focus in depth on the work and the opinions of the person interviewed. In a few cases group interviews were used. That included the interviews with the divisions Gardena and Husqvarna division, as well as one meeting with several members of the project management team, where interviewing more than one person at the same time gave a better and more holistic overview of the elimination process run in those divisions.

3.3.1.4 Interview Communication Media

There are several forms of communication media, including telephone, mail and face-to-face. When performing in-depth interviews, face-to-face is the favorable

form. Remote interviewing, such as telephone or mail, offers more flexibility and interviewees feel less committed. However, they lack the immediate contextualization, depth and non-verbal communication. (Easterby et al., 2015)

Most of the interviews were conducted face-to-face on Husqvarna Construction sites in Jonsered, Huskvarna and Åsbro. Stakeholders located in China were interviewed using a video interview. Also, some follow-up meetings with stakeholders that had been interviewed before were held using video conference tools.

3.3.1.5 Interview Category

Alvesson (2011) describes that the interview design has to be adapted depending on what "category of people" is interviewed. That can be of relevance when interviewing people within different managerial or hierarchical levels. It is suggested that at the higher level of management the problem has to be tackled in a broader sense to find potential sources to the problem, whereas once more specificity has been achieved the questions to the lower level managers can be adapted.

In this study, interviews with stakeholders from different managerial levels were conducted. When having interviews with higher levels, the topics discussed focused less on the operational level of product elimination, and more on the strategic decisions behind it. For example, interviews with the director of purchasing as well as with the purchasers of the factories in Huskvarna and Åsbro were conducted. The questions asked to the director were of broader nature and focused more on general purchasing strategies, whereas the factory purchasers were asked questions regarding operational aspects.

3.3.1.6 Interview Topic Guide

The topic guide or interview protocol is a piece of material that guides the interviewer through the interview process with beforehand determined guidelines (Easterby-Smith et al., 2015).

When preparing a topic guide, it is important to reflect on how potential respondents might understand and feel about certain questions in order to ensure that questions relate to the world and identity of the respondent. Abstract theoretical concepts and scholarly talk should be avoided. Furthermore, it is important to promote open-ended answers and allow for reflection on an experience and certain pieces of information. (Easterby-Smith et al., 2015)

Topic guides should be roughly organized into at least three sections: opening questions, questions around a number of key topics and closing questions. However, the detailed content of the topic guide should be subject of change

and be revised depending on the position of the interviewee and based on information gathered in previous interviews that can be used in following interviews (Alvesson, 2011).

A topic guide used for interviews conducted in this study can be found in the appendix (Appendix 1). Generally, each topic guide consisted of a short introduction, that aimed at “breaking the ice” and then consisted of the three sections opening questions, questions about the interviewee’s role in the product elimination process and closing questions. The opening questions aimed at understanding what general tasks the interviewee handled as part of her/his job and what other stakeholders the interviewee works with. The core part of the interviews consisted of questions about what tasks the interviewee is executing as part of the product elimination process. Those questions were adjusted to the role of the interviewee and updated when new knowledge and insights were gained. The closing section allowed feedback of the interviewee what they think works well or does not work well in the elimination process currently and left space for further comments or remarks. Finally, the interviewee was asked to follow-up if necessary.

3.3.2 Archival research

When executing a case study, it may be relevant to consider archival records. Archival records include corporate reports, statistical and financial databases, public use files, service records and organizational records (Easterby-Smith et al., 2015; Yin R., 2014)

When conducting archival research, it is important to consider what the original purpose of the documentation used is. A publicly commercial flyer might not give the same picture of a company as internal documentation does. In addition, it is important to focus on data that is relevant to answer the research question (Yin, 2014).

For the purpose of this thesis, Husqvarna Construction granted access to the internal platform ‘How We Work’, that compiles internal documentation of all processes run in the Husqvarna Group. In order to understand current processes and prepare for the interviews, the platform was screened, and relevant documents were read. In addition to that, some interviewees provided documents that helped understand their work or the role they play in the elimination process. Lastly, external and internal documents about Husqvarna Construction were read to get a better understanding of the organization as a whole.

3.4 Conducting the thesis

During the initial phase of the project a Gantt chart planning activities and milestones throughout the research time was developed. Thereby it was easy

to keep track of the achieved progress and to ensure that activities happen on time. As major milestones, the chart contained activities such as literature research, interviews and analysis (Fig. 9). Time buffers were scheduled in order to keep flexibility towards uncertainties. Based on changes within the initial schedule and additional input, the chart was adjusted several times throughout the thesis.

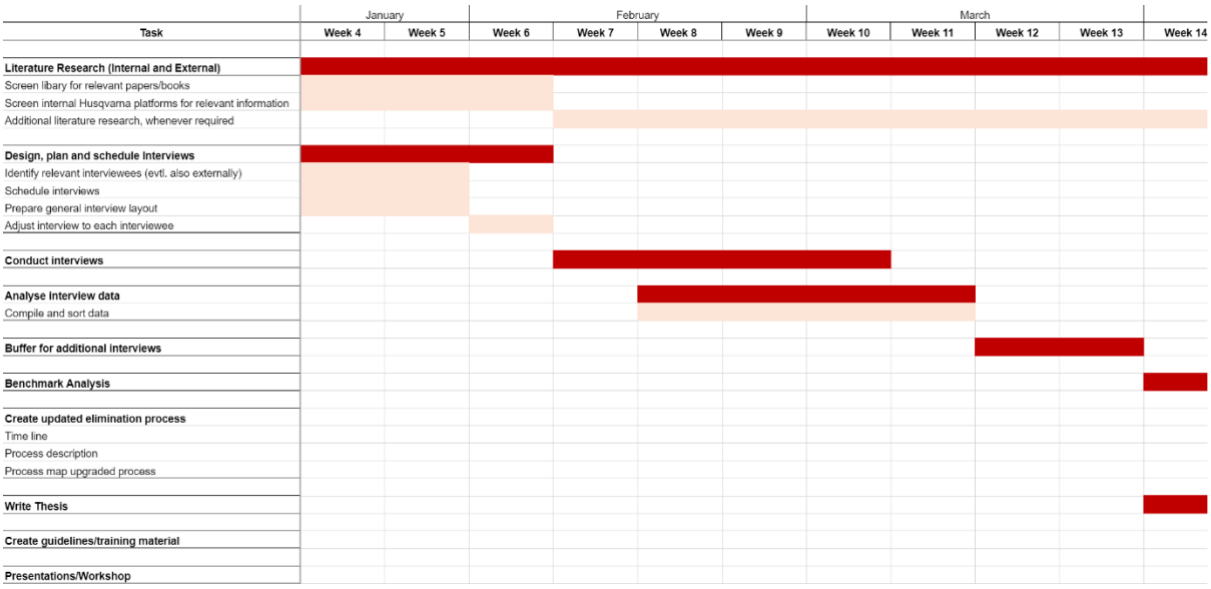

Fig. 9, First rough timeline.

3.5 Data Analysis

In order to comprehend the qualitative data collected, to develop links between information, and to draw conclusions, data was analysed (Easterby-Smith et al., 2015). This section introduces the techniques that have been used to draw conclusions.

3.5.1 Logic models and business process mapping

In order to create a good understanding of the existing elimination process at Husqvarna Construction, business process mapping, which is considered a specific type of logic model, was used. “Logic models are words or pictorial depictions of real-life events/processes that depict graphically the underlying assumptions or bases upon which the undertaking of one activity is expected to lead to the occurrence of another activity or event” (Millar, Simeone, & Carnevale, 2001). They represent reality and causal relationships in order to reveal the basic logic at the base of the event or process considered (Millar et al., 2001).

Logic models were used for different aims, such as (1) understanding what to do to achieve a specific goal, (2) evaluating the likelihood of occurrence of

specific events, (3) identifying critical factors impacting on a specific result (Fig. 10), (4) understanding relationships within an organization, (5) identifying core processes, (6) analyzing different strategies, and (7) addressing different interests on a common goal (Millar et al., 2001).

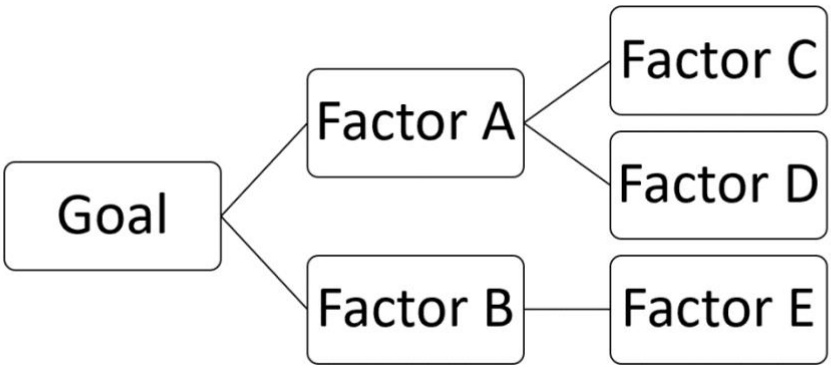

Fig. 10. Example of a logic model.

The logic model used to visualize the current elimination process is business process mapping. “A business process is a network of connected activities and buffers with well-defined boundaries and precedence relationships, which utilize resources to transform inputs into outputs for the purpose of satisfying customer requirements” (Damij & Damij, 2014).

Every activity performed in the process is characterized by a series of parameters, namely 1) inputs, which allow the activity to be performed, 2) events, that initiate the execution of an activity, 3) business rules, which define how the activity have to be conducted and its conditions, 4) resources, which are required to execute the activity, 5) time, to measure the performance of an activity, and lastly 7) outputs, the results of the activities (Damij & Damij, 2014). Consequently, in order to better understand the process itself and the opportunities for improvements, it was decided to draw a business process map, relying on the data provided by the internal Husqvarna database and the interviews.

2.5.1.1 Business Process Management Notation (BPMN)

The business process was mapped using the Business Process Management Notation (BPMN). It is a modelling technique based on a flowchart diagram and models processes by using different process modelling categories and groups of elements (Damij & Damij, 2014).

BPMN uses three categories when modelling: orchestration, choreography, and collaboration. The former is related to representing a process within a defined business entity (e.g. a firm, a division, customer, etc.), identified as pool, within which the flow is represented. Choreography depicts the interactions between different business entities. Graphically, these interactions are represented as flows between different pools. Collaboration is a

combination of the other two, therefore representing two or more pools and their interactions. (Damij & Damij, 2014)

When modelling following BPMN, the elements that can exploited belong to four main categories: flow objects, such as activities and gateways, connecting objects, such as association and message flow, swim lanes, which are part of the pool dedicated to one actor within it, and artefacts, such as data objects and text annotation. Some of the main elements will be described here. While activities represent a task or group of tasks carried out within the process, gateways are elements used to redirect the flow within the process by verifying specific conditions. Events occurs during the process, triggering, delaying, interrupting or ending activities. Even if their specifications differ from case to case, three main categories are identified: starting events, which trigger the process, intermediate events, which highlight an occurring situation, and ending events, which highlight the conclusion of a path in the process. An example of different elements is shown in Fig. 11. (Damij & Damij, 2014)

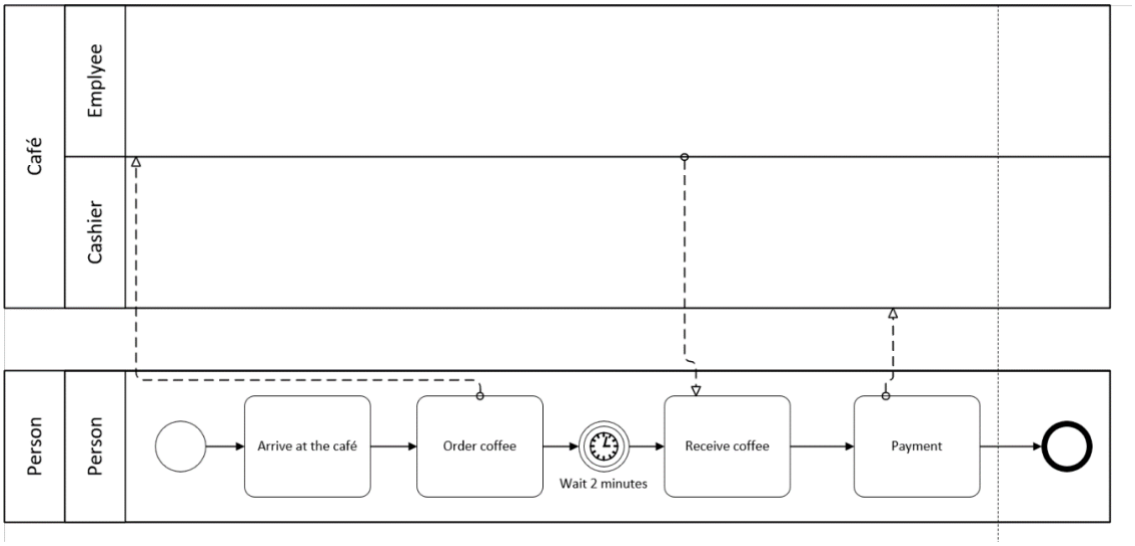

Fig 11. Example of a process - Purchasing a coffee at a café.

3.5.2 Content analysis

Content analysis is a qualitative technique used to make sense of the collected data. There are different approaches towards content analysis, for example conventional or quantitative content analysis. In the former, categories based on a shared theme emerge from the data (Hsieh & Shannon, 2005). The latter is used to generate numerical values from the data gathered (Brewerton & Millward, 2001).

3.5.2.1 Conventional content analysis

“Conventional content analysis is generally used with a study design whose aim is to describe a phenomenon” (Hsieh & Shannon, 2005). With this method, categories and insights stem from interviews. After the data collection, researchers have to obtain the idea of the general picture by going through the data multiple time. Then, codes can be derived from concepts or thoughts

developed. Consequently, codes can be grouped and categorized, based on their relations (Hsieh & Shannon, 2005).
This type of analysis was used to organize reoccurring improvement suggestions or issues regarding the currently used process. Similar issues or suggestions were highlighted and coded and afterwards clustered in a comprehensive category (e.g. code: actor X require information Y earlier → cluster: communication).

3.5.2.2 Quantitative content analysis

Quantitative content analysis is used to obtain quantitative data, in this case from the qualitative data generated from the conventional content analysis. In this kind of sense, it is rather a 'translation' tool which provides data that can be statistically analysed. Therefore, it is not the last step of the general analytical process (Brewerton & Millward, 2001). Quantitative content analysis is composed by two stages: the former requires the selection of the data to be analysed. The latter is constituted by the identification of the units of analysis, and then a quantification of the material through them (Brewerton & Millward, 2001). In the research, four main units of quantification have been identified: (1) frequency of appearance, (2) relevance of the instance, (3) connections with the literature and (4) probability of improvement. Each improvement suggestion was rated on a 1-3 scale for each unit of analysis. The total score for each improvement suggestion was calculated to then prioritize.

3.6 Validity & Reliability

To ensure the quality of any empirical research, validity and reliability need to be proven. It is distinguished between construct validity, internal validity, external validity and reliability (Yin, 2014).

3.6.1 Construct Validity

Construct validity can be achieved by identifying and establishing correct operational measures for the studied concepts. This can be done by using multiple sources of evidence, also referred to as triangulation (Yin, 2014). In order to ensure construct validity, this research uses different methods of data collection, such as archival research and quantitative interviews.

3.6.2 Internal Validity

Internal validity concerns if the investigator succeeds to explain the causalities between different events and if all possible causalities are found and stated. To strengthen internal validity, it is important to use appropriate analysis methods and conduct a thorough investigation. This study aims to achieve high internal validity by using different analysis methods, such as logic models and content analysis.

3.6.3 External Validity

External Validity concerns the generalizability of the study outside the immediate studied area (Yin, 2014). Since this research consists of a single-case study, it is difficult to determine whether the theory applies to similar situation and developing a generalizable theory can be challenging. However, this research study aims to provide a clear, step by step description of how the given situation is analyzed in order to provide a general insight into the field of study.

3.6.4 Reliability

The reliability of a research study measures if the same study can be replicated by another researcher and lead to the same outcome. For qualitative studies it is mostly difficult to achieve high reliability since the social setting greatly impacts the outcome and is more or less impossible to replicate (Yin, 2014). Aiming at a maximum amount of reliability, this research study is making use of extensive documentation, such as interview protocols, case study protocols and study protocols.

4 Empirical Data

This chapter summarizes the data gathered during the empirical case study and therefore equals the “documentation phase” in Harrington’s Business Process Improvement Model (Harrington et al., 1997). Chapter 4.2 is based on information and documents screened during the archival research, whereas chapter 4.3 contains the information gotten throughout the interviews with the stakeholders. The chapter begins with an introduction to the empirical study, followed by an explanation of the organization’s current product elimination process and a description of the existing NPD process.

4.1 Introduction and Guideline to the Empirical Study

The purpose of the empirical study is to create an understanding of what the product elimination process at Husqvarna Construction currently looks like and to identify improvement potential that can be used to improve the existing process. Additionally, processes that stand in relation to the elimination process are examined. Those include the PCP and the NPD process. Understanding those processes is important, since the product elimination stands in direct relation with those processes.

The interviews were designed to first get a description of what the product elimination process looks like at Husqvarna Construction. All interviews contributed towards understanding one specific part of the process, complementing each other and creating a holistic process overview after having conducted all interviews. In order to link the activities of the different stakeholders together during each interview, the input, the performed activities and the output of the stakeholder as part of the elimination process was identified. Based on the input and output from different stakeholders, activities were linked together in a logic sequence, as illustrated in Figure 12. Moreover, the stakeholders were asked about what in their opinion currently does not work well in terms of product elimination and they were encouraged to suggest improvements to the current process.

Figure 12: Sequential process logic

In total, interviews with nine departments within Husqvarna Construction, one department at Husqvarna Division, and one department at Gardena were conducted.

- The **Project Management Office (PMO**) defines and maintains the standards for project management within Husqvarna Construction. The

Office coordinates New Product Development, as well as elimination projects and is responsible for directing and controlling those projects.

- **Product Management**. The product managers, or product owners, are responsible for one product group each. It is the product manager that decides the fate of a product (e.g. the date for a product's launch or removal). The scope of the product managers is to plan, create and manage Husqvarna Constructions product portfolio.
- **Manufacturing** consists of the different factories within Husqvarna Construction. The factories are preparing, planning and executing the production, as well as planning and organizing the material needed for production.
- **Sales & Operations Planning** is gathering the forecasts made by demand planning and sales and produces forecasts and orders for the factories.
- **Purchasing** is responsible for securing the right material and components at the right point in time, and at the right place. Purchasers have regular contact with suppliers and manage all upstream material flow.
- **Research & Development** is in charge of the technical development of new products and the improvement of existing products.
- **Spare Parts Management** is responsible for the spare parts of the Husqvarna Construction products. The function controls that the spare parts are produced in the correct amount, monitors spare part stock levels and provides service concepts for spare parts.
- **Master Data Management** manages the structure of governance. The function makes sure that Husqvarna Master Data system is up to date regarding article numbers and improves the integration of master data supply with the groups ERP systems
- **Controlling** is responsible for the accounting operations, including the production of financial reports, the maintenance of accounting records and a set of controls and budgets to mitigate risk
- **Business Support (Husqvarna Division)** is running the product elimination process at Husqvarna Division
- **Organizational Excellence – PMO (Gardena)** is responsible for process management at the Gardena Division

4.2 Husqvarna Constructions New Product Development Process

Product Elimination at Husqvarna Construction is part of the Product Creation Process (Figure 13). The PCP consists of ten stages, starting from designing a product strategy and ending with the elimination of the product. This thesis focuses on the elimination process of products that are getting replaced by a new product. Thereby the elimination of the old product and the new product development of the new product are closely related, and it is of importance to understand the NPD process used by Husqvarna Construction.

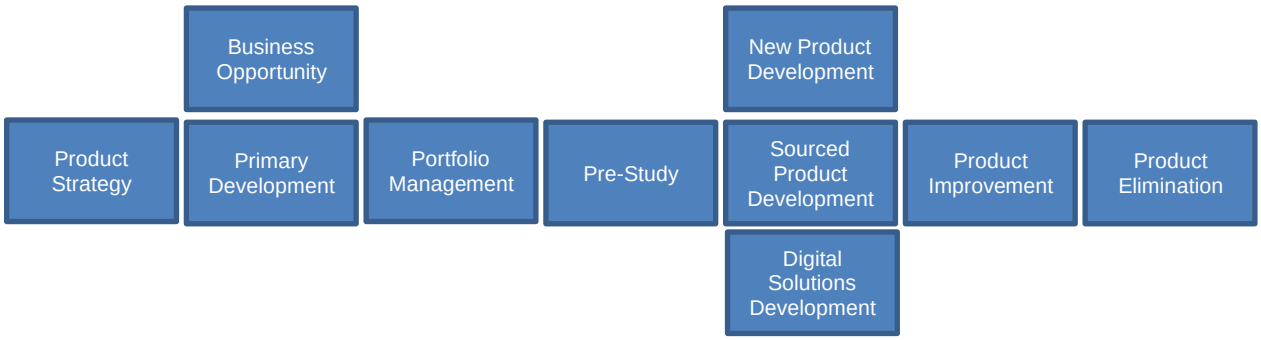

Fig. 13: Husqvarna Constructions Product Creation Process

The NPD process at Husqvarna Construction consists of seven stages and nine gates (Figure 14). The whole process typically takes between two and four years depending on the product and scope of the project.

Stage 1: Specification Stage

In the specification stage, the project proposal and all input from the Pre-Study are analyzed and relevant requirements are compiled, evaluated and specified. Product Concepts are developed and fulfilled towards requirements and relevant attributes (e.g. technical, compliance, band design, manufacturing, cost, sourcing etc) are evaluated by all relevant stakeholders. Physical pre-prototypes may be used to verify that concepts fulfill the requirements. Potential suppliers are identified and evaluated to meet relevant requirements, e.g. quality, chemical compliance etc.

Stage 2: Development Stage 1

An industrial- and engineering design for the selected concept is developed, starting on system level and broken down to subsystem and component level. This includes the development and approval of an Industrial Design Model, geometrical packaging- and interface definitions, CAD models of each part and preliminary drawings of all critical elements. A stable software architecture is developed and demonstrated. Feasibility must be ensured through simultaneous product- and process engineering and involvement of relevant stakeholders (suppliers, manufacturing, costing, compliance etc). The team commits to the business case in the investment request, including:

- Engineering- and costed Bill of Material
- Project Costs
- Sales volume and pricing

Stage 3: Development Stage 2

3D & 2D drawings and specifications are finalized and released for ordering design verification protypes. Prototypes are manufactured and measured according to engineering specification. Design Verification testing and customer validation is performed to confirm fulfillment of the product specification and market- and user requirements. Feasibility must be ensured through simultaneous product- and process engineering and involvement of

relevant stakeholders (suppliers, manufacturing, costing, compliance, service etc).

Stage 4: Industrialization Phase 1

Minimum one Engineering Pilot is built to verify and validate product to the specification and customer experience. The parts used shall be supplied from production tooling and processes. The team starts with external drawing reviews of new parts and release Engineering Change Orders for purchase order. Tools, equipment, design samples and components for Engineering Pilot are procured.

Stage 5: Industrialization Phase 2

A Manufacturing Pilot is built to finally verify and validate the product, manufacturing system and supply chain. MP units must fulfill all requirements to qualify and compliance as 'sellable' units. The manufacturing system shall be completely installed as intended for serial production prior to the Manufacturing Pilot. Product cost is confirmed, spare parts are ordered. After approved evaluation of MP, Product Approval of Serial Production (PASP) is submitted to management for sign-off.

Stage 6: Production Stage

Products are produced according to production planning (launch planning) and distributed to supply chain distribution points (warehouses) awaiting sales start sign-off for ship out. Market launch activities shall be finalized.

Stage 7: Sales Stage

Market feedback data and input/feedback from customer, dealers' sales companies are followed up to assure quality targets are met. Agreed outstanding issues are handed over to maintenance (R&D line organization). IR is recalculated, including review of product cost, to check ROI. Lessons learned summarized and reviewed in Steering Team.

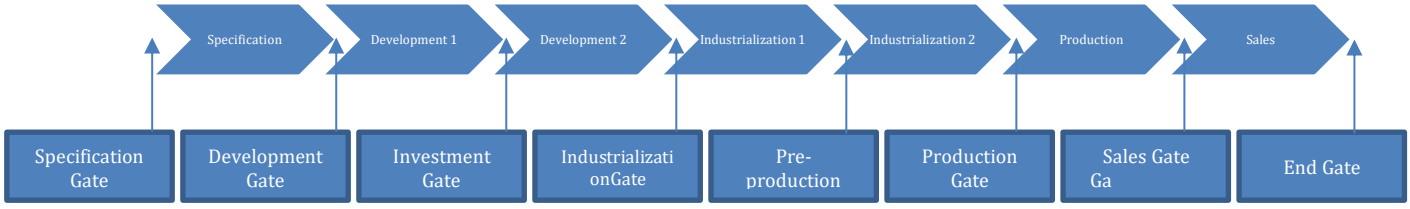

Figure 14: Husqvarna Constructions New Product Development (NPD) Process

4.3 Description of Husqvarna Constructions Product Elimination Process

In this section, an in-depth description of the activities carried out within the elimination process at Husqvarna Construction is provided. All data described in this subchapter was received as part of the interviews conducted. For each of the functions involved, their activities will be listed, followed by a table briefly summarizing them (Table 3 to 7).

The elimination process for products that get replaced roughly lasts about 6-7 months. However, this time specification is subject to variance due to the uncertainties that characterize the NPD process, such as longer lead time than expected from suppliers adapting their production lines, suppliers going bankrupt or changing production, issues in the new design, security factors, and so on. Moreover, every factory has its own specifications, characteristics and needs, leading to great variability within the company. An example of different needs is related to the manufacturing volumes: light demolition robots are manufactured in really small volumes, roughly one or two per week, whereas power cutters follow mass production. The impact on the elimination process is related for example to the amount of raw materials or components in stock that risk to be scrapped, as well as their value. Another case is the difference between the place of production of the replaced product and the one of the introduced products, which may not be the same. This difference has implication for the production inasmuch as there might be commonality within the production lines and therefore some equipment or tools from the old factory could be needed in the new factory in order to produce the new product. One other implication is related to material planning, since the new factory might as well need raw materials or components that will be provided from the old production.

Product Management

Product Managers are key actors in the process, since they initiate the NPD process and are the ultimate responsible for both the replaced product and the introduced one. One of the most important tasks for which the product manager is responsible, according to the interviews done, is to maintain a healthy product portfolio. For example, it is a product managers' responsibility to develop a strategic plan for the elimination of the replaced product (e.g. elimination date, rollover strategy, etc.). Therefore, many activities undertaken within the elimination process depend on initial decisions taken by product managers.

Even though Product Managers' activities are mainly conducted at the beginning of the process, they are accountable for the final results and for the execution of the process. However, if difficulties occur later on, such as a delays or mismatched stock levels, they usually get informed, and are the final decision maker in the matter.

Once the release date of the new product is defined, the product manager sets a strategic plan and the date for the elimination of the replaced product. Usually, the product elimination process starts 6 months before the End of Production

(EoP), which has to be coordinated with the release date of the new product. Since the duration of the NPD process varies depending on the complexity of the product and of the new developments planned, product managers propose an average of 2-4 years, but it has to be considered that there might be consistent differences from one NPD process to one other.

The product managers are in charge of the early actions, related to the development of the new product, its approval, and the development of the elimination strategy. Some of these actions belong to the NPD process, but since the elimination process is related to the NPD process, they are still relevant for the purpose of this paper. A brief description of each relevant activity is provided below.

New product ideas generation

Early on, mainly informally, product managers collect data and information regarding products, markets, customers, and profitability, identifying opportunities and threats in the environment. For examples customer complaints, new technologies, safety requirements, law modifications, marketing data, and so on. Through these data, the product manager develops improvement ideas regarding the existing product and later compiles a formal product proposal.

Business case development

A business case is then developed by the product manager, supported by information provided by many different departments, such as R&D, Sales, Marketing, Finance, and S&OP. However, at this stage, the new product is still not approved and therefore the elimination of the old one is still uncertain.

SPPM presentation

In order to obtain the necessary funds to completely develop, manufacture, sell the new product, and eliminate the old one, the approval of the SPPM team is necessary. This meeting happens two times per year, and the team is composed of different functions. At this meeting, the product managers present their proposals and the most promising ones are chosen, obtaining the approval. This gate is relevant for the elimination process as part of the NPD process because its occurrence directly depends on the introduction of the new one. Thus, it is here that the elimination of the old product is confirmed.

Elimination strategy definition

Once the new product launch strategy has been decided, the product manager decides on the elimination strategy and on the consequent End of Production date. Therefore, at this point, it is possible to know more precisely when the elimination process will start, since it usually happens six months earlier.

Follow up actions

These actions take place whenever it is necessary all long the elimination process. It can be undertaken in different forms, from deciding whether to scrap eventual overstock, to modifying the elimination date from the factories, to changing the end of sales date in the sales companies. Due to the responsibilities of their role, in case of problems the decisions are pushed higher in hierarchy towards them.

	Input	Activity	Output
NPD	Information from internal and external environment	Generation of ideas for improvements on the existing product	New product proposal
	Development of the product proposal in order to create a business case	Business case development	Completed business case to support the new product approval
	Business case proposal to be presented in order to obtain approval	SPPM presentation	Formal approval that entails funds to the project
Elimination Process	New product launch strategy	Elimination strategy definition	Elimination strategy coordinated with the new product introduction
	Occurrences in the project	Follow up actions	Smoother process flow

Table 3: Activities Product Management

Problems identification and improvements suggestions

As Product Management reported and as stated before, the removal process is mainly carried out through projects, and there is currently no structured and standardized process to do so. Moreover, a proper measurement system is absent, and scrapping costs are not accurately evaluated.

According to the interviews, problems reported are connected to communication with the factories, which happens not to be on time and causing delays along the process.

Project Management Office

Project managers and project coordinators are in charge of managing, coordinating, and organizing projects, distributing tasks and information among

the stakeholders. In case of problems they are on the first line with the product managers to find a viable solution.

Project managers, supported by project coordinators, lead the elimination process related to the development of the new product. Tasks such as coordination between actors, transfer of information and development of the project's timeline are typically carried out by the project management.

Creation of ECO

Engineering Change Orders are always created and issued to inform and trigger actions of specific stakeholders. Different types of ECOs do exist. Relevant for the elimination process is the elimination ECO, which informs of the incoming product replacement, and the implementation ECO, which provides the Bill of Material (BOM) of the product and triggers actions within the factories.

Creation of unique spare parts list

The unique spare part list is created by project coordinators and then forwarded to Parts Management. This list is needed in order to understand which spare parts will be eliminated or replaced in the future. This task is carried out by project coordinators because Parts Management does not have access to the systems needed to complete it.

Ensure that all the required parameters are in place in the relevant systems

Project coordinators request official product status modifications into the company systems such as active, eliminated, in elimination, and so on.

Input	Activity	Output
Start of the process	Creation of ECOs	It informs relevant actors and triggers specific activities
Creation of the ECO	Creation of unique spare parts list	Unique spare parts list provided to Parts Management
Elimination process progress	Ensure that all the required parameters are in place in the relevant systems	Firm's systems updated

Table 4: Activities Project Management

Problems identification and improvements suggestions

A problem identified concerning the PMO activities is the responsibility over the creation of ECOs, which fall in between R&D and PMO causing confusion and

delays due to uncertainties on which of the two departments has to carry out this task.

A second issue related to ECOs is the absence of a standard template for the description and creation of ECOs.

A last issue is related to the creation of the unique spare part list. This action is complicated by the absence of reliability on the data in the system, which is not completely up to date and leading project coordinators to use multiple sources and analysis in order to identify unique spare parts.

One suggestion provided is to have the same project manager or project coordinator in both NPD and related elimination process in order to ensure a smooth and continuous communication flow.

Manufacturing

Manufacturing is carrying out the operational activities that, based on the accuracy of the forecasts and the coordination with the NPD process, will generate scrap cost at the end of the elimination process. The main activities are summarized below.

Identify unique components

Once the implementation ECO containing the BOM is completed by the project coordinator, it is received by the manufacturing preparer at the factory. The manufacturing preparer has to identify unique parts of the phased-out product and creates a list with such parts. This is done to allow other relevant stakeholders to understand which parts won't be used anymore, and therefore their procurement can to be stopped and their stocks can be depleted.

Plan production

At the same time, the production planner defines the production within the last six months prior to End of Production (EoP). This period's demand has usually been frozen by S&OP in order to ease the production and the depletion of stocks, as well as procurement of components and material.

Define stock levels for unique components and issue orders to suppliers

Once the two beforementioned activities are executed, the production planner defines the target stock levels for the unique components listed. Consequently, after production and stock levels have been defined, purchasing agreements and orders are adjusted and issued.

Input	Activity	Output
Implementation ECO containing BOM	Define unique components	List of components that need to be eliminated
S&OP frozen forecast	Plan production	Planned production based on frozen demand
List of unique components and planned production	Define stock levels and issue orders to suppliers	Plan to deplete stocks of phasing-out components

Table 5: Activities Manufacturing

Problems identification and improvements suggestions

First of all, manufacturing highlighted that the process should be clear and easy to understand. More than once it was said that a difficult to understand process is not followed in practice and too many specifications will hinder the adoption of the process. A second issue is related to spare parts, which need to be considered and possibly integrated early on in the process, as well as tools that will need to be scrapped. Finally, some relevant stakeholders are informed quite late in the process and they are not aware of what is going to happen until the last moment possible.

Sales & Operation Planning

S&OP is responsible for providing the expected production volumes to the factory, based on demand forecasted by the product manager and Central Demand Planning.

First update and more detailed updates

S&OP gets updated on which product will be introduced and which products will be phased-out at the monthly sales and operation planning meeting in which the product manager updates on products and projects. However, detailed information is provided only later on to S&OP. That usually happens around six to eight months prior to SoP by the project manager during project meetings related to the phasing-out product.

Frozen production and issue orders to the factory

Afterwards, S&OP obtains estimated demand volumes from the product manager as well as from Central Demand Planning. Here, S&OP [the planner] freezes the production for the six months prior the EoP, then forwards the frozen volumes to the production planner (Manufacturing).

Monitor stock

Starting from when the decision to eliminate a product was made, S&OP monitors the stock level of finished goods and, once the EoP is reached, gets in contact with the product manager to discuss what actions to take on eventual overstock.

Input	Activity	Output
Demand forecast and estimated sales	Frozen production and issue orders to the factory	Production orders to the factory
Stock level	Monitor stock	Input for eventual actions on stock

Table 6: Activities S&OP

Problems identification and improvements suggestions

One of the problems reported is the lack of communication and timing. Often the frozen volumes are communicated late due to poor prior communication, creating delays later on along the chain. Regular updates on the Start of Production (SoP) and Sales Start Gate (SSG) are also missing. Another problem reported is the transfer of information between the ERP systems of the company and the systems run by the Sales Divisions, which are not integrated. Due to this issue, sometimes the status of products mismatch, causing order errors.

Even though the demand is frozen, sometimes the actual demand changes within this period, causing high scrapping cost or, in an even worst situation, lost sales and no production due to absence of enough products.

A last issue is related to stock monitoring. Usually actions are taken on the stock left after the EoP, whereas adjustments could be notified and done during the last six months of production.

Purchasing

Purchasing is usually in constant contact with the suppliers since the start of the NPD process. Since there are barriers to exit when changing to a different supplier, it is preferable to keep incumbent suppliers.

Once the ECO with the BOM of the new product arrives and all the relevant parameters are available in the system, Purchasing can start to deal with the suppliers to finalize and adjust contracts.

Problems identification and improvements suggestions

Sourcing is the function that manages the relations and formal contracts with the suppliers. To cancel or modify an agreement, or to get in contact with a supplier, can take quite some time. Therefore, it is important that Sourcing is informed quite early in the process, with all the required information needed to be able to deal with the suppliers. It has been reported that often Sourcing is not included early on in the ECO, thus not formally informed.

One suggestion given was to keep as much flexibility as possible, for example through smaller batch sizes. By having smaller batch sizes, agreements can be canceled more spontaneously, without having the risk of creating large overstock when eliminating a product just after having bought a large batch of new components.

Parts Management

Parts Management is in charge of spare parts. That concerns managing their status, forecasting their demand, managing inventory, and purchasing spare parts. In the elimination process, they have to identify spare parts that will be eliminated or replaced in the future and manage them until the respective Last Production Date (LPD). In Parts Management the LPD represent the last date in which a specific spare part will be kept and will be available for sale.

Set parts as replacement in the system

New spare parts that will work as replacements have to be registered, while old spare parts have to be marked as replaced.

Set LPD for to-be-eliminated parts

An LPD has to be defined for the unique parts that are to be eliminated. If a spare part has to be replaced, the LPD is closer (e.g. 3 years), otherwise, in case it has to be eliminated without being replaced by another spare part, it is set further away in time (e.g. 10 years). Once the LPD is identified, it has to be registered in the system.

Define forecasts and inventory levels within LPD

Within the time frame provided by the LPD, Parts Management forecasts the demand and sets the inventory levels for each spare part.

Review stock levels and issue purchase orders

Once the forecast is available and inventory levels are set, purchase orders can be issued. They can follow two possible strategies, namely continue sourcing or last time buy. The former assumes a continuous release of orders with small volumes, while the latter refers to one last order that needs to be efficiently large to cover the demand of the spare part until the day it is not sold anymore.

Moreover, around three or four times per year the stocks levels are checked, and if purchasing is continued, purchase orders are adjusted.

Overstock management

It is Parts Management responsibility to manage the stocks of spare parts. That includes the monitoring of inventory levels and possibly the purchasing of additional spare parts or the modification of existing spare part purchase orders.

Input	Activity	Output
Unique spare part list	Set LPD for to be eliminated parts	LPD
Implementation ECO	Set parts as replacement in the system	System updated.
Spare parts with LPD	Define forecasts and inventory levels within LPD	Expected inventory levels
Actual inventory levels	Review inventory levels and issue purchase orders.	Actions taken to adjust inventory levels

Table 7: Activities Parts Management

Problems identification and improvements suggestions

Currently spare parts are treated completely separately for finished goods. Consequently, one of the problems that has been highlighted is the absence of connection between a part and the product to which it belongs, which complicates the identification of spare parts affected by the replacement. Moreover, unique spare part lists are not always received, meaning that Parts Management gets informed too late about the removal of a spare part and doesn't have the time to take action.

R&D

R&D is not particularly involved in the elimination process. However, it is their responsibility to create and issue ECOs, as well as to approve product status changes. Therefore, their tasks are mostly concentrated at the start of the process with the initial ECOs.

It has been reported that there is an ownership issue related to the creation of ECOs with PMO. Because of this it is often not clear which department should have to carry out the task.

Management

With management all the stakeholders that provided relevant input and belong to the Category Management but that are not operatively involved in the process were integrated.

As other stakeholders said before, one of the problems reported is the lack of proper communication flows between the NPD process and the removal process, causing issues into the removal process and a consequent rise of the scrap cost. Therefore, one of the inputs was to have a removal process closely tied to the NPD process. Furthermore, in order to have a standardized process for many different situations (different factories, products, etc.), high relevance was given to keep the process flexible within a standardized frame. Conclusively, another improvement potential area provided was the reduction of scrap and inventory cost.

Other stakeholders (Finance, Master Data Management)

This category groups together Finance and Master Data Management, which are necessary functions for the elimination process at Husqvarna but minimally involved.

Finance reported that scrap costs are not measured centrally, and as of now a general numeric evaluation of the process is missing. However, it has to be considered that the scrap cost highly varies dependently on the product that it refers to, and other different variables. Thus, a general evaluation in term of scrap cost can be conducted, but necessary considerations have to be made.

5 Analysis

In order to structure and make sense of the collected empirical data, an analysis is required. The analysis constitutes the second step in Harrington's Business Process Improvement Model (Harrington et al., 1997). As a first step, the information gathered regarding the input, activities and output of all interviewed stakeholders is visualized and structured by creating a business process map of the current product elimination process. This is what was referred to before (see section 3.5) as the 'as-is' model. The purpose of this step is to create an easy to understand overview of how certain stakeholders are connected and depend on each other and in what timely sequence the different activities happen. Moreover, the 'as-is' model works as a basis for the following analysis step, consisting of the content analysis. In this stage, the empirical data is structured in a way that allows to draw conclusions regarding the weaknesses and improvement potential of the current process. In order to do so, the empirical data is organized to create themes and topics of interest that can be addressed. Afterwards, those themes and topics are prioritized and ranked based on several factors. The aim of the analysis is to clearly identify the strengths and weaknesses of the current product elimination process and to use that knowledge to create the improved process.

5.1 Business Process Mapping

As a first step of analysis, the causal relationships between the activities performed by different stakeholders in the product elimination process have to be understood. Business Process Mapping is used to visualize those relationships by creating a network of connected activities. Thereby an understanding of following aspects can be achieved: 1) the input needed to perform a certain activity, 2) the events that initiate the execution of an activity, 3) the resources which are required to execute the activity, 4) the time needed for the activity, and 5) the output generated by the activity.

The Business Process Management Notation (BPMN) was chosen to visualize the current product elimination process, since it does not only allow to depict activities in a given sequence with a stakeholder being responsible for that activity, but also visualizes the message flow between stakeholders that triggers activities or is needed to execute activities (Appendix 3).

Firstly, the stakeholders involved, and their rows are represented vertically from the left to the right. Secondly, the empirical data belonging to the interviews previously made was mapped. Actor by actor, the actions of the different stakeholders were mapped according to the BPMN. Consequently, the activities were connected sequentially. Whenever events triggered specific actions it was noted. This is the case of the 'timer', which allows the flow to continue when reached a specific time condition, for example the SoP date towards the end of the PMO lane. The message flows have also been drawn. An outbound message is depictured with a black envelope, whereas an inbound is represented as a white envelope. The transmitter and receiver of the message are connected with a dashed arrow. In case more activities are performed at the same time, a gateway with a cross is represented. In the

process presented below, this is the case for Manufacturing, where they plan production and find unique components at the same time. However, if the situation requires an exclusive choice of path, a normal conditional gateway is used.

5.2 Content Analysis

Conventional content analysis aims at describing a phenomenon by deriving codes from empirical data and consecutively grouping or categorizing those codes based on their relation to each other and thereby creating a structured meaning of the empirical data. Here, content analysis is used to structure the improvement suggestions given by the interviewed stakeholders. In a first step, all improvement areas are listed and problem statements that stakeholders expressed are formulated. In a second step, the improvement suggestions are prioritized based on by how many stakeholders the issue was mentioned, how firmly the improvement suggestion was expressed and how literature relates to the statement. The prioritized list of improvement suggestions is used in chapter 6 to create a new product elimination process.

5.2.1 Creation of Improvement Themes

Communication

Communication is one of the broader themes and therefore contains more data. During several interviews the topic of communication between different stakeholders involved in the elimination process was brought up.

Firstly, it was mentioned that the information exchange between stakeholders being involved in the elimination process and the corresponding New Product Development process must be of high frequency and quality. That is important, since changes in the NPD project, such as delays, can have a direct impact on the elimination process and therefore need to be communicated quickly and effectively.

Secondly, all relevant stakeholders regularly need to be updated on changes regarding important activities within the elimination process. If e.g. the phase-out strategy, the EoS Gate, or the EoP Gate changes, that information needs to be distributed in order to make stakeholders know how the deadlines for their activities change. More specifically, it was brought up that the factories and sourcing are sometimes not informed early enough that a product is going to be eliminated. That leads to the problem that those stakeholders won't have enough time to prepare for elimination, by e.g. adjusting supplier contracts.

Lastly, the issue of not having a standardized template for the ECO was highlighted. Thereby, each time an ECO is triggered, the creator needs to fill out all information by hand and each creator has their own way of designing the ECO.

- Improvement Potential A: Not always good communication flow between NPD process and elimination process

- Improvement Potential B: No regular updates on SSG and EoP to all stakeholders
- Improvement Potential C: The factories and sourcing are not informed early enough about product elimination
- Improvement Potential D: ECOs don't have a standardized format

Frozen order volumes/ Changing demand

In order to have time to adjust supplier contracts and production, manufacturing demands to get the frozen order volumes of the eliminated product 6 months before the elimination date from S&OP. However, often delays occur and the factories don't get the frozen order volumes on time, leading to unprecise purchasing of components and raw material and thereby increased scrapping costs. However, in that context it was also mentioned that not for every product a frozen period of 6 months is needed. Some products have shorter supplier lead times and their demand could therefore be frozen later. Thereby the frozen order volume would be adjusted more precisely to the actual sales volume.

- Improvement Potential E: Frozen order volumes are communicated too late
- Improvement Potential F: Sometimes demand changes after orders have been frozen. That leads to high scrapping costs in the end or not enough products

Update systems

Husqvarna Construction uses a variety of different IT systems to run their business. The company has a Master Data System, different ERP systems, sales planning systems, a system used by R&D to develop new products and many more. Many of those systems rely on information being manually transferred from another system. For example, when a product is marked as eliminated in the Master Data System, it manually needs to be deactivated in the sales planning system. Those manual updates happen to be forgotten sometimes, which can in the worst-case lead to the situation that a sales representative sells a product that is not produced anymore and that no stock exists for. A similar problem is that when a product is eliminated, it can happen that the components and spare parts of that product are not registered as inactive.

- Improvement Potential G: Sales systems are not always updated
- Improvement Potential H: Eliminated parts/spare parts not always erased/marked as inactive from the systems

Overstock

A problem that was mentioned by several stakeholders is that after a product has been eliminated, a substantial amount of overstock remains that needs to

be scrapped and thereby creates costs. It was said that one reason behind that problem is that it generally is aimed at rather having too much stock than not enough stock, since that would potentially lead to the situation that customers cannot be supplied anymore. Another reason is that actions on overstock are taken too late and the expected amount of overstock is not anticipated early enough, when there still is time to take measures to reduce overstock.

- Improvement Potential I: Actions on overstock are mostly taken after EoP, which is too late

Responsibilities

For some activities that are part of the elimination process, responsibilities are not well defined. Most prominently, it is not defined whether PMO or R&D is responsible for creating the ECOs that trigger the elimination, since a part of the PMO department was integrated into R&D in the past and some project coordinators that were transferred from R&D to PMO continued creating ECOs even after they left the R&D department. This has led to the situation, that in some project teams PMO is doing it, whereas in others R&D is doing it.

- Improvement Potential J: It is not clear if PMO or R&D should create the ECOs

Measurement

Currently, Husqvarna Construction does not measure the total elimination costs of an elimination process. When eliminating a product, the related scrap costs are only measured by entity, meaning that each factory and warehouse is scrapping what they need to scrap and carry the created costs. It is therefore difficult to follow up how much the scrapping of a removed product adds up to, and the success of an elimination in terms of what scrap costs it created cannot be measured or compared to how other eliminations performed.

- Improvement Potential K: Scrapping costs are not measured centrally

Tools/Equipment

When running a product elimination, it can happen that product-specific tools or equipment that becomes obsolete when removing a product is neglected. It is important to evaluate and decide what to do with those tools once a product is not produced anymore. Perhaps the tools can be used for something else or can be shipped to another factory. Otherwise they have to be scrapped.

- Improvement Potential L: When eliminating a product, tools/machines that become obsolete are sometimes forgotten

Spare Parts Management

During the interviews it was said that spare parts management often is neglected when eliminating a product. That leads to Part Management being informed too late about a product being eliminated and not having time to adjust the service concepts for the spare parts that were unique to the eliminated produced and therefore also need to be removed. Additionally, it was said the system does not contain information about what finished products the spare part is used for. Therefore, manual work is required to identify what other products a spare part that is used for the eliminated product is used for.

- Improvement Potential M: Parts management is not informed early enough/not informed at all when spare parts should be eliminated
- Improvement Potential N: Spare parts are not connected to finished goods

5.2.2 Prioritization of Improvement Potentials

When prioritizing the improvement potentials expressed by the stakeholders, multiple factors have to be considered. Three major factors have been found to be significant. (1) The frequency of appearance in interviews, (2) the importance of the problem and (3) the connection to literature. Additionally, the possibility of improvement is taken into account.

The frequency of appearance is based on how many times the problem statements were brought up during interviews with stakeholders. A statement brought up multiple times in an interview with one stakeholder will still only be counted as one.

The importance of the problem is rated by how firmly the stakeholders expressed the need for the problem to be solved. Each problem statement is rated with a number between 1 (not that important) up to 3 (very important) to visualize the statements importance.

The connection to literature is based on similar problem statements being mentioned in the literature and information given in the literature about solving given problem statements.

The possibility of improvement can be explained by how possible it would be to acquire substantial improvement through actions taken. Areas that Husqvarna Construction cannot influence or suggestions that are connected to extremely large investments in terms of money and time have a lower chance of improvement compared to areas that have not been exploited much before. The decision how to rate the improvement possibility was done based on feedback from the stakeholders and observations of the authors.

Each problem statement is rated with a number between 1 and 3 within each category. The total score is calculated based on the sum of frequency,

importance and literature. The improvement score is saved as a separate score and used later on. The ratings equal the following characteristics (Table 8):

Frequency	Importance	Literature	Improvement
1 = one stakeholder group 2 = two stakeholder groups 3 = three or more stakeholder groups	1 = not important 2 = relatively important 3 = very important	1 = literature does not address the problem 2 = literature addresses the problem and finds it to be relevant 3 = literature addresses the problem and finds it to be very relevant	1 = difficult to improve 2 = possible to improve 3 = easy to improve

Table 8: Rating scores

Following, table 9 provides the evaluation of the improvement potentials:

Improvement Potential	Frequency	Importance	Literature	**Total**	Improvement
A: Not always good communication flow between NPD process and elimination process.	3	3	3	**9**	2
B: No regular updates on SSG and EoP to all stakeholders.	2	2	3	**7**	3
C: The factories and sourcing are not informed early enough about product elimination.	3	2	3	**8**	3
D: ECOs don't have a standardized format.	1	1	1	**3**	3
E: Frozen order volumes are communicated too late.	2	3	3	**8**	2
F: Sometimes demand changes after orders have been frozen. That leads to high scrapping costs in the end or not enough products.	1	2	3	**6**	2
G: Sales systems are not always updated.	1	3	1	**5**	2
H: Eliminated parts/spare parts not always erased/marked	3	2	1	**6**	1

as inactive in/from the systems.					
I: Actions on overstock are mostly taken after EoP, which is too late.	1	3	3	**7**	2
J: It is not clear if PMO or R&D should create the ECOs.	2	1	1	**4**	2
K: Scrapping costs are not measured centrally.	1	3	2	**6**	1
L: When eliminating a product, tools/machines that become obsolete are sometimes forgotten.	2	2	1	**5**	2
M: Parts management is not informed/informed too late when spare parts should be eliminated.	1	2	3	**6**	3
N: Spare parts are not connected to finished goods.	1	2	1	**4**	1

Table 9: Improvement potentials scores

Consequently, to the results of the evaluation of the improvements potentials, they have been assigned to three groups according to their total value: high priority (7-9), medium priority (6), and low priority (3-5). Hereby follows an in-depth description of how the values have been appointed to each improvement potential.

High priority

A: Not always good communication flow between NPD process and elimination process (9 points)

The communication difficulties between the NPD process and the elimination process was brought up by PMO, Project Management and the Category Management. The elimination process is closely linked to the NPD process when replacing a product, since delays or changes in the NPD process have a direct impact on the elimination process. Therefore, it is of high importance that changes are communicated quickly and effectively. Furthermore, the literature introduced highlights that companies that work in functional areas often face challenges in terms of coordination and communication when running cross-functional business processes. However, with a standardized NPD process already being in place, the improvement potential is well within the possible limits of what Husqvnarna Construction can do, and therefore is considered to have a good possibility of being improved.

C: The factories and sourcing are not informed early enough about product elimination (8 points)

Project Management, Sourcing and Manufacturing mentioned that the information about the elimination of a product is not always shared early enough with Manufacturing and Sourcing. Since Manufacturing and Sourcing need enough time to prepare for elimination in terms of adjusting purchase agreements and production, it is considered relatively important that they receive information on time. As mentioned before, that improvement potential is also discussed in the literature quite extensively in terms of communication challenges between functional silos. Since not much effort is connected with establishing mechanisms to spread the information earlier, the improvement is considered to be easy to be carried out.

E: Frozen order volumes are communicated too late (8 points)

The difficulty of frozen order volumes being communicated too late to the factory was brought up by both S&OP and Manufacturing. If the factories don't get informed about frozen order volumes on time, they cannot adjust their purchase agreements and plan their production on time, which is important to secure smooth production and avoid a shortage or excess of components and raw material. The literature also addresses the importance of having fixed production volumes for the replaced product. Given that a punctual distribution of frozen order volumes seems to be mostly a coordination issue, it can be improved easily.

B: No regular updates on SSG and EoP to all stakeholders (7 points)

S&OP and Manufacturing addressed that they don't receive regular updates on changing dates SSG and EoP. The improvement potential was ranked as relatively important, since stakeholders need to be up to date to effectively fulfil their tasks, but also it does not happen often that major changes in terms of SSG and EoP occur. The problem can also be considered as being part of the general cross-functional communication challenge mentioned in the literature. It is very easy to improve, given that only short written updates are needed.

I: Actions on overstock are mostly taken after EoP, which is too late (7 points)

It was brought up by S&OP that activities to reduce overstock are usually only taken after EoP, but not during the elimination period. Tracking the actual sales and comparing it with the production volumes, will allow to anticipate earlier on how much overstock will be left after EoP. Thereby actions to reduce overstock can be planned and executed in advance. Considering that reducing the overstock results in lower scrap costs, the improvement potential is considered as very important. Literature about elimination processes, highlights the importance of taking measures to reducing overstock. Husqvarna Construction can take actions on this improvement potential.

Medium Priority

F: Sometimes demand changes after orders have been frozen. That leads to high scrap costs in the end or not enough products (6 points)

S&OP reported that even though they forecast as accurately as possible, demand changes after that they freeze the orders. This create overstock or out-of-stock situations, causing higher scrapping cost or lost sales. This improvement potential has been categorized as relatively important since the impacts are relevant for the process. Elimination process literature also thematizes scrap costs and frozen order volumes and considers it as relevant when eliminating. The frozen time is required by the factories, and variation in demand cannot be avoided. Even though variation in demand cannot be eliminated, Husqvarna can implement solutions to reduce the frozen time if possible.

H: Eliminated parts/spare parts not always erased/marked as inactive in/from the systems (6 points)

This improvement potential has been mentioned by many stakeholders, from PMO, to Parts Management, to R&D. When people belonging to these functions require information about the status of a component or spare part in the system, these simple data are not always up to date and reliable, causing an increment of the consumption of time by their standard activity. Instead of one system, more than one have to be consulted in order to obtain the necessary information. This improvement potential has not been found in the literature, probably due to its high specificity to the case. Moreover, its possibility to be improved is low inasmuch as it requires a maintenance and upgrade of the systems currently owned by the company.

K: Scrap costs are not measured centrally (6 points)

One of the relevant improvement potentials of the current process it's the absence of any kind of measurement. As it has been mentioned during the interview with the controller (Finance), scrapping costs, which is one of the main information regarding the elimination process, is not measured centrally. Thus, a general overview of how much an elimination cost to the company is currently not carried out properly. The literature mentions reducing scrap costs as relevant and suggests using the total scrap costs as a tool to measure the success of an elimination process. Establishing a procedure for measuring scrap costs centrally requires however more research about the financial processes at Husqvarna Construction and is therefore rather difficult to implement.

M: Parts management is not informed/informed too late when spare parts should be eliminated (6 points)

Parts Management stated that sometimes they actually find out that a spare part should have been or should be set for elimination when receiving orders. The relevance has not been set high due to the long life of a spare part after the elimination of its product (from a minimum of three to a maximum of ten years). The improvement potential can be categorized as a communication issue, and its solution lies within the possibilities of Husqvarna Construction.

Low priority

G: Sales systems are not always updated (5 points)
S&OP mentioned that sales systems are not always updated with the newest information about what products are eliminated and therefore can't be sold anymore. That is a major improvement potential, since customers will be promised products that are not for sale anymore. However, system updates are not mentioned in the literature in relation to elimination processes. Considering the chance for improvement, it is relatively easy to establish procedures to make someone responsible for updating the system. The ultimate solution however, integrating the sales system in the Master Data Management system and hence updating it automatically would result in major costs and is therefore difficult to improve.

L: When eliminating a product, tools/machines that become obsolete are sometimes forgotten (5 points)

PMO and Manufacturing addressed that tools and machines that are unique to the production of the eliminated product are often forgotten to be evaluated about if they need to be scrapped or can be used somewhere else. The improvement potential is ranked as relatively important, since on the one hand side finding other application areas for the tools and machines can reduce scrap costs, but on the other hand side those situations that a tool or machine can be used somewhere else rarely occurs. The elimination process literature does not focus much on tools unique to the eliminated product. Evaluating tools and machines before a product is eliminated comes along with some effort in terms of financial aspects and double-checking with other factories if they need the machine, but can still be considered as possible to improve

J: It is not clear if PMO or R&D should create the ECOs (4 points)

PMO and R&D said that there is no clear responsibility for who should create the ECOs that trigger the product replacement. That leads to some project teams having PMO do it and others having R&D do it. Since both stakeholders are capable of doing it and it mostly depends on the backgrounds of the persons involved who ends up doing it, the improvement potential is considered to be rather less important. Also, given that it is very specific, it is not addressed in literature. Establishing clear responsibilities seem to be easy on paper, but it will be more difficult to be implemented practically.

N: Spare parts are not connected to finished goods (4 points)

Parts management addressed the improvement potential of not being able to see in the system what finished goods a spare part is connected to. That makes it harder to identify what other products than the eliminated product a spare part is used for. This improvement potential is relatively important, since it makes the work for parts management easier. On the other hand, it does not result in any direct cost savings or process improvements. Also, it is too specific to be mentioned in elimination literature. The possibility to improve in this regard is

rather low, given that multiple systems would need to be integrated and updated.

D: ECOs don’t have a standardized format (3 points)

PMO mentioned that ECOs don’t have a standardized format, meaning that every project coordinator design is slightly different. Since that does not result in any additional costs, communication problems or delays, the improvement potential is considered to be rather unimportant. It is not addressed in the literature. However, it also is very easy to improve, creating a standardized template once that can be used by everyone.

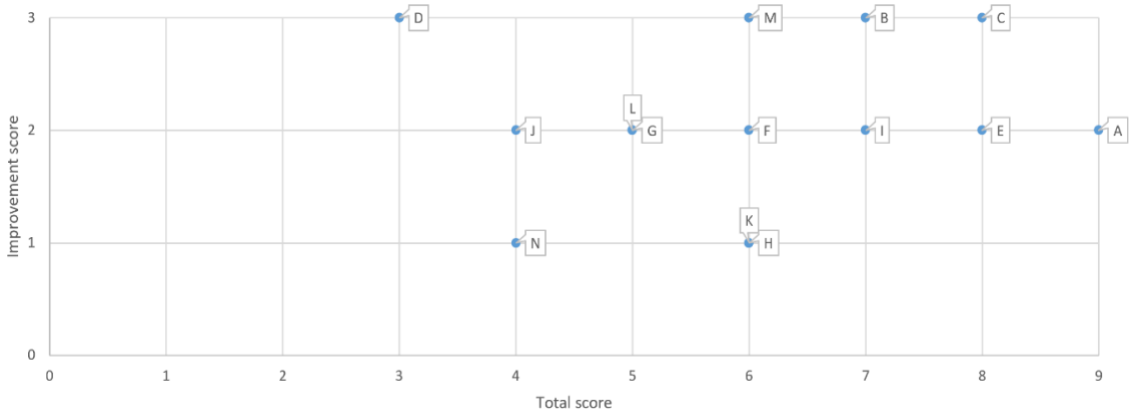

Figure 15: Probability of improvement vs Total score (from table 6)

Due to the relevance of the feasibility of the improvements, the Improvement category has been directly confronted with the total value obtained through the sum of the other categories. In the figure above (Figure 15) it can be highlighted the most relevant, and at the same time solvable, problem statements in the top-right corner (e.g. A, C, E, etc.), against the less relevant, and hardly solvable, problem statements in the bottom-left corner (e.g. N, H, J, etc.). To be noted that the actual minimal value on the X axe is 3, whereas for the Y axe is 1, since the minimum value assigned for each category is 1.

6 Improved Process Implementation

The third step of the Business Process Improvement Model by Harrington et al. (1997) is the implementation phase, in which the results of all the data analysis that went into the development of the future-state solution is transformed into real performance improvement. This chapter introduces how the improvement suggestions made in the analysis are developed into solutions to improve the process, and how those solutions are integrated into the existing product elimination process.

6.1 General Approach

The general aim of improving the product elimination process at Husqvarna Construction is to turn the existing process into a better one, without erasing its fundamentals. That means that the as-is model, the way how the company currently runs elimination, builds the foundation of the new elimination process. The improved process still involves the same stakeholders as the current process, many tasks and activities are not changed or only slightly changed, and the input and output of the process stay the same.

Research highlights that the implementation phase, the phase when the new process is developed and implemented, is the phase that is most often responsible for the failure of a business process improvement. Therefore, it is important to execute this phase properly, and to devote high attention to the implementation. The process improvement archetypes from Ponsignon et al. (2013) provide a broad framework of how to approach the implementation phase. For improving the product elimination process at Husqvarna Construction, a hybrid business process improvement approach was chosen. The hybrid approach suggests that employees are empowered and encouraged to make decisions independently, but that also tasks are standardized. The approach was chosen, since the elimination process needs to be standardized to a certain degree in order to apply it in similar ways every time a replacement takes place. At the same time however, stakeholders need to decide by themselves how to execute certain activities and need to be empowered to adjust to variations within the process independently.

Harrington et al. (1997) highlight some general considerations that are important when implementing the new process. An important point is that the individuals that are involved in the process that is improved have to be properly prepared for the change and willing to support it. In order to secure the support and the preparedness of the stakeholders of the elimination process at Husqvarna Construction, they were frequently involved in the development of the process. They were asked about their own ideas that could be implemented in the new process and once a new version of the process was available, constant feedback loops with the stakeholders were kept in order to secure that the new version of the process is well understood and supported by them. A second important consideration when improving a process is that documentation is in place that clearly shows how the process needs to be executed. For the improved product elimination process at Husqvarna

Construction, a process map was created that shows all process steps, their interrelations and their responsibilities. In order to make the process less complex and more understandable, an extensive handbook and process description was prepared and handed out to all stakeholders.

6.2 Process Improvements

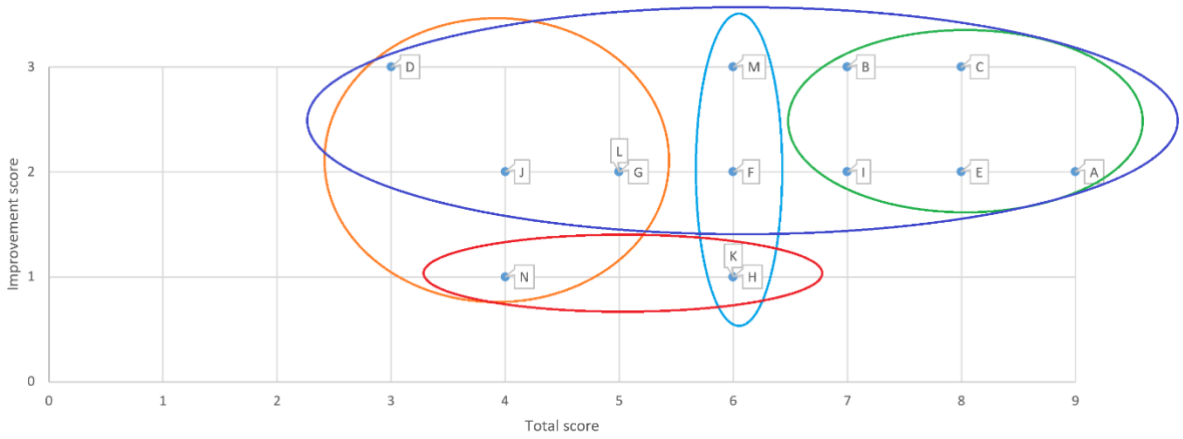

Figure 16. Improvements' categorization

As introduced in the content analysis (chapter 5.2), Figure 16 prioritizes the relevance of the improvements based on their improvement scores. In this figure, the different categorizations are highlighted. Green, azure, and orange represent high, medium, and low priority respectively. Moreover, two more categorizations are made, related to the red and blue areas. While the upper one refers to improvements that can be adopted in the short or intermediate term, the one at the bottom is related to improvements that can be adopted only in a long-term view. In fact, the improvements suggestions in this category (H, K and N) refer to systems upgrades and modification, and to implementing a robust measurement system, which are not possible to implement in the short term, since they require an extensive amount of resources. Therefore, for example improvement H won't be integrated in the improved process, while improvement D will be integrated, even though it has a lower total score (6 compared to 3 out of a maximum of 9).

6.2.1 Immediate Improvements

This section provides the improvements that can be implemented in the short-term and will be integrated in the improved process.

Communication

The communication-related improvement suggestions A, B and C were ranked as high priority and the improvement suggestion D as low priority. All of them were considered to be easy or possible to be improved in terms of time and resources. Therefore, solutions for the four suggestions are developed and will be integrated in the process.

Good communication flow between the NPD process and the related replacement process has been defined as critical requirement for the process (A). In order to ensure a fast and effective transmission of information, as well as a proper coordination between the two processes, two solutions are created. The former is to have the same PMO team (project manager and/or project coordinator) being responsible for both of the related processes. In this way, changes or delays in the NPD process will be easily forwarded to the stakeholders working on the replacement, increasing the quality of coordination between the two processes. If this is not possible, it will be the responsibility of PMO to ensure a good communication flow between the processes, for example having frequent and brief meetings to ensure the status of the processes. This improvement is assigned to PMO due to the coordinating and managing nature of their role. The latter solution is to structure the replacement process stages and activities in correspondence with its related activities in the NPD. Even though the replacement process is set to run as a stand-alone process, it depends on the NPD process, since some actions in the elimination process can't take place before some others are completed in the NPD process. For example, it is not possible to define which components will need to be eliminated before knowing precisely what the design of the new product will be, or when will be set the elimination date without knowing when the new product will hit the market. Therefore, the replacement process will run in parallel, like a second layer on the NPD process, benefitting from a good information flow and coordinated activities.

Within the same area, the job of PMO is further clarified, keeping all the stakeholders involved updated. Sometimes, stakeholders are not updated, especially S&OP and Manufacturing (B). It will be PMO's responsibility to update the stakeholders on modifications of the process, particularly in terms of EoP and SSG. This improvement comes along with a need for coordination and management and is therefore to be executed by PMO.

Another improvement suggested in the communication area is the timing by which Manufacturing and Sourcing get informed of the elimination of a product (C). This information is not always provided at the right time, preventing this functions to properly prepare for the elimination in object. Therefore, in the improved process, these functions are integrated in the initial ECO in order to ensure the happening of the communication and consequently to allow them sufficient time to prepare. This is needed to verify the agreements with suppliers and to find out how the production will be affected. Since the ECO is created by R&D, it will be R&D's job send out the ECOs on time.

Lastly in the communication area, ECOs currently don't have a standard template (D). Not only it is not clear who has to create the ECOs but also there is no current procedure to create them, nor a standard template. This improvement is not evaluated as very important. However, it will be feasible and fast for Husqvarna Construction to provide a standard template, simplifying the task of the creator as well as defining the information expected by the receiver.

Frozen order volumes/changing demand

Two improvements are related to variation in demand (E and F), of which E relates to the frozen order volumes, the production volumes frozen before EoP. Since demand changes, variation in the frozen demand cause stock to vary compared to the expected one, leading to overstock or stock-out of finished products, meaning scrap cost or lost sales. However, the shorter the frozen time, the less the time the factory has to adjust and prepare for the elimination. Therefore, there is a trade-off between cost due to stock variation and cost due to a lack of time for the factory to prepare. Usually, in Husqvarna Construction the frozen order volume period has been set at six months, the minimum required time for the majority of the products to be properly eliminated from a factory.

The first improvement is related to the late communication of the frozen order volumes (E), which cause activities to be postponed and not efficiently carried out. This is mainly due to delays in the activity chain prior to the factories, meaning that S&OP or Product Management does not pass the information on in time. In order to better perform in this area, some activities related to communication are integrated earlier on in the process, to ensure the timing of the communication to the factories.

The second improvement is directed towards stock optimization during the frozen period, meaning the first side of the trade-off (F). Two actions are undertaken: firstly, an initial assessment and establishment of safety stock towards variation of the EoP and SSG are set at the start of the process. This will aim at reducing eventual stock-out through a proper assessment. Secondly, in order to increase the accuracy of the forecasts and therefore of the frozen order volumes compared to the actual demand, instead of having a standard frozen period, an assessment of how much is the minimum time needed by the factories is done before freezing. In this way, if possible, the frozen period will be reduced, thus reducing the horizon of the forecast and consequently increasing its accuracy.

Overstock

Considering that overstock reduction is one of the most important targets of the company and for an elimination process in general, it is important to improve in this regard. Since actions related to reducing occurring overstock of finished products are mainly considered and undertaken after the EoP, in the improvement process it is suggested to take action earlier (I). In particular, S&OP and Sales, who are constantly reviewing their stock, can provide useful information on current stock levels to the product manager, who will be responsible of taking action towards eventual mismatch between the actual stock levels and the expected ones. Eventual actions can take different forms in different aspects, for example selling overstock in different markets than usual, introducing promotion campaigns, outsourcing for more production, remanufacturing similar parts with the old products in case of highly expensive parts, and so on.

Responsibilities

As introduced above, there is no clear split of responsibility between PMO and R&D on who should create the ECOs, thus this blurred area might create confusion as well as discussions (J). It is important that ECOs are issued on time since they are triggering multiple actions in the replacement process. After discussing with the stakeholders, R&D was defined to carry out the ECOs creation. However, since some of the employees in PMO are as of now skilled in this task and are used to create ECOs, the final decision will be delegated to the team.

Tools/Equipment

An improvement suggestion targeting the decrease of the scrap cost is the one related to the consideration of the tools and machines (L). As said before, they are sometimes not taken into account, conclusively finishing as scrap. Therefore, an activity will be introduced that has the sole purpose of evaluating the current tools and machines involved in the replacement process in order to be able to find an eventual use, be it at another production line or another factory. This action will have particular relevance in case the elimination will be carried out in a different factory compared to the introduction of the new product. In this case, if the tools/equipment are needed for the new product, most likely the tools can be shipped to the new factory.

Spare Parts Management

An improvement addressed by Parts Management is the lack of early communication to the function that a replacement is taking place, and therefore some spare parts will need to be eliminated and others substituted (M).
In order to increase the awareness of Parts Management regarding the replacement of a products and its consequences related to spare parts, Parts Management is included in the implementation ECO early on in the process.

6.2.2 Long-term improvement

In this sub-chapter the improvements that are relevant and necessary but are not implementable in the short-term due to large investments required are described.

Systems upgrades

Some of the upgrades cannot be implemented in the short-term. These are mainly referring to bigger investment in IT, requiring upgrades and integration of the current used systems, therefore consuming a conspicuous amount of time, money, and resources.

The status of some parts and spare parts are not correctly registered in the systems (H). Modifying the status of these articles is a manual process that requires the involvement of the R&D and IT departments for modification in the

Master Data System, as well as other actors to manually modify the articles' status in the other systems that are not integrated with the Master Data System. During time, some modifications have been forgotten, causing some systems to be unreliable. Two improvements are available here, but none of them can be completed in the short-term. Firstly, an integration of the systems in the company, hence once one article's status is modified in a system, all the others will be automatically updated. Secondly, a complete review of the articles' status available at the current time. Another system modification that would need to be improved is related to spare parts, due to the currently missing integration between spare parts and its related product within the system (N).

One last improvement that requires more system integration is related to not up-to-date definitions of the products' status in the Sales systems (G). It is not feasible to completely solve this problem at this time. However, introducing a task to review the right registration of the updates on products will mitigate this problem, even though not solving it due to the operativity of the task.

Measurement

A relevant improvement identified is the absence of a central measurement of the scrap cost (K). Even though it was given medium priority, in order to carry out a proper and robust measurement, a deeper analysis on this topic has to be conducted. The proposed analysis should address questions related to: (1) identification of the stakeholders involved, (2) definition of the financial process and calculation, (3) how to integrate the financial related information flow with the process in terms of chronological location and data needed or requested. Considering the proposed questions are beyond the time available for this research, this improvement area needs to be further examined in a future research.

6.3 Improved Process

After having developed solutions for the improvement suggestions, those solutions were used to create an improved elimination process. As a first step, the Visio process map that showed the existing elimination process was updated and modified. As a second step, an Excel sheet containing the elimination activities, a timeline and a RACI matrix was created to display the process in a format that is easy to grasp.

6.3.1 Create improved Business Process Map

In order to integrate the improvement solutions into the Husqvarna Construction elimination process, the Visio process map of the existing elimination process was modified accordingly. The aim for creating the new process map was to keep the same stakeholders and the rough activity streams from the existing process and modify activities, activity packages or stakeholder interactions that were identified to have improvement potential.

When integrating the improvements into the process, most generally three ways of changing the process were used:

- **Modify/add activities:** in comparison to the old process, certain activities were modified or added to the new process. That was the case for activities related to determining the future use of unique tools/machines, or when integrating additional activities that allow more flexibility when deciding on the frozen order volume time. The activity of monitoring the overstock only after EoP was modified towards continuously monitoring overstock throughout the elimination process.
- **Modify/add connections:** connections symbolizing information flow between the stakeholders were modified and added. That was done primarily in parts of the process where certain stakeholders did not receive sufficient information in the old process. For example, in order to inform Parts Management earlier about the elimination of a product, an additional information flow to that stakeholder was introduced.
- **Change responsibilities:** to create a clearer definition of what stakeholder is executing what activity, some responsibilities were assigned differently by moving the activities into the business process line of a different stakeholder. For example, the responsibility for creating ECOs was moved into R&Ds task area.

More generally, in order to create a stronger connection between the elimination process and the NPD process, the elimination process was organized into six process stages that could be linked to the NPD process. Therefore, all activities in the Visio map were placed in the timely order in which they need to be executed and were sorted into the process stage that connects them to the fitting stage of the NPD process. Activities that appear in both the NPD and the elimination process, such as having the Engineering Pilot design to start the elimination process, EoP and EoS were used as connecting parts around which other activities were sorted.

6.3.2 Create ‘easy-to-understand’ Excel version of the process

Since the process map created through Visio is rather complex and difficult to quickly understand for those who are not used to its design, it was decided to use a second tool. In order to represent the process to the stakeholder and to let them more intuitively understand the process and their related tasks, an excel version has been used (Appendix 4). This choice was done because it was used to represent the elimination cycle process, thus the stakeholders were already used to this type of design. Hereby, the structure of the excel file is reported.

The first sheet was used as an introductory page, providing the stakeholders basic and necessary information needed to understand various specifications given later on in the file. An example is what the process represented should be used for, in which situation and when, what does it mean a different color used, how the roles were attributed, and so on.

The main body of the file is composed by six sheets one for each corresponding stage of the NPD in which the replacement process is actively running. In every

sheet a table is presented, which can be divided into three parts: in the first column the activities, listed chronologically, which are the basic tasks that have to be carried out by the stakeholders. The second column is a timeline, representing the chronological sequence of the tasks. However, since the duration of each activity can vary depending on various factors (e.g. NPD), the timeline is based on the NPD sub-stages of the stage related to the specific sheet instead of a 'pure' time measure. The third column is a RACI matrix, therefore representing the responsibility of each stakeholder in relation to each activity. Since two main scenarios were analyzed, one related to a replacement of an old product and an introduction of a new product in the same factory, and one related to replacement and introduction in two different factories, a different color has been used to highlight actions that need to be done additionally only in the second case.

The last part of the excel fila is composed by pages addressed to each single stakeholder. In every sheet, a continuous timeline with all the stages of the NPD process are represented. Thus, while the vertical axis represents the flow of time through the NPD stages representation, the horizontal axis, differently from the timeline in the main body, represents the type of involvement of the stakeholder, in relation to the RACI matrix. Therefore, four rows are represented, one for each responsibility type (responsible, accountable, consulted, and informed. Moreover, the actions represented are only those in which the specific stakeholder is involved. Further, below the timeline, a short description of each action is provided. In this way it has been provided a brief overview on the process from each stakeholder's perspective.

6.3.3 Handbook

A handbook of the improved product elimination process was created to provide the material needed to understand and execute the process. The handbook was presented and distributed to all stakeholders involved in the process and is to be used whenever a product elimination takes place.

The handbook consists of some introducing slides that explain what the process is about, and in which environment it operates. Consecutively the different process stages are displayed, and the activities are described. In order to be able to potentially integrate the elimination process into the NPD process, the elimination process was visualized using the same design that the Husqvarna Construction database use to display processes.

7 Discussion

This chapter discusses the findings drawn from the analysis and the creation of the improved process. It begins with considerations regarding the process implementation, followed by the discussion about how well the findings can be applied to other organizations. The chapter ends with a discussion of the limitations and further research.

7.1 Process implementation considerations

Carrying out the research, three main considerations had to be made. Firstly, how flexible the process should be in terms of how many process variations are integrated, and how specific the activity descriptions should be. Secondly, when and how often the process should run. Lastly, how to represent the process in terms of time.

The first consideration, how the process should respond to process variations, is based on the trade-off between flexibility and standardization. Too much flexibility would result in not clearly defined responsibilities and therefore inefficiencies, whereas too much standardization results in the difficulty to describe a process that can be applied to different factories or scenarios, as well as it would negatively affect employees' engagement. There are multiple reasons why each elimination process has slightly different needs: every factory has its own specific processes, responsibilities within the factories can be divided differently, and the best practice affirmed differ as well. Moreover, some products are mass produced, whereas others are manufactured in small volumes, resulting in differences in terms of purchasing agreements, lead times, and stocks. Furthermore, the NPD process highly depends on the product and its complexity. Some can take up to 2 years, others to 4. Taking into account these differences altogether, necessarily requires the process not to be highly detailed and specified. Therefore, it was decided to avoid activities specification in the sense of "How should I perform an activity?" and to rather aim at defining the output of the activities, answering the questions "What should I do?", or "What do I have to accomplish?".

The second consideration is related to possibly integrate the replacement-related elimination process into the elimination cycle. Having the replacement-related elimination process taking place once every year and integrated with the elimination cycle could simplify its' execution. However, in order not to cause stocks to be kept in vain, the related product that should be introduced, would need to be perfectly timed with the elimination date. Therefore, all the new products related to a replacement would need to be introduced annually too. Since that is not in line with the strategy of Husqvarna Construction, and the numbers of replacements per year are not consistent, it was decided not to have the replacement-related elimination integrated in the yearly elimination process.

The third consideration is related to the NPD process and the timeline of the elimination process. As mentioned before, it is important to provide at least a rough timeline for the process. However, the specific length in terms of time of

the activities was often not provided since it differs from case to case. Furthermore, some activities depend on the NPD process and therefore the specific moment in which they will be able to be conducted depends on the progress of the NPD process. Taking that into account, it was decided to exploit the NPD process as a timeframe itself, using its milestones, stages, or activities as reference for the timeline. In other words, instead of having an activity "lasting for two weeks", the activity "starts in parallel with the milestone X of the NPD process", "starts at the conclusion of activity Y of the NPD", or "in the Production Stage of the NPD process".

7.2 Generalizability of findings

An issue that needs to be addressed is if the described problems are present in all companies that work with product elimination, and if the findings of this thesis can be generalized and applied to other organizations. Since the report is based on a one case study, it is not likely that the same conditions (company size, product range etc.) are to be found in exactly the same way in other organizations. Also, it is not clear if other organizations have the same improvement potentials when it comes to product elimination. For example, a company that is much smaller than Husqvarna Construction or produces different types of products might have a product elimination process that looks very different from the one Husqvarna Construction is running, which means that improvement suggestions would look different as well.

However, the general methodology applied in this study to improve the elimination process can probably also be applied to other organizations. The procedure of first documenting the current situation, then analyzing where improvement potentials of the process lie, and finally creating an improved version of the process is quite universal and can be adjusted to the specific company environment. The research methods used in each of the three stages, such as interviews/archival research in the documentation stage and content analysis/process mapping in the analysis and improvement stages, can be applied by each organization aiming at improving its elimination process.

7.3 Limitations

As described earlier in chapter 3.5, the business process improvement model consists of five main phases (Harrington et al., 1997). However, the limited timeframe of this study didn't allow to carry out the management phase, which consists of updating and adapting the process to changes in the environments and needs of the stakeholders once the implementation is carried out successfully. Alongside with the management phase, and for the same reason, the continuous improvement phase remains undone. This last phase works as a loop meant to integrate incremental improvements in the process. Nonetheless, it cannot be applied without having a process in place, thus, as said before, it was not implemented.

This study is done by analyzing data coming from only one company. Even though some interviews were based on other divisions, they still belonged to the same firm. Therefore, a proper benchmarking analysis is currently missing.

Consequently, the data provided belongs to only one firm. Thus, the overall process proposed cannot be fully generalized, especially considering that there are consistent differences between industries.

The evaluation of the improvement suggestions used to rank and prioritize the suggestions in 5.2.2 was partly done subjectively. The 'importance rating' was created based on the perception of the authors and their opinion about as how important stakeholders considered a suggestion to be. Moreover, the 'improvement rating' that describes how easy/difficult it is to implement a suggestion was also decided based on perception and understanding of the authors. Therefore, it has to be kept in mind that different researchers may come up with a slightly different priority list.

As introduced before, the research focuses on the categories Concrete Sawing & Drilling, Concrete Surfaces & Floors and Light Demolition. Therefore, since the sales function is independent of the categories, it was not interviewed. Thus, the needs and eventual suggestions that Sales could have provided are not integrated nor considered in the proposed process.

7.4 Future Research

This study only covers a fraction of the subject product elimination. Product elimination is still understudied in some areas and needs to receive more attention. Since most research focuses on the decision-making phase of the elimination process, the actual removal process still lacks extensive research. Especially researchers in the field of operational management are encouraged to study the subject and investigate the operational aspects of elimination, such as optimizing the logistical flow and storage of the eliminated product.

Often, in a replacement scenario, the focus is towards the new product rather than equally be towards both the introduction and the elimination. Can the replacement process exploit synergies from multiple replacements or eliminations? Are there best tools to ensure flexibility towards the introduction of the new product and at the same time decrease scrap cost? More case studies digging deeper in the area of product replacement could help to identify and define common practices of successful replacement implementations.

One important research area that needs to be studied deeper is how the success of an elimination process can be measured. What are the most relevant KPIs of the process? How should they be calculated? Moreover, it needs to be further investigated how scrap costs can be gathered in an effective way to be a meaningful factor for measuring the process and what other factors can be used to measure and quantify the elimination process.

Lastly, there is a need to study the topic of product elimination on a larger scope, not only by using a single case study. Is there an optimal elimination process? Are there different optimal elimination processes different types of industries? A multiple case study involving companies of different sizes and from different industries would help to create a more generalizable theory on product elimination.

8 Conclusion

This thesis aimed at identifying improvement potential within the current product elimination process at Husqvarna Construction and to develop an improved elimination process that has a higher degree of cost-efficiency, transparency and a suitable balance between flexibility and standardization. More specifically, the following Research Questions were investigated:

1. *What are the improvement potentials with the replacement-related product elimination process at Husqvarna Construction?*

2. *How can the replacement-related product elimination process at Husqvarna Construction be improved?*

The improvement potentials related to the current elimination process are described in detail in chapter 5.2.1. In total 14 improvement potentials were identified, those being sorted in seven broader themes: (1) Communication, (2) Frozen order volumes, (3) System updates, (4) Overstock, (5) Tools/Equipment and (6) Spare Parts Management and (7) Measurements.

The first theme that can be improved is the communication between the elimination process and the corresponding NPD process, as well as the communication within the elimination process in terms of communicating information at the right time to the right stakeholder. Secondly, order volumes are not always frozen on time and are not managed flexibly enough, leading to overstock. Another improvement theme covers IT systems containing product information not always being up to date and therefore complicating the elimination process. Moreover, overstock is mostly only addressed after the end of production, leading to a lack of time in reducing it and tools/equipment that are unique to the production process of the eliminated product are sometimes neglected. The sixth theme covers the lack of attention towards spare parts involved in the elimination process. Lastly, no clear measurement exists to evaluate the success of an elimination process.

Taking into consideration the improvements potentials developed, an improved version of the product elimination process was created (chapter 6). Most generally, the existing process was used as a foundation when building the improved one, meaning that the process did not get changed fundamentally, but rather improved and adjusted. As suggested in the literature, the involvement and engagement of the stakeholders participating in the process was paid high attention to. Not only were they asked for their improvement suggestions, but they were also properly prepared, and it was made sure that the stakeholders are willing and motivated to carry the change out. Additionally, the new process was well documented and made understandable for everyone. When creating the improved process, it was distinguished between immediate changes and long-term changes. Immediate changes were integrated in the improved process and meant to be applied directly. Long-term changes required large investments in terms of time or resources and were therefore suggested to be implemented in the future. Improvement suggestions addressed in the fields of (1) Communication, (2) Frozen order volumes, (4)

Overstock, (5) Tools/Equipment and (6) Spare Parts Management were mostly included in the improved process, solving them immediately. Suggestions related to the fields (3) System updates and (7) Measurement were not feasible to be solved in the short term and therefore labeled as long-term improvement suggestions.

Finally, it is concluded that the current product elimination process at Husqvarna Construction has been neglected in the past, since the New Product Development Process was considered to be more relevant. With the aim of shedding more light on product elimination, improvement potential in the process was identified and an improved process was designed. Once tested and implemented, the process is expected to reduce costs and equip stakeholders with a transparent process guideline. Since the improved process was developed specifically for Husqvarna Construction, it cannot be applied in exactly the same way to improve other organizations' product elimination processes. However, the thesis provides a generalizable framework of methods to be used when approaching the task of improving an elimination process.

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Appendix

Appendix 1

Interview Topic Guide

1) Introduction: (5 min)

- Explaining the Master Thesis topic and the purpose of the interview
- Ask if it is okay to record
- Inform interviewee about discretion (recording only for internal purpose, no names published)
- Shortly introduce agenda

2) Opening questions: (5 min)

- What is your role within the company?
- What tasks do you execute? What other stakeholders do you work with?

3) Questions about the **process**: (35 min)

<u>Mapping:</u>

- What is your part in the elimination process**?** (Input, activity, output)
    - **Input**:
- Who do you get information from? What type of information? How?
    - **Activity**:
- What activities do you perform within the elimination process? Why are you supposed to do them?
- Does your work within the elimination process always look the same? How does it vary? What does that variation depend on?
- Do you have any instructions for your activities (e.g. deadlines or how-to-do lists)?
    - **Output**
- What information do you pass on? Who do you pass it on to? How? Why to this person?

<u>Measurement:</u>

- How much of your working time do you typically dedicate to elimination process related tasks? How is this time used/what activities are most time intense?
- Do you have any direct costs related to the elimination process?
- How do you evaluate your work within the elimination process?

<u>Problem identification:</u>

- What works less well within the elimination process? Who is affected by that and why?
- If you could change something related to your role in the process or the process itself, what would you change? Why?
- Are there any tasks that you think are non-value adding?

4) Closing questions

- Ask to potentially have follow-up interview, if necessary

Appendix 2

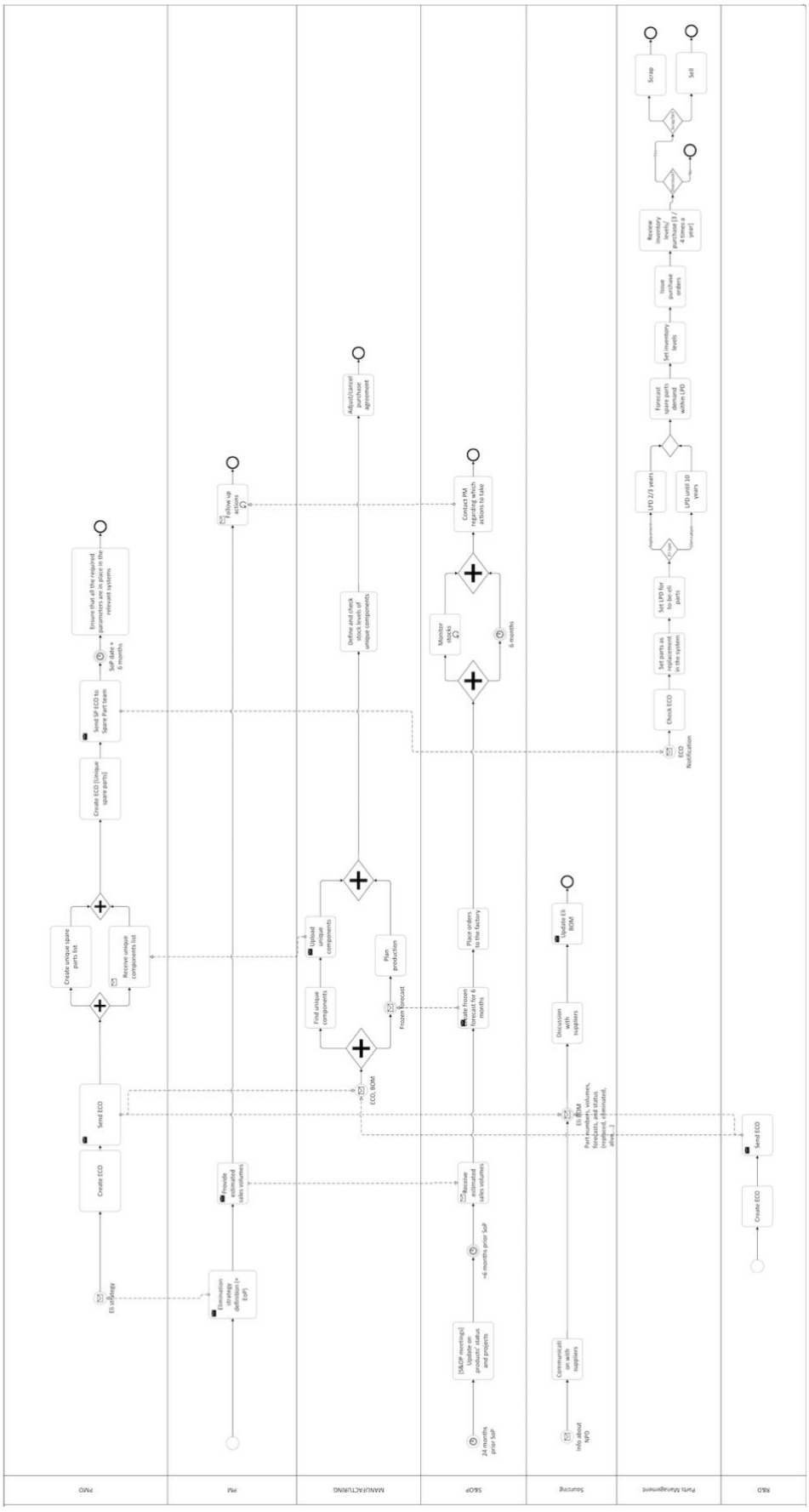
First Round			
Interview	Function involved	Date	Face-to-face/digital
Focus group discussion	Gardena - Process development	February 3, 2020	Face-to-face
Interview #1	Product Manager 1	February 10, 2020	Face-to-face
Interview #2	Product Manager 2	February 11, 2020	Face-to-face
Focus group discussion	Husqvarna Division – Business Support	February 12, 2020	Face-to-face
Interview #3	Product Service Management	February 13, 2020	Face-to-face
Interview #4	Parts Manager 1	February 13, 2020	Face-to-face
Interview #5	Parts Manager 2	February 13, 2020	Face-to-face
Interview #6	Sales & Operations Planner 1	February 17, 2020	Face-to-face
Interview #7	Project Coordinator	February 18, 2020	Face-to-face
Interview #8	Product Improvement Driver	February 19, 2020	Face-to-face
Interview #9	Project Manager 1	February 21, 2020	Face-to-face
Interview #10	Project Manager 2	February 21, 2020	Face-to-face
Interview #11	Project Coordinator	February 21, 2020	Face-to-face
Interview #12	Purchasing Director	February 24, 2020	Face-to-face
Interview #13	Sales & Operations Planner 2	February 26, 2020	Face-to-face
Interview #14	Sales & Operations Planner 3	February 26, 2020	Face-to-face
Interview #15	Sales & Operations Team leader	February 26, 2020	Face-to-face
Interview #16	Production Preparer 1	February 28, 2020	Face-to-face
Interview #17	Purchasers 1 and 2	February 28, 2020	Face-to-face
Interview #18	Production Planner 1	February 28, 2020	Face-to-face
Interview #19	R&D Chief Product Engineer	March 2, 2020	Face-to-face
Interview #20	Production Preparer 2	March 3, 2020	Face-to-face
Interview #21	Production Planner 2	March 3, 2020	Face-to-face
Interview #22	Central Demand Planner	March 5, 2020	Digital meeting

Interview #23	Production Preparer 3 and Planner 3	March 10, 2020	Digital meeting
Interview #24	Master Data Manager	March 13, 2020	Digital meeting
Interview #25	Controller	March 18, 2020	Digital meeting

Second Round			
Interview	Function involved	Date	Face-to-face/digital
Interview #26	Production Preparer 2	April 22, 2020	Digital meeting
Interview #27	Division Vice President	April 28, 2020	Digital meeting
Focus group discussion	Project Management Team	May 5, 2020	Digital meeting
Interview #28	Production Preparer 1 and Planner 1	May 12, 2020	Digital meeting
Interview #29	Production Preparer 3 and Planner 3	May 20, 2020	Digital meeting

Interviews conducted – First and second round

Appendix 3



Business process map of the existing elimination process

Stage Input	Development Stage - Phase 2	Product Design	Evaluate Product Design	Review Project	Summarize and Report	PMO	Master Data Management	Product Manager	Manufacturing	S&Op	Sourcing	Parts Management	Sales	R&D	Finance	Stage Output
Engineering Design Freeze	1. Evaluation of essential (own) production tools/equipment to be shipped (Only when eliminating in different factory)							A	R							Phase-out strategy
Business Case	2. Evaluation of essential (external) production tools/equipment to be shipped (Only when eliminating in different factory)							A			R					Defined EoP date
Risk Analysis	3. Decide Phase-out strategy and EoP date					I		A/R								Defined EoS date
Manufacturing Concept Freeze	4. Communicate Phase-out strategy to stakeholders					A	I	I	I	I	I		I	I		Elimination ECO
	5. Request Elimination ECO					A		R					I			Tools/Equipment concept
	6. Creation of Elimination ECO (at least 6 months before EoP)					A			I		I	I	R			
	7. Inform Compliance about product that will be eliminated					A/R										

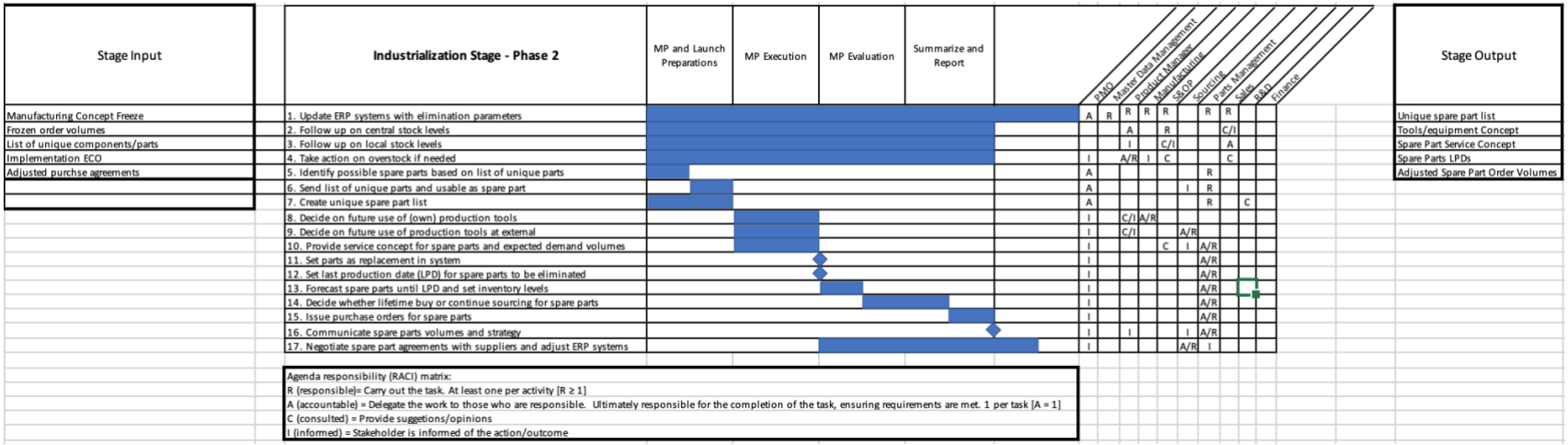
Agenda responsibility (RACI) matrix:
R (responsible)= Carry out the task. At least one per activity [R ≥ 1]
A (accountable) = Delegate the work to those who are responsible. Ultimately responsible for the completion of the task, ensuring requirements are met. 1 per task [A = 1]
C (consulted) = Provide suggetions/opinions
I (informed) = Stakeholder is informed of the action/outcome

Process stage 1 – Excel visualization

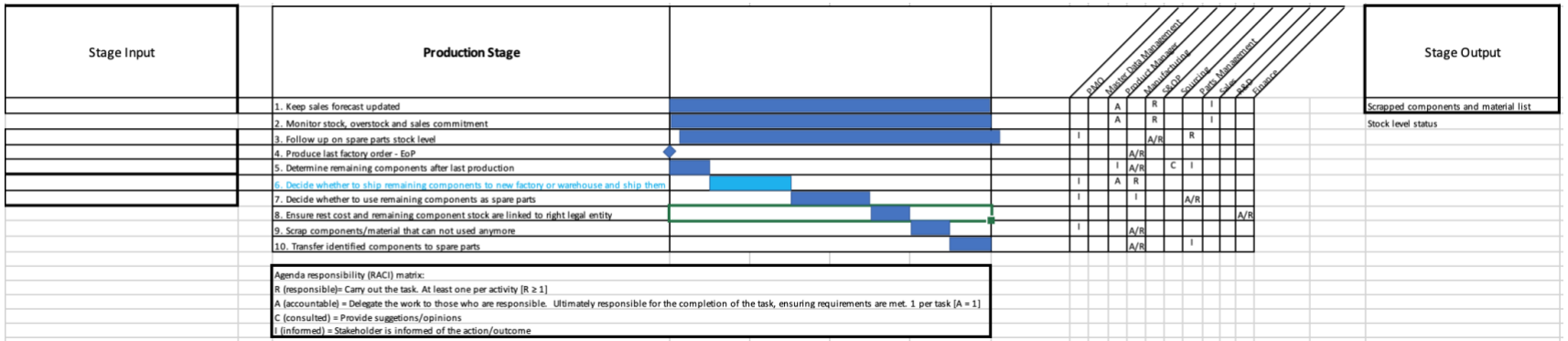
Stage Input	Industrialization Stage - Phase 1	EP and Launch Preparation	EP Execution	EP Evaluation	Summarize and Report	PMO	Master Data Management	Product Manager	Manufacturing	S&Op	Sourcing	Parts Management	Sales	R&D	Finance	Stage Output
Elimination ECO	1. Update article lifecycle attributes in STEP					A	R	I								Implementation ECO
Defined EoS date	2. Request Implementation ECO					A			R						I	Frozen order volumes
Defined EoP date	3. Create Implementation ECO					A			I		I	I			R	List of unique components/parts
Defined SSG date	4. Define overstock needed to keep flexibility towards possible delays of SSG					I		A		R	R		C			Concept for remaining components
Phase-out strategy	5. Identify unique parts to variant					I			A/R		I	I			C	Adjusted purchse agreements
Engineering Design Freeze (BOM)	6. Cycle count factory - check stock on hand of component and raw material					I			R		A					
Risk Analysis	7. Cycle count supplier - check stock on hand of component and raw material at supplier					I			R		A					
	8. Check suppliers contract and identify shared volumes with other factories from the same suppliers							I			A/R					
	9. Identify expected remaining stock of raw material and components								R		A					
	10. Manufacturing and Sourcing identify the time before EoP in which order volumes need to be frozen					I			R	A	C					
	11. Freeze order volumes before EoP								I	A/R						
	12. Evaluate relocation of remaining stock of raw materials/components							A	R							
	13. Identify potential production/use of remaining components					I		A	R				I			
	14. Sourcing adjusts/cancels purchase agreements					I			I		A/R					

Agenda responsibility (RACI) matrix:
R (responsible)= Carry out the task. At least one per activity [R ≥ 1]
A (accountable) = Delegate the work to those who are responsible. Ultimately responsible for the completion of the task, ensuring requirements are met. 1 per task [A = 1]
C (consulted) = Provide suggetions/opinions
I (informed) = Stakeholder is informed of the action/outcome

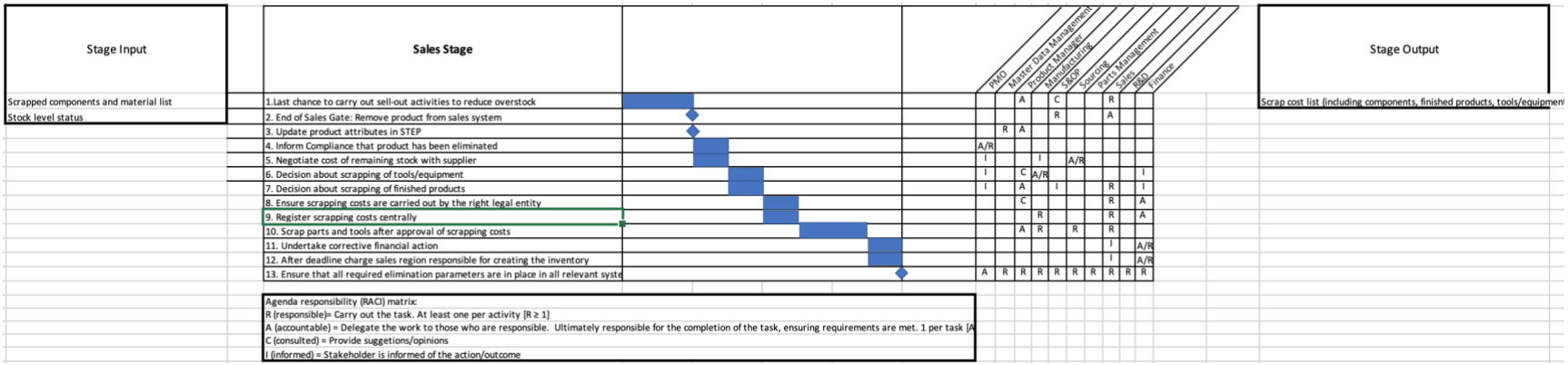
Process stage 2 – Excel visualization



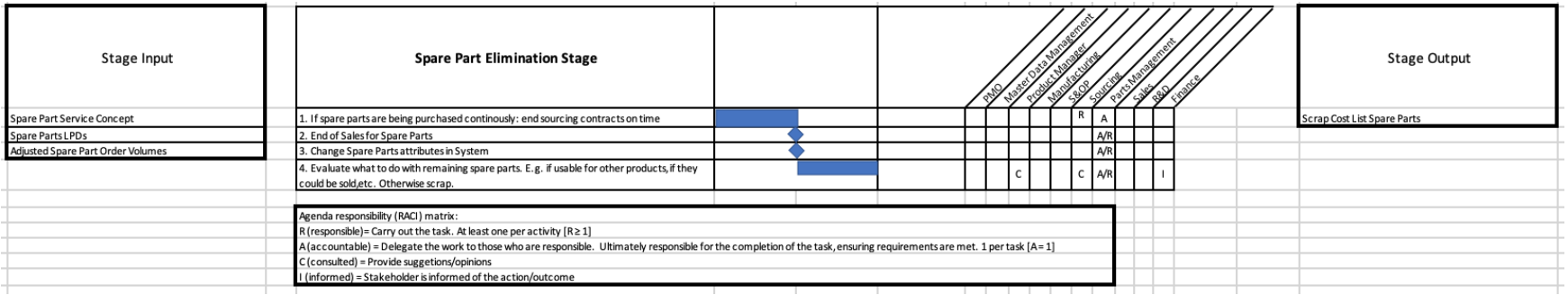
Process stage 3 – Excel visualization



Process stage 4 – Excel visualization



Process stage 5 – Excel visualization



Process stage 6 – Excel visualization

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