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A CUSTOMER-ORIENTED PRODUCT PHASE DOWN PROCESS IN A GLOBAL COMPANY

Master's Thesis

Supervisor: Professor Asta Salmi

ABSTRACT

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Companies product portfolio shows how well companies answer to customer requirements and needs. To make product portfolios competitive and comprehensive, older and unprofitable products must be phased down. The objective of this thesis is to understand how customers perceive a product phase down and how phase downs affect customers so the case company would operate in a customer-oriented way. Additionally, the benefits of product phase downs are searched to find motivation to conduct product phase downs in the future.

Product lifecycle management and product portfolio management are presented in the literature review. The empirical part of the thesis is based on interviews with customers and representatives within the case company. How product phase downs are seen in large companies that operate in global markets can be identified because of this research. Customers see communication, replacement product and its availability as well as proper control of the phase down process as the most important elements in product phase downs. Proper communication to customers improves the quality of phase down process and satisfies the customers. The case company should thus use regular checkpoints within the phase down process. It is then ensured that the customers are informed of needed issues on time.

TIIVISTELMÄ

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Tuotteen alasajoprosessi, tuotteen elinkaarihallinta, tuoteportfolion hallinta, tuotehallinta, asiakaslähtöisyys

Yritysten tuoteportfoliot pyrkivät vastaamaan asiakkaiden tarpeisiin ja toiveisiin. Jotta tuoteportfolio olisi kilpailukykyinen ja kattava, vanhoja ja kannattamattomia tuotteita pitää toisinaan ajaa alas. Tämä ei vaikuta ainoastaan kyseisen toimittajan toimintaan vaan myös toimittajan asiakkaisiin. Tämän työn tarkoituksena on selvittää, millaisena asiakkaat näkevät tuotteiden alasajoprosessin sekä miten tuotteiden alasajo vaikuttaa asiakkaiden toimintaa, jotta case yritys toimisi asiakaslähtöisesti alasajoprosesseissa. Lisäksi tutkitaan alasajon mahdollisia hyötyjä, jotta löytyy motivaatio toteuttaa tuotteiden alasajoja tulevaisuudessa.

Tuote-elinkaarihallinta sekä tuoteportfolion hallinta esitellään työn kirjallisuuskatsauksessa. Työn empiirinen osuus pohjautuu asiakas- ja case yrityksen haastatteluihin. Työn lopputuloksena ymmärretään, miten tuotteiden alasajot nähdään isoissa yrityksissä, jotka työskentelevät globaaleilla markkinoilla. Kommunikaatio, korvaava tuote ja sen saatavuus sekä asianmukainen prosessin hallinta nousivat asiakkailta esiin tärkeiksi asioiksi tuotteiden alasajoihin liittyen. Kommunikointi asiakkaille parantaa alasajoprosessin laatua ja tyydyttää asiakkaita. Case yrityksen tulisi hyödyntää alasajoprosessissaan tarkastuspisteitä, jolloin case yritys pystyy varmistamaan, että asiakkaita informoidaan tarvittavista asioista alasajoon liittyen ajallaan.

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Viola Helynranta

Espoo

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ABBREVIATION LIST

B2B – Business-to-Business

B2C – Business-to-Consumer

BOL – Beginning-of-Life

BOM – Bill of Material

EOL – End-of-Life

FG – Finished Goods

JIT – Just-In-Time

KPI – Key Performance Indicator

MOL – Middle-of-Life

LCM – Life Cycle Management

NPD – New Product Development

PDM – Product Data Management

PLM – Product Lifecycle Management

PPM – Product Portfolio Management

RQ – Research Question

R&D – Research & Development

SCM – Supply Chain Management

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1 INTRODUCTION

Companies use product portfolios to answer customer needs. However, technologies and desires change as the knowledge, markets and the world overall improves and changes constantly. This leads to the need for continuous updates of product portfolios. Some new products are added, some are kept in the portfolio with limited services and additional elements and some are removed from the portfolio overall. So simultaneously while product portfolio management is conducted, product lifecycle management is also needed.

PLM's role has increased due to globalization. With an increasing number of actors involved, using product lifecycle management can help finding the necessary information at the right time in the complex and constantly changing environment. Other reasons why companies should use product lifecycle management are the easier management of complex products, decrease in the time span of product lifecycles, the increased role of environmental issues and a push into the supply chain. (Ameri & Dutta 2005, p. 583-584; Stark 2015, p. 25) A company can be seen as its products. Products are the heart of the company as they are what the customers want and what brings the company revenues. The focus on products and customers is also a reason why PLM is seen as an important management activity. (Stark 2015, p. 18-19) Other reasons to focus on PLM can be quality and business process Improvement and time and cost Reduction (Stark 2015, p. 307-308). PPM is used to align the portfolio with company's strategy and targets, and especially to be able to answer effectively to customer and market needs (Cooper et al 1999, p. 334).

In B2B markets, conducting product phase downs are difficult as companies are afraid of how customers will react to phase downs (Homburg et al 2010). This leads to product phase downs not being so present. In this study product phase downs are considered as a process or activity when products are removed from the market and from the product portfolio. Some may refer to this as product

elimination or ramp down. Phase down term can be also considered as an activity when a product is phased from one lifecycle phase to the following one. For the case company a phase down is a process when the product is moved to its next lifecycle phase, but simultaneously the product is removed from the case company's portfolio and is no longer available to the customer.

The thesis' literature review reveals that product phase down's specifically are not researched much, especially in B2B markets. New Product Development and product lifecycle management and product portfolio management related to NPDs are more apparent. This shows a research gap in areas related to product phase downs, which this study aims to answer.

1.1 Background of the thesis

The case company sees that they need to improve their product offering and one of the areas to focus on is the complete product portfolio. Product Management is the function that is in charge of managing products throughout their lifecycles and aligning the portfolio with business strategy. Product Management also ensures that the case company's product portfolios bring value to customers. To help in these tasks, the case company utilizes product lifecycle management and product portfolio management. Over the years, the focus has been on developing new products or upgrading existing products. From now on, the case company wants to focus on harmonizing their product portfolio and this will require phasing down products, which are possibly not bought by customers or are becoming outdated.

The case company has not removed products from its product portfolios in many years and the portfolios have grown to answer customer requirements by developing new products and upgrading existing products. Now as the focus has moved to portfolio harmonization and making a more competitive portfolio, which will require product phase downs in the case of the case company, there

must be a systematic product phase down process developed. The case company is conducting a Portfolio Simplification program to reduce the complexity in product portfolios and each function and all involved parties are considered in the project. Customers are one of the involved parties and this thesis explores how to make product phase downs more customer-oriented.

1.2 Targets and settings

Product phase downs are not that much conducted in the case company and it is also a quite unfamiliar subject in research. Previously the focus in the case company has been more on fulfilling customer requirements with new products but the older products in the portfolio were neglected. Product phase downs affect the case company's customers as well, so the aim of this research is to get an insight on how the customers are affected by phase downs, what the customers require from the case company's product phase downs and what kind of support customers might need when the case company conducts product phase downs. From this thesis, the case company wishes to receive customers' opinion, which they can take into consideration when developing a systematic product phase down process. Also, the aim of this thesis is to bring knowledge to B2B markets on how product phase downs should be conducted in a customer-oriented way.

The main research question in this study is:

- *How to conduct product phase downs in a customer-oriented way? (RQ)*

To get an understanding on the product phase down process, three sub-questions are used:

- *How does the case company perceive a product phase down process? (RQ1)*
- *How do different customer types of the case company perceive a product phase down process? (RQ2)*

- *What are the possible benefits of conducting product phase downs in the case company? (RQ3)*

The question RQ1 focuses on the case company's, especially Product Management's, view of a product phase down process and the link between product lifecycle management and product portfolio management to phase downs can be found. By utilizing this, it can be understood how the customers view on product phase downs differs from the case company's view and conclusions can be drawn on how the case company might have to change their Product Management activities and especially their perceived phase down process to answer their customers' requirements.

The aim of the research question RQ2 is to understand how the case company's customers see a product phase down process. This helps the case company to see how they could satisfy the customers with product phase downs by considering the actions that customers see as the most important ones. The research question RQ3 aims to give the case company a motivation to conduct product phase downs even though they are quite unfamiliar and product phase downs might affect negatively on business. These three sub-questions give then a deep understanding on what needs to be considered in customer-oriented product phase downs.

1.3 Structure of the report

This thesis report consists of nine chapters, which are demonstrated in Figure 1 below. The report of the study is structured by starting with the theory of the study. The identified theory topics were product lifecycle management and product portfolio management, and these are described in Chapters 2 and 3. Overall the target is to find a comprehensive view on PLM and PPM to form a foundation to product phase downs. A short consolidation of these two topics is

also provided in Chapter 4 to understand how product phase downs are connected to PLM and PPM.

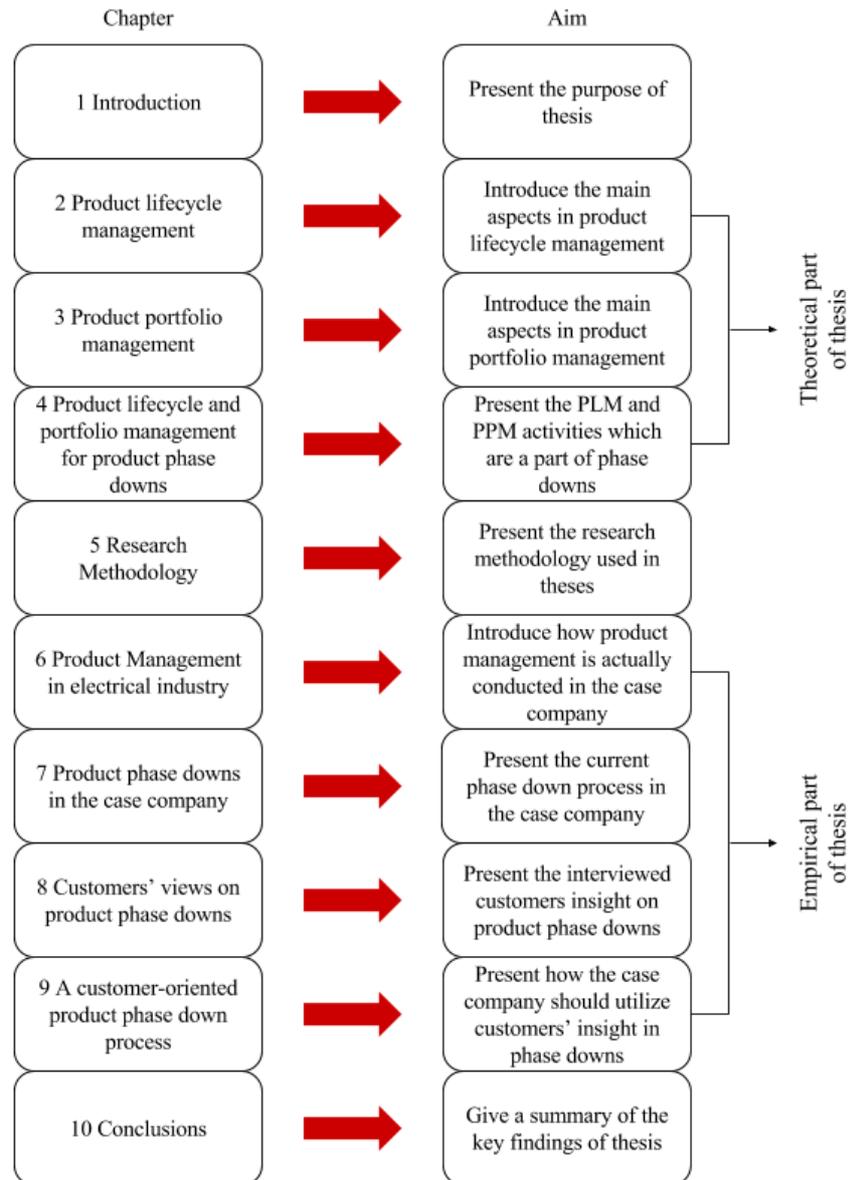


Figure 1 Chapters and their aims

Chapter 5 focuses on presenting the utilized research methodology. In addition, the data collection methods and data analysis methods are described. The validity of the conducted research is also evaluated.

The case company is presented in Chapter 6. The basic practices in the case company's Product Management are described to understand how product lifecycle management and product portfolio management are conducted and how product phase downs are related to those management practices.

Chapter 7 focuses on presenting the case company's view of product phase down processes in addition to the benefits of doing product phase downs. In Chapter 8 the customers' view on product phase downs is described. The focus is on how customers see the case company should conduct product phase downs. Also, the effects of the case company's product phase downs are presented to the case company to see how their operation affects their customers.

The findings from interviews with the case company and the customers are combined in Chapter 9 to see how the case company should conduct customer-oriented product phase downs. Chapter 10 contains a short conclusion of the study.

2 PRODUCT LIFECYCLE MANAGEMENT

When managers are evaluating how a product performs, they should take into consideration the product's lifecycle stage. In this chapter product lifecycle as well as its management characteristics are introduced. This helps managers to evaluate for example what should be each product's expected sales volumes and what will be the next steps for the product.

2.1 Product lifecycle model

Product lifecycle has different phases and it depends on the product, the researcher and the viewpoint how many phases exist. One of the most recognized views in product lifecycles is the marketing lifecycle. Its steps are introduction, growth, maturity and decline. The marketing lifecycle includes the phases after a product is produced: the product's lifecycle in the market. The marketing lifecycle model (Figure 2) shows the sales volume or revenue measured against time and this forms a bell-shaped curve with the lifecycle stages. (Taylor & Taylor 2012, p. 542-543; Nieto et al 1998, p. 443) Hsueh (2011) demonstrates that in the introduction phase demand is at a low level, in the growth phase demand increases rapidly, in the maturity phase demand stabilizes and in the decline phase demand begins to decrease. Stark (2015) introduces five different phases in the product lifecycle and here the viewpoint of the lifecycle is on manufacturers and users. The phases within this cycle are: imagine, define, realize, support/use and retire/dispose. Also an environmental viewpoint is considered. Stark's (2015) lifecycle (manufacturing and usage viewpoint) includes the phase when the product is just an idea in the designer's head and the definition phase focuses on making a detailed description of the idea, the product.

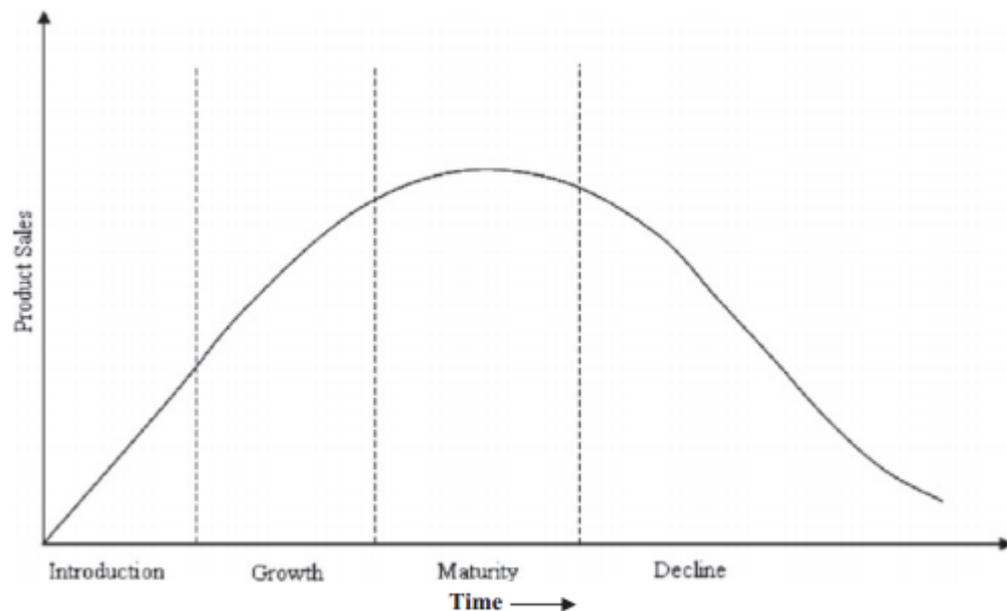


Figure 2 Product lifecycle model (Taylor & Taylor 2012, p. 543)

Product lifecycle can also be seen as different stages. The first stage is Beginning-of-Life. BOL consists of the design and manufacturing of a product. The second stage is Middle-of-Life where the product is distributed and it will be in the hands of the final customer. End-of-Life is the final stage of the product. During this stage, the product will be recollected to the company so it can be disposed or recycled. The discussion when a product enters the End-of-Life stage depends on what the manufacturer has decided, but one reason can be that it does not provide value to the customer anymore. (Terzi et al 2010, p. 364-365; Kiritsis et al 2003, p. 190)

Product lifecycle models have been adopted widely, but it has faced criticism as well. Concerning the phases' length and timing between products or their sales volumes that will be reached, standardization is mostly nonexistent. The time spent in a certain phase depends on products and this affects the shape of the product lifecycle model as different product classes and product characteristics each have a different lifecycle need. Taylor & Taylor (2012) refer to Moon's

(2005) article of how the value of the product lifecycle as a predictive managerial tool can be questioned. Wrong decisions can be made, for example in marketing, if one does not know correctly in which stage the product is in the life cycle. (Taylor & Taylor 2012, p. 542-543)

2.2 Product lifecycle management's characteristics

Product lifecycle management is seen as a business activity companies use to manage their products as individuals across their entire lifecycles, where product's components must also be considered. Thus, PLM is a holistic approach. When managing product lifecycles, it is important to notice that as both the products and the products' parts have to be included as well as different services, activities, processes, people, skills, data, ICT, knowledge, techniques and standards. (Stark 2015, p.1&16; Terzi et al 2010, p. 364) The aim with product lifecycle management is to improve product related performance and capability. When succeeding in this, revenues will improve, product costs will be reduced and the value of current and future products will be maximized as well as the value of the product portfolio. (Stark 2015, p. 1) There are different methods and techniques, which have been recommended in improving product development time, decreasing product development costs and product quality costs. Concurrent Engineering, Lean Production, Life Cycle Design and Total Quality Management are few of these. (Stark 2015, p. 12)

Product lifecycle management is conducted by using databases effectively. Previously product lifecycle management was used at a departmental level. Marketing had their own information and knowledge, research & development had their own and manufacturing had their own. The isolated thinking was also visible in each department having their own way of working and storing data. Nowadays, product lifecycle management is a more business-oriented, joined-up and product-focused approach, where not only functions but also activities are

joined together. Cross-functionality is key as product lifecycle management is used in cross-functional business processes. Marketing shares their knowledge with the research & development department and vice versa. (Stark 2015, p. 2-3&17) Previously product data was managed mainly when the product was in the hands of the company itself. Now with product lifecycle management it is possible to have a seamless flow of data and it can be updated and traced by all actors involved. Data can flow from designers to distributors and from customers back to producers and designers. This enables that all necessary data can be stored, from the design and idea to the end of the product's lifecycle. With this way of sharing and storing a big amount of data, current products can be fixed before they end in the customers' hands and future products can be improved. (Terzi et al 2010, p. 383; Kiritsis et al 2003, p. 189)

It is important to know where the company is at before starting to implement product lifecycle management. Knowing where a company is and what it represents helps to understand what needs to be improved and what practices fit the company better in switching and using PLM. There is different paths companies use when starting to implement PLM and there are three different steps in each path. The first step is the situation where the company was before starting to implement PLM, which refers to a more isolated way of managing products through their lifecycles. In the transition step companies are partially using their previous way of working and partially using PLM. The last step is the full implementation of PLM. The different paths occur as the length of the three steps varies between companies. (Stark 2015, p. 35)

2.3 Management practices in product lifecycle management

Stark (2015) introduces 5 key pillars that are supporting elements of the Product Lifecycle Management practice. These elements help the company to succeed with PLM. The first one is business processes, where the processes of business

should be aligned with the lifecycle of the offered products and vice versa. One of the pillars is Organizational Change Management and it will be covered in chapter 2.5. The remaining 3 pillars, product data, PLM applications and Project Management will be described shortly below.

Managing product data is important and Stark (2015) introduces Product Data Management system, which manages product data throughout the product's lifecycle. As PDM is a computer system, data can be updated easily. Product data consist of the know-how of the product and know-how of the product's design, manufacturing, support, usage and disposal (Stark 2015, p. 132). According to Stark (2015), if a company is not able to have control of the data of products, it will not be able to manage the products. As the amount of product data is big, companies are using Product Data Architecture to show with models how the data is organized and related to each other. Related parts of data creation such as procedures, standards and rules are defined as well as use and storage. Product data architecture makes effective working throughout the product lifecycle possible. (Stark 2015, p. 142) PDM helps in providing the correct information at the needed time to whoever needs it as there are many different individuals in a company providing data and needing product data. With PDM companies can respond to customers more flexibly and companies can improve productivity, as data is up-to-date and should be in easy access (Stark 2015, p. 188). This helps the reusability of data. However, it is important that product data does not get in unauthorized hands, for example a competitor. (Stark 2015, p. 132) There are many computer systems that companies can use in product lifecycle management. It is important to find the appropriate systems and applications, which fit the company's business and help reaching the performance levels wanted. (Stark 2015, p. 198)

Project management has a key function in product lifecycle management as PLM consists of many smaller interrelated projects. Because of this, everybody involved in PLM must to understand the basic principles of project management.

New product developments as well as a product phase downs are examples of PLM projects. By utilizing project management in PLM, roles and responsibilities are clear for individuals from different functions and it helps in conducting PLM on-time and on-budget. (Stark 2015, p. 270-271)

2.4 Product lifecycle management's actions and processes

Product lifecycle management has different tasks in different stages of the lifecycle. Concerning Kiritsis et al's (2003) lifecycle stages, during the Beginning-Of-Life stage product lifecycle management is mainly a design support system. Sharing information is essential between actors during Middle-Of-Life and End-Of-Life, and product lifecycle management is a service support system also. MOL and EOL also need information from BOL to understand and analyze how the product behaves and how it is structured. (Terzi et al 2010, p. 379-381)

Stark (2015) highlights management activities in each of the manufacturers' and users' lifecycle phase. During the imagination phase, products need to be managed to ensure that the ideas are not lost or misunderstood. Meeting customer requirements is the main management activity in the definition phase. During the realization phase, product management focuses on ensuring that correct product definitions are used in production. Maintenance is the key management activity in usage phase. During disposal, management makes sure that toxic waste and poisonous components are handled accordingly.

Environmental sustainability pressure has increased rapidly in the last years and not just in how the end-product is environmentally friendly. Companies must evaluate more what they should do with products as they reach the end of their lifecycle. Remanufacturing is seen as a reasonable choice when there has also been an increased pressure on shorter product lifecycles. With remanufacturing, used or broken products are reused. Other reasons for remanufacturing can be

legislation, secured spare part supply and increased profitability. Hsueh (2011) refers to Mukhopadhyay's and Ma's (2009) research article where it is demonstrated how remanufacturing inventory control is hard. For each lifecycle phase production lot size, reorder point and safety stock has to be set. If these are not considered, product shortage or overstocking might occur. (Hsueh 2011, p. 645-646; Östlin et al 2008, p. 338)

Processes are an essential part of business activities and there are also certain processes in product lifecycle management, which are industry-, product-, and company-specific (Stark 2015, p. 79). These processes also differ between the different phases in the product lifecycle. According to the manufacturers' and users' lifecycle model, the processes are the Product Idea process, the Product Definition process, the Product Realisation process, the Product Support process and the Product Phase Out process. There is also an additional process, the Product Portfolio Management process, which will be covered in Chapter 3. These processes in PLM must be managed accordingly and some companies utilize a Process Group, which task is to define, maintain and improve the processes. For a process to work, the process's target needs to be clearly defined and stated as well as the scope of the process needs to be decided. The definition of the process scope is important in understanding where the process starts and ends and what are its boundaries. Other important characteristics of the processes, which need to be clearly defined, are where the process is in the company's whole process architecture, what are the process activities and the process's customer needs to be recognized and understood. (Stark 2015, p. 76-78)

Critical processes in the product lifecycle are the design and analysis of the lifecycle. Both the design and analysis handles the whole lifecycle, from the idea to the disposal of the product. Info will be gathered for example from raw materials, production methods and usage/disposal patterns. The analysis of the product lifecycle as well as the lifecycle modeling will show where are the most value-added work and activities in the cycle and where waste can and should be

removed. Concerning the EOL phase, the value can be added by increasing sales by upgrading products or another option is to exit the market with removing the product from the portfolio, licensing or by selling it. (Stark 2015, p. 100) Essential is to also have a standard product development process and support methodology. These let participants know what is happening currently and what has happened as well as what will happen at each lifecycle stage and what resources are needed at each phase and its activities. They also show how well the lifecycle and its phases fit the company's organization and business. (Stark 2015, p. 101)

Hines et al (2005) present new product development in the context of PLM by adding Lean thinking also to it. NPD processes as well as PLM and PDM have a few complications. These may not understand the poor alignment of product development strategy to business strategy and the poor understanding of customer requirements as well as there can be a lack of standardized processes. By using a Lean approach these problems can be tackled. (Hines et al 2005, p. 868) Lean processes start by understanding the customer needs and requirements first. The customer can be both external and internal. Kano analysis is a model companies can use as it helps in understanding if their products provide value to their external customers (Hines et al 2005, p. 873). The target is to "meet or even exceed the expectations" of customers (Pai et al 2016, p. 3-4). To understand the internal customers, companies need to focus on activities, which bring value and eliminate the ones that do not bring value by making sure operational activity is aligned with business strategy.

Once the customer requirements are understood, the next step in a Lean NPD process is to map the current AS-IS process, analyze what is right and wrong in it and then map out a TO-BE process. Mapping the AS-IS and TO-BE processes helps also when improving or deploying other PLM and PDM processes, for example in product phase downs. The next steps are adding technical and people aspects to the process. The fifth step is developing the single project standard. The single project standard should have repetitive cycles of product development and

the aim is to define particular product value streams. By having repetitive cycles, PLM teams can more easily learn from their previous errors. By having a few standard processes, future projects can be more easily conducted. By categorizing products, the analysis and deciding on future steps are easier. The final step is developing a complete process standard, where product strategies are defined and illustrated. (Hines et al 2005, p. 872-882)

2.5 Challenges and benefits in product lifecycle management

Product lifecycle management is used to help companies have control over their products in challenging environments and markets. The control can however be lost and it will have different effects in each lifecycle stage. When control is lost during the imagine phase or product development phase, the product development project may go over the budgeted cost or the product may be released late to the market. Critical challenges may arise if control is lost during usage phase. This may result in poor satisfaction for the customer but also in the worst-case scenario to a physical accident. PLM helps in overcoming these challenges but it is not the solution. It is important to have control throughout the PLM grid matrix (in Figure 3), which helps preventing the before mentioned scenarios from occurring. (Stark 2015, 26-27)

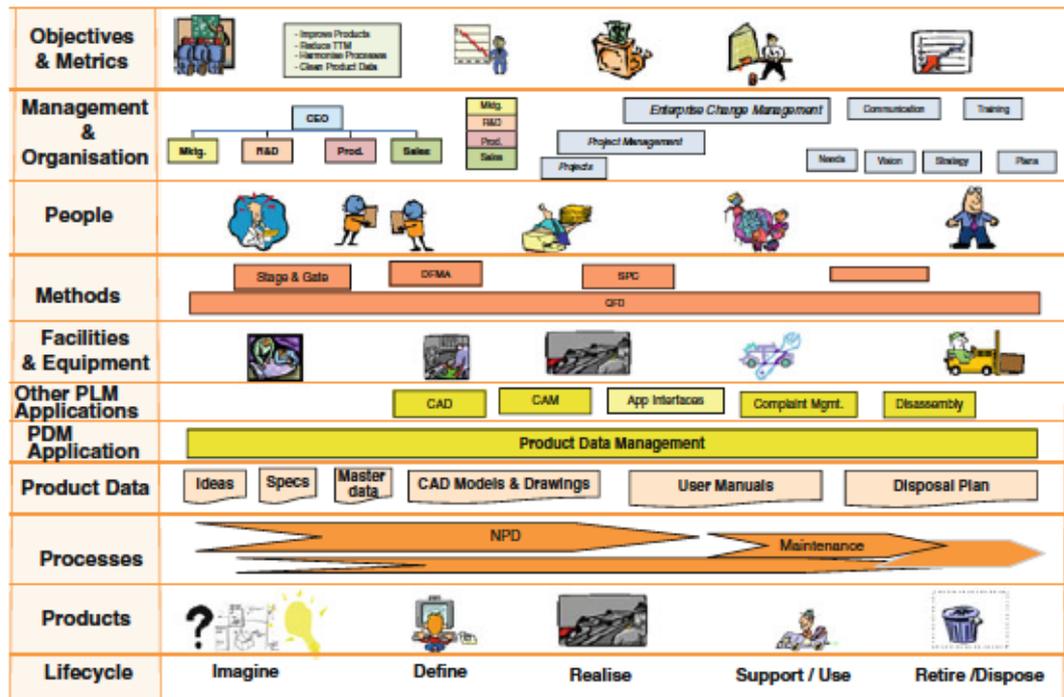


Figure 3 The PLM grid (Stark 2015, p. 9)

One of the key challenges in product lifecycle management is getting all the necessary people involved and being able to use the necessary information and processes. These three aspects (people, information and processes) have to also work on the same page, as a common goal has to be reached. Managing and sharing product data is essential for this to succeed. Understanding how people impact and are involved in different tasks and phases of product lifecycle management is also essential. (Terzi et al 2010, p. 362-363 & 369) Another challenge in product lifecycle management is the focus on not only product families but also single products. In addition, companies have not set any targeted durations for each stage of the lifecycle (Tolonen et al 2015, p. 471; Trappey et al 2009, p. 274). Stark (2015) visualizes how complex PLM can be by using a PLM grid matrix (see Figure 3). The PLM grid's main component is the company's business processes. These are the ways a company designs, manufactures, supports, uses and recycles a product when aiming for a business objective. Throughout the product's lifecycles, it is essential that the processes involved have good quality to avoid excess spending and effort. (Stark 2015, p. 70-71)

Another key challenge in implementing product lifecycle management is that it usually requires changes in companies when moving towards PLM. There will be new roles and responsibilities, old tasks need to be modified and new ones introduced, product data must be used differently and people will have to be willing to adapt to upcoming changes. It is common that making changes is difficult in companies. Organizational Change Management can help in implementing these changes. OCM is a structured approach and it assists a company when it is changing from its current organizational structure to a future organizational structure, which is precisely described, and it supports the affected individuals. OCM activities are communicating about the change to the company's employees, aligning the expectations of change, making clear what are the new job descriptions as well as planning, coaching and mentoring. The activities are defined in an organizational change plan, which helps the OCM team succeed in its mission. For OCM to succeed effectively, the OCM team should focus on making small-scale improvements in areas company's individuals have the best expertise. (Stark 2015, p. 236-238)

As product lifecycle management is a wide concept, it is important to use correct key performance indicators to see how well the company is performing compared to set targets. In PLM, it is essential to use business-oriented KPIs. Some of the KPIs must measure how well the PLM's processes are performing and the KPIs can help to improve those processes (Stark 2015, p. 78). The targets in PLM can be in financial performance, quality and business improvement as well as time reduction. Also because the PLM is a big concept, there are many resources involved as well as there are complex and constantly changing relationships that need to be managed between products, its components and the customers. Management activities must be decided and set so that all appropriate parts and resources of PLM are managed accordingly. (Stark 2015, p. 9-10) Companies and the PLM team must also recognize which facilities and equipment are necessary in PLM activities (Stark 2015, p.12&20).

For a product lifecycle management to work it is also important that the top management is involved and that they are in control of the processes and activities in PLM. Top management must show the way and lead, and they have to have a strong and widely agreed ambition to use the processes. Management should be committed to the PLM and its processes and management must ensure that the PLM structure and team are the best possible for processes and activities to be implemented and improved. The team should for example include individuals who think across the whole flow of the product lifecycle and who understand how the products are produced now and will be produced in the future as well as individuals who understand what are the customers' requirements and how to answer them. It is also top management's responsibility to make sure that the company has a working culture within its employees, which fits and improves PLM. (Stark 2015, p. 129-130)

Product lifecycle management may bring companies both strategic and operational benefits. Strategic benefits can be the improvement in product development's activities. Innovation might improve, time-to-market can reduce and giving excellent support and services might become easier. In addition, product-related costs may decrease and the value of products can be maximized over their lifecycles. Operational benefits can be seen as PLM helps in developing and producing products at different sites by getting data of the whole lifecycle and collaborating throughout the value chain. PLM also maximizes reuse of product knowledge and gives transparency over product lifecycles. (Stark 2015, p. 21-24)

Overall Product Lifecycle Management may answer and solve issues, which occur throughout the product's lifecycle, and helps in providing superior services and products. These issues are for example faster time to market, providing customers the product they want when they want them at a cost-competitive price, faster evolving technology, the growing pressure on health, safety and environment and products becoming obsolete faster. (Stark 2015, p. 66)

2.6 Key points of product lifecycle management

When conducting product lifecycle management there are few issues that should be remembered. First is that there is not a set rule on how long is a product's lifecycle and that the lifecycle model should follow Taylor & Taylor's (2012) model (see page 11). Each market and also product is different, so they have differing sales volumes and are in the market for a different amount of time. It is important to find a consistent model that works for the whole portfolio for the company.

One of the most important things to acknowledge from product lifecycle management is that it requires cross-functional collaboration within the company to work effectively. Also not only does the exact product have to be managed, but also all aspects related to the product, for example services, data, people, knowledge, and standards. To help this multifunctional collaboration and versatile management practice, databases must be in everyone's reach, it must be easily managed and continuously updated and overall they must be used effectively. (Stark 2015)

Stark (2015) introduces five different pillars that will help companies use product lifecycle management effectively, especially if they have not used it before. First is that business processes should be aligned with the product lifecycle, and especially with the lengths of the lifecycle phases to ensure that all processes are conducted on time. Organizational Change Management helps in transitioning the companies operation towards including PLM as new roles and responsibilities might be needed and the usage of product data might need to be changed to fit the cross-functional and continuous practice. The third pillar, product data management, focuses on ensuring that all of the necessary data is used, updated and managed accordingly throughout the whole lifecycle of the product. PLM applications, the fourth pillar, help in having control of the product data and the data of other aspects such as services and standards. The last pillar, project

management, ensures all the smaller processes and projects in PLM are conducted accordingly.

Product lifecycle management has smaller processes and projects, as each lifecycle phase requires different actions, for example during the decline phase Product Phase Out process is required to ensure the removal of the product from the market is done systematically. (Stark 2015) The lean approach can be utilized to ensure that all of the PLM activities are done so that it gives as much added value to the customer as possible (Hines et al 2005). A correct analysis of the whole lifecycle helps in this (Stark 2015).

Product lifecycle management has multiple challenges. Some companies may struggle more with getting all necessary people involved, some may struggle with working with the databases and some companies may struggle with having the support from top management. The corrective actions to overcome the companies PLM challenges are important to find and companies should analyze what challenges affect their operations the most to ensure that PLM is conducted efficiently and systematically.

3 PRODUCT PORTFOLIO MANAGEMENT

Within this chapter, different characteristics of product portfolio management found from existing scientific research are introduced. The concept of product portfolios is opened up to give a deeper understanding what is involved in them. Also, the challenges in PPM are described to see what might need to be considered when conducting PPM and existing research of product phase downs as a part of PPM are presented.

Businesses operate to generate revenue and serve their customers and this is done by having products or services to offer to the market. Companies have products in their selection and this forms the companies' product portfolio. As there are many products and in addition, the markets and customer requirements are continuously changing with product portfolio management managers can more easily understand and decide what needs to be involved in a product portfolio and what is the best possible strategy and process for the company. In the history, product portfolio management has not received much attention in businesses but currently, companies have been focusing more on it due to the positive effects on long-term profitability and competitiveness (Trappey et al 2009, p. 260).

Understanding customer value is necessary for survival in B2B markets and it is an important aspect of product portfolio management, as a company wants to answer to their customers' needs and requirements. Customer value can be seen as either the ratio of the benefits and sacrifices customers encounter or as the difference between those benefits and sacrifices. Benefits can be understood as the benefit of the product and sacrifice means the product's price and the efforts customers have to do in purchasing the product. Companies have to understand what are the attributes in their business, which influence the customer value positively or negatively. Few of these attributes, which have to be fulfilled in a portfolio, are product quality, supplier flexibility, customer focus, innovation

capacity and customer expertise. (Rebentisch et al 2016, p. 83-85; Woodall 2003, p. 11-12)

3.1 Product portfolio

Product portfolio consists of a company's or its unit's whole range of products (Seifert et al 2005). Overall it is a collection of all product functions and physical components and the products can be classified in many different ways: by product families, by customer segments or by technology generations (Jacobs & Swink 2011; Tolonen et al 2015, p. 469). Product portfolio is dependent on the market's the company is operating in and the company's cost structure as well as the company's position in a value chain (Bordley 2003, p. 39; Tolonen et al 2015, p. 469; Kinnunen et al 2013, p. 17-18). With a product portfolio, a company can make sure that they are operating according to their business strategy (Cooper et al 1999, p. 334).

Product portfolios are large in many B2B companies. This is due to companies trying to fight the challenges occurring from globalization, increased competition pressure and shorter lifecycles of product and at the same time answering their customers' requirements (Rebentisch et al 2016, p. 82). By having broad portfolios, companies gain a couple of advantages. An example of these is with diverse product portfolios, companies can satisfy their customers' needs better (Quelch & Kenny 1994, p. 155-156). Overall companies believe that by having a large and diverse product portfolio, it will lead to higher sales volumes. However, when the product variety exceeds an "optimal" level, the sales will start to decrease while product variety is increasing. This is caused by customers' confusion (Tolonen et al 2015, p. 468; Wan et al 2012, p. 323)

Companies can also gain benefits by having narrower product portfolios. Companies have a better possibility to have lower production costs per unit if

scale economies are present. Lower production costs occur when the production process is standardized and fewer material types are needed. Standardized production is one factor in product quality, which is an important customer value attribute. By having a narrower product portfolio, product quality is higher and it brings more value to the customer, especially for those customers who are seeking for high quality. (Rebentisch et al 2016, p. 84-86) Another economic benefit is that with narrower product portfolios, companies can have lower design and inventory holding costs as well as reduced complexity in assembly. All of these advantages have to be considered when deciding and managing the product portfolio. (Bordley 2003, p. 39)

3.2 Elements in product portfolio management

Managers use product portfolio management to make decisions and to affect the performance of new product development and also to define revisions, updates and when products should be phased down from the portfolio. The decisions made in product portfolio management define which NPD projects will be accelerated, deprioritized and finished and which resources are used in each project and how they are used. PPM can for example help in avoiding waste in situations of scarce resources and help in establishing priorities. (Cooper et al 1999, p. 335) When deciding on a product portfolio, managers should consider the profit. In this case, the profit includes the effective number of entries, the development costs per those entries, the time between when entries are developed and sold as well as each entry's marginal profit. Development costs are hard to determine exactly as it is often unsure when the product development has actually begun. (Bordley 2003, p. 42) When considering these factors, companies should focus on whole product families, not just on a single product to gain higher benefits. To make sure that the product portfolio is good, there are three product portfolio performance areas to focus on, which Tolonen et al (2015) refer to in their article: the product portfolio strategic fit, value maximization and the balance of the product portfolio. The

strategic fit makes sure that the portfolio's consistency and alignment are according to the company's strategy and its targets. Value maximization focuses on return-on-investment, profitability, success and business value. Balancing portfolio can be seen as terms and parameters (time, risk, markets, and technologies). (Tolonen et al 2015, p. 469-470; Vähäniitty 2006, p. 1) However, managers must not forget that essentially they want to answer customers' needs and requirements (Trappey et al 2009, p. 259-260).

One of the most important parts of product portfolio management is decision-making and new product development is one of the main aspects in PPM. NPD is also the most highlighted part of PPM in literature. In NPD there are many decisions to be made, which affect the whole product portfolio as well as the company's business and performance. Examples of these decisions are selecting NPD projects, killing/closing NPD projects and delaying projects as well as continuing NPD projects with fewer resources. Killing/closing NPD projects are hard decisions to be made as the individuals involved get emotionally attached to the project. However, these projects should be discontinued if it is revealed that they do not provide satisfying profits, they do not answer customers' needs or they do not fit the company's strategy. When discontinuing NPD projects it is important to remember that it frees resources to other projects, which could be better.

Kester et al (2011) developed a decision-making model, which is presented in Figure 4 and described below. The model focuses on new product development and it presents that cross-functional collaboration is extremely important in NPD projects. It includes the portfolio decision-making processes' components and outcomes. Also, insights are presented by how some of the related components can give to the portfolio decision-making effectiveness. (Kester et al 2011, p. 642) It is important to consider if and how the elements in the model can be used in other decisions made in PPM, for example cross-functional collaboration might also be needed in product phase down processes.

A lot of focus has been on basing the decision-making in product portfolio management on financial and operational issues and numbers, which Kester et al (2011) refer to in their article. These financial methods have significant faults. NPD project data is unreliable until market launch or it might be unsure also a while after market launch. Methods and models developed to answer this problem are usually not user-friendly as they are more academic than practical. Even though financial methods are not absolute, they are the most used decision-making method, but companies focusing only on financial methods perform worse than other companies. If long-term existence and performance are something a company is aiming for, managing both the whole product portfolio as well as launching successful NPD projects is essential for the company. This leads to the need for effective decision-making processes in NPD and the development of Kester et al's (2011) decision-making model. (Kester et al 2011, p. 642-644; Poh et al 2001, p. 72)

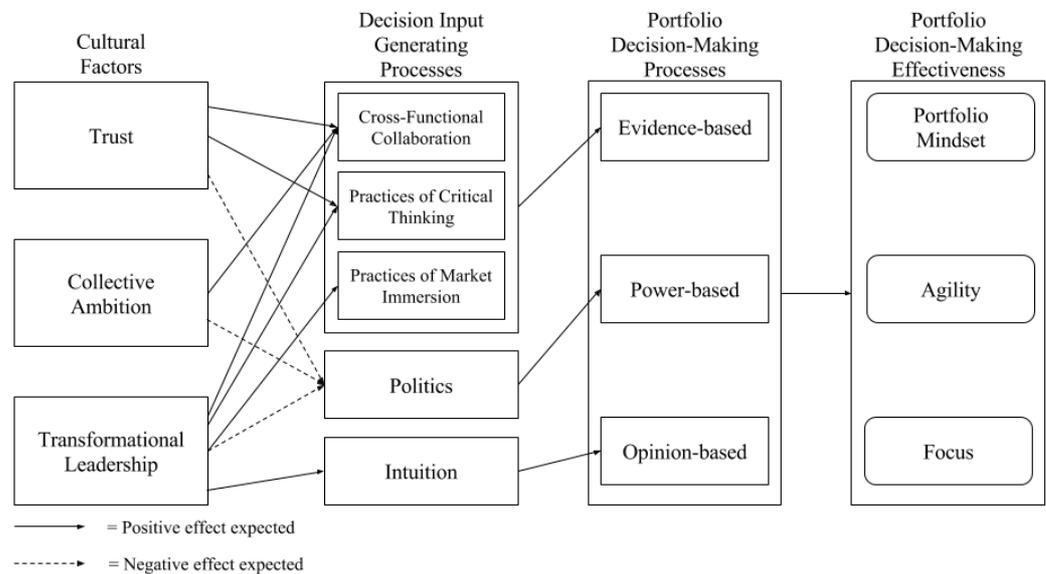


Figure 4 Model of Portfolio Decision-Making (Kester et al 2011, p. 646)

Companies estimate the performance of the product portfolio decision-making process by investigating three dimensions: “the extent to which the decision-

making system produces a portfolio mindset in the company; allows for decision-making agility; and produces focused development efforts” (Kester et al 2011, p. 647). Portfolio mindset consists of managers making decisions by considering the whole new product development portfolio and how the portfolio projects are fit together with the company’s strategy. A transparent and continuous top-down and bottom-up communication ensures that a portfolio mindset is kept during the decision-making, as lower level knows how the product project is connected to the market and customer needs and top level knows how the portfolio is aligned with the long-term strategy. Decision-making agility ensures that companies and managers can make quick decisions especially since the business environment changes rapidly. These decisions include for example discontinuing an NPD project or building a new NPD project. The focused effort takes into consideration both short-term and long-term actions to achieve the most appropriate product portfolio. (Kester et al 2011, p. 647-649)

There are three decision-making processes, which lead to the effectiveness of the product portfolio decision-making: evidence-, power-, and opinion-based processes. Evidence-based decision-making process includes facts and data from technical, financial and market information, which are produced by cross-functional collaboration, critical thinking (understanding the risks of the portfolio decisions) and market immersion (understanding the market and customers). Power-based decision-making process consists of organizational politics when individuals or small groups dominate other individuals or groups by not giving them decision-making power. The opinion-based decision-making process includes the use of intuition instead of facts. This type of process can lead to conflicts between individuals and groups due to lack of argumentation. Companies can use a combination of these processes but it is important to acknowledge the shortages of the processes. For example, power-based decision-making processes do not focus on what’s best for the whole company. (Kester et al 2011, p. 647 & 649-651)

Cultural factors affect the input of the product portfolio decision-making processes. These cultural factors are possible trust or distrust in the expertise and the motivation of other people involved, their collective ambition's strength which means the extent people across functions share the company's goals and values with each other, and whether or not the strategic business unit's leadership and management are innovative. (Kester et al 2011, p. 647) Trust, collective ambition and transformational leadership are associated either positively or negatively to the inputs of NPD portfolio decision-making, which is shown in Figure 4 (Kester et al 2011, p. 655). Companies can be considered most efficient if they have a portfolio mindset, which applies also to other product portfolio decisions, for example in product phase downs (Kester et al 2011, p. 647). It is important to consider the company's characteristics, strengths, and weaknesses when deciding how to make decisions. However, the evidence-based decision-making process is generally the most appropriate process to improve product portfolio decision-making effectiveness and simultaneously the company's long-term business performance. (Kester et al 2011, p. 659)

Jugend and Da Silva (2014) provide a framework (Figure 5), which aim is to help companies to choose its new products and decide which products to keep in its product portfolio in the best manner possible. The three main aspects of this framework are Methods, Organizations, and Strategy. (Jugend and Da Silva 2014, p. 18) By using formal portfolio management methods and evaluating different strategic, market, technological and risk factors it is easier as well as the economic return on the portfolio simultaneously (Verbano & Nosella 2012, p. 362-365). The methods have to be easy to understand. Otherwise, companies will not utilize them (Archer & Ghasemzadeh 1999, p. 207). Financial methods analyze the value of the portfolio by measuring the ratio of resources used and projected returns from product projects (Oliveira & Rozenfeld, 2010, p. 1346). Scoring methods, checklists and ranking methods help the team to be more involved in PPM in analyzing, scoring and ranking products for example by their expected performance. Balanced Scorecard and analytic hierarchy process can be good

models in defining the different criteria used in scoring products (Calantone et al 1999, p. 66; Jugend & Da Silva 2014, p. 21). With a checklist, the PPM team can check whether the product projects meet the company's strategy and criteria. (Coldrick et al 2005, p. 187; Jugend & Da Silva 2014, p. 21) By using visual communication, the team gets a better understanding how the product projects are meeting the business strategy and different criteria (Jugend & da Silva 2014, p. 22).

The second aspect, Organization, is important as PPM is closely related to decision-making, negotiations and allocation of resources among different product projects. Integration in decision-making improves the quality and the communication of knowledge is strengthened. Marketing, engineering, research & development, production, and sales are functions, which should be involved in the decision-making as well as the PPM team. This way the company ensures that the customer requirements and needs are transmitted throughout the organization and hence the customer value of the portfolio increases. (Jugend and Da Silva 2014, p. 22; Jacobs and Swink 2011, p. 679) Cross-functional teams and matrix organizations bring the best results in PPM (Mikkola 2001, p. 425). Including top management is also important for motivation (Jonas 2010, p. 826). The third aspect, Strategy, highlights the importance of including PPM into strategic management activities, which are responsible for agreeing on product projects and distributing financial, human and material resources for each project. Overall product projects must be aligned with the company's innovation strategy (Oh et al 2012, p. 9871&9881). The usage of Methods helps in ensuring this. Review meetings and activities are important for making sure that the portfolio is still the best possible in the complex and changing market and environment. (Jugend & Da Silva 2014, p. 23; Archer & Ghasemzadeh 1999,p. 208) The frequency of these meetings depends on the company and the products' lifecycles. If the markets are fluctuating, meetings should occur more often for example once in every second month, but when the market is stable, meetings are not needed as often. (Jugend & Da Silva 2014, p. 23)

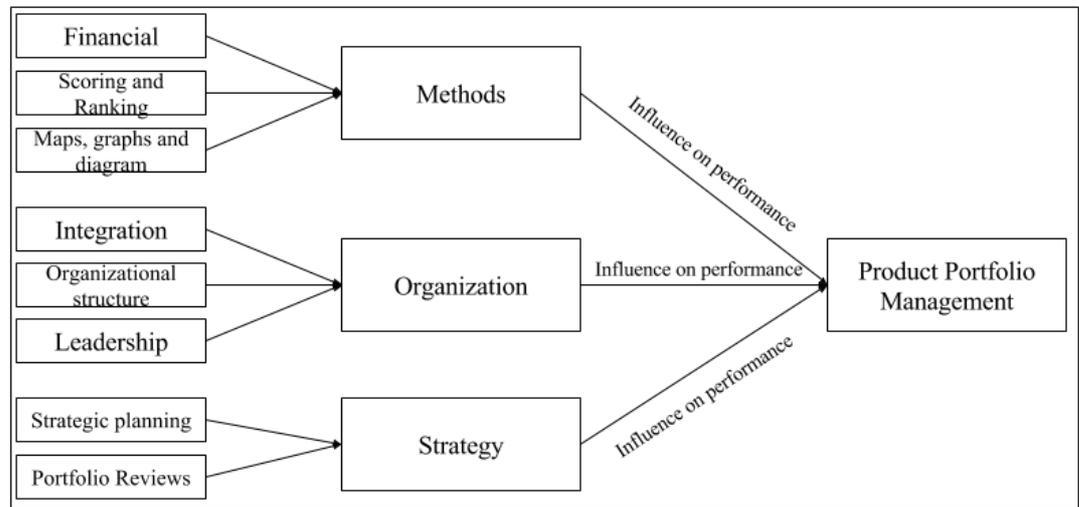


Figure 5 Conceptual framework for product portfolio management (Jugend & Da Silva 2014, p. 20)

Trappey et al (2009) demonstrate a PPM analysis process, which helps to decide what products to include in the product portfolio. The process includes three steps. The first step is the evaluation and selection concerning new product development projects. Different criteria weights need to be calculated to assess the new products. Trappey et al (2009) provide a Fuzzy Hierarchical Analysis to do this, where fuzzy values for product performance are given and these turn into the criteria to recognize which NPD projects are most competitive. When selecting a product portfolio, managers must be sure that they consider certain internal and external factors. The external factors consist of answering customer needs, which is especially essential in engineer-to-order companies and products, having state-of-the-art technologies, considering the impact of competitors and how intellectual property and environmental laws affect the product portfolio. The internal factors are time, risk and profit of an NPD project, using and benefiting from the technological capabilities that the company possesses, making sure company strategy is met and answered, and considering how company patents affect the portfolio and also how phasing down products affect the portfolio.

During the first step, it is also important to consider the lifecycle phases of products, as in availability of critical parts, manufacturability, risk of technical and business failures and how the design for environment differ in each lifecycle phase. The second phase is the evaluation and allocation concerning resource requirements of certain projects. This phase takes into account how the resources interact with each other within a portfolio and this is used for the analysis of resource requirements and allocations for the company's product portfolios. This helps to avoid violation of resource constraints. The final step is a systematic analysis of the most appropriate product portfolio. In this step, the profits and risks of the possible product portfolios are evaluated and this gives managers an applicable portfolio strategy. (Trappey et al 2009, p. 260-263)

Renewing and managing product portfolios means companies add new products to their product portfolio, they modify or upgrade the existing products and some products could be removed from the product portfolio. New product development is seen as a vital asset for a company to be able to secure its market position. However, according to Hänninen et al (2013) to achieve cost reductions companies are focusing more on upgrading existing products than manufacturing new products. Still, when one product is taken out from the product portfolio, 1.8 new products are added to it and this widens the product portfolio significantly. (Droge et al 2012, p. 250)

New product development is highlighted in most of the articles and researches focusing on product portfolio management. Customers demand more and more differentiated products and thus product portfolios have broadened and deepened. Overtime products become unprofitable and this results in a decrease in the company revenue. This all leads to operational, financial and strategic reasons to eliminate the product from the product portfolio. (Homburg et al 2010, p. 531) From the customers' point of view, large and diverse product portfolio's can lead to confusion of what to buy. This will weaken the sales of the supplier. (Wan et al 2012, p. 323) Product variety and complexity are factors, which have negative

effects on productivity, on costs, on the time of NPD and on customer satisfaction (Tolonen et al 2015, p. 468; Orfi et al 2011, p. 69). Large and diverse product portfolios also affect negatively on operational supply chain's performance as it leads to longer lead times, decreases in on time deliveries as well as lower value-added per headcount (Tolonen et al 2015 p. 468; Gunasekaran et al 2004, p. 337). These challenges lead to "firefighting" activities, which mean having to resolve the same issues continuously, rather than tackling the issue before it occurred (Repenning 2001, p. 286; Kester et al 2011, p. 642). Anderson and Narus (1998) highlight the importance of understanding what the customers want and value. Companies are trying to satisfy customer needs and requirements at any cost rather than offering fewer and preferable product variants in their portfolio. This would lead to a less internal effort in the company. Some companies have tried to optimize the product portfolio, but this is mainly conducted by focusing on profitability, not on customer value. If a company would focus on delivering customer value in their product portfolio, the company would gain a long-term, strategic and profitable competitive benefit. (Rebentisch et al 2016, p. 82-83)

3.3 Challenges in product portfolio management

Product portfolio management is seen as a challenge in by Tolonen et al (2015), as it does not receive any, or receives minimal, attention from management. Also seeing a product portfolio as a whole is difficult because of different product views and reporting capabilities might not be that good. There can also be seen cannibalization within product families in negative product cases and obsolete materials as the total revenue share per product declines and it is more difficult to maintain products and their technical relations. These occur due to the fact that many companies do not have a structured Project Portfolio Management process (Ölundh & Ritzen 2004, p. 913; Trappey et al 2009, p. 260). Companies are merely following customers' requirements and behavior rather than focusing on product portfolio management over lifecycles. This has resulted in an unprofitable

way of using KPIs, as companies are measuring only some related metrics of PPM. (Tolonen et al 2015 p. 471-472) Another challenge in PPM is that the results in the front-end of operations are uncertain, fuzzy, and the decisions made in PPM are associated with the company's political values (Heising 2012, p. 583; Bentzen et al 2011, p. 334).

The importance of having the correct key performance indicators in product portfolio management is highlighted in research articles. As an example, Jonas (2010) presents that the main cause of the failures in NPD is due to managerial issues in PPM process and activities (Jonas 2010, p. 826). Neglected topics in PPM are how to manage product plans, products under development and products in the market already through the product lifecycles from an end-to-end view. These require different targets, objectives, and KPIs than new products do, and they should not be forgotten as the companies, which are high performing, use PPM, its targets and KPIs more systematically and regularly. This is essential especially in new product development as products and technologies introduced five years ago bring the company about one-third of its sales. For a PPM to be successful, constant incremental innovations and architectural innovations are required. Incremental innovations are expanding existing products' lifecycles, decreasing costs and creating more value to the customer. Architectural innovations are related to fundamental changes or updates in products. Removing unnecessary or oldest products and technologies are also required in product portfolio management, which means discontinuous innovations should also be present. (Tolonen et al 2015, p. 469)

3.4 Product phase down in product portfolio management

In literature and research product phase downs are mostly nonexistent. Homburg et al (2010) have provided a customer perspective on product phase downs. The

focus is especially on how possible product phase downs affect the customer's business and the relationship between the company and customer as well as how much the eliminating company's actions are a contributing factor to the before mentioned issues. Homburg et al (2010) refer to Foa and Foa's (1974&1980) research where they introduce two different factors. Hard factors, which are economic costs and benefits, as well as soft factors, which are psychological costs and benefits, and they are analyzed in Homburg's et al (2010) study. These factors affect the customer's loyalty and satisfaction level. Economic costs of elimination refer to the customer's economic burden and expenses, which are caused by the product phase downs. (Homburg et al 2010, p. 531-533) Psychological costs of the elimination refer to the degree the customer doubts the business relationship with the company as the customer is unsure if the company is reliable, flexible and co-operative (Karakaya 2000, p. 653).

In businesses, managers are unsure whether a product should be phased down or not. The product's sales volume could be in the decline phase of its product lifecycle, but managers are afraid of the phase down affecting negatively on customer loyalty and satisfaction (Mather 1992, p. 41). Instead, when phase downs are conducted, the effects on customers and how it affects the company's relationship with customers are not considered properly. The company phasing down products should be aware of how they conduct product phase downs, as customers are interested in the implementation process' quality and outcome as well as in the product's importance to the customer, customers' product-specific investments and the product interrelatedness in the customer's operation. (Homburg et al 2010, p. 533, 541&543)

Homburg et al (2010) found in their research that when the quality of the elimination process increases, the costs (economic and psychological) the customer perceives decreases. Also if the economic and psychological costs are significant for the customer, the customer's satisfaction decreases. Overall, the psychological costs affect more negatively on the relationship between the

company and the customer than the economic costs do. Companies should focus on decreasing the customer's psychological costs mainly in the phase down process than phase down outcomes as psychological costs impact mostly on customer loyalty (Karakaya 2000, p. 664-665). Managers' focus should be on maintaining the customer's confidence in the company than just eliminating costs. Actions could be an on-time announcement of the product phase down and allowing the customer to participate in the compensation decision. It is also important that managers adapt their product phase down process according to each product's characteristics. (Homburg et al 2010, p. 539-540, 542-546)

When the company is in the process of phasing down products, they should ensure that they are providing the highest customer value. Rebentisch et al (2016) provide two key steps when building a customer value-optimized product portfolio in the B2B market. The first step is classifying variants on a quantity scale. The specific variant quantity can be found by dividing the number of variants by the technical and practical sensible variants. The second step focuses on the recommendations of actions. These are enablers to achieve the optimal variant quantity. The company should analyze what is its product portfolio's position compared to the optimum and make necessary changes to achieve the optimal level. Rebentisch et al's (2016) case company was able to bring their product portfolio down to one-third by focusing on building a customer value-optimized product portfolio.

Jonas (2010) highlights how top management involvement is crucial both in product portfolio management and the same can be considered in product phase downs. As Homburg et al (2010) stated in their article, many managers are afraid to conduct product phase downs as they might affect negatively on customer satisfaction and loyalty. Managers must get the confidence by estimating and understanding what might be the positive outcomes for the company itself. These could be cost reductions, less need of resources and better maintenance of the product portfolio. Managers must not forget also that the customer may receive

positive outcomes as well, for example by receiving a better product at a reasonable price. Once managers understand what are the positive outcomes of product phase downs, they must take leadership of the actual product phase down processes to make sure that they are conducted appropriately. Homburg et al (2010) raised the importance of the quality of product phase down processes and managers are the ones ensuring that the quality levels will be met.

It is important to conduct product phase downs to maintain the portfolio's competitiveness and it enables a portfolio that is easy to manage. This is due to not having overlapping products and by having a manageable number of products to offer. By phasing down products to 'make room' for new products and technologies, companies show they want to improve themselves. They are also able to understand their portfolio better and thus provide the exact product the customers need. However, it must be kept in mind that product phase downs should not be conducted in a hurry, rather by making sure the customers are also acknowledged in the process.

3.5 Key points of product portfolio management

By having a portfolio of products, companies answer to market and customer needs and requirements. In B2B companies' portfolios are usually large due to reasons like increased competition pressure and globalization (Rebentisch et al 2016). Product portfolio management helps in managing the whole set of products and in aligning the portfolio with the company's strategy. Essential is to find and have the best set of products to have a competitive and balanced portfolio that brings value to customers and is aligned with company's strategy and targets (Tolonen et al 2015; Trappey et al 2009).

Within product portfolio management the decisions are made on whether or not conduct a new product development project or whether existing products should

be removed from the portfolio. When deciding on these, not only should the financial side like profit be considered but also the value of the portfolio to customers is one of the most important aspects (Bordley 2003; Tolonen et al 2015). The decision-making is one of the most essential elements in PPM. Kester et al (2011) developed a decision-making model (see page 29 Figure 4), and from that the diverse aspects of decision-making can be seen and companies can focus more on different aspects in their decision-making depending on what they want and value the most. Jugend & Da Silva (2014) also have developed a framework to help companies decide on which products to develop, which to keep in the portfolio and which to remove from it. The framework is presented on page 33, Figure 5.

Product portfolio management has different challenges, including the ability to see and understand the portfolio as a whole and managing the portfolio over the products' lifecycle. One PPM activity that is seen as a challenge is conducting product phase downs, in other words removing products from the portfolio. Companies have not conducted them in B2B markets, as they are afraid of how it will affect the customer relationship and business (Homburg et al 2010). However, removing products is important. When new products are added to the portfolio, the management of the whole portfolio gets harder. By removing products that are unprofitable, outdated, or do not answer customer needs, the management is more efficient and work is focused on value-added activities. But as Homburg et al's (2010) and Rebentisch et al's (2016) articles show, it is important to conduct phase downs in a way that customers are acknowledged and that the portfolio brings value to the customers. Top management involvement is also essential in PPM (Jonas 2010). When management is committed and gives guidance actively, better results are achieved and the process is more efficient.

4 PRODUCT LIFECYCLE AND PORTFOLIO MANAGEMENT IN PRODUCT PHASE DOWNS

Globalization has been one of the reasons why product portfolios have evolved. Globalization has also led to the need to have product lifecycle management and product portfolio management. (Ameri & Dutta 2005, p. 583) PLM can help in finding the correct data, which can be spread throughout the world at the right time and PPM can help managing the portfolio. These are affected by customers all over the world and by the company's internal operation, which can be present simultaneously in many countries and continents. At the same time globalization can be seen as a challenge both in PLM and PPM as for example the amount of information is large and cultural factors may affect PPM's performance and in PLM the lifecycles are affected by global factors and the product data input can come from multiple countries and making sure all data is correct and reliable can be a challenge.

Products have to be managed individually and as a whole group. When managing products individually product lifecycle management is a good method to understand how a product should be performing now, what has to be done to it and how it will move forward. For managing products as a group, product portfolio management should be used to understand how the whole group of products works together with the company's strategy and how the whole group of products should move forward (Trappey et al 2009, p. 260; Jugend and Da Silva 2014, p. 23). The combination of PLM and PPM by one product is demonstrated in Figure 6. When deciding on the product portfolio, the products' lifecycles should be analyzed to know where each product stands and to evaluate how the portfolio will change according to each product's next lifecycle phase. By conducting PLM and PPM simultaneously, customer requirements can be answered in a more efficient way. Product lifecycles have different phases which each require different management actions as during the growth phase the

company aims to improve product's market position and on the contrary during the decline phase the company starting to remove the product from their portfolio and thus, from the market also. With PPM, managers decide what will be included in the portfolio, will some products need an update and will new products be developed. (Cooper et al 1999, p. 335) Narrow product portfolios have different benefits than large product portfolios. With narrow product portfolios, companies can gain lower production, design and inventory hold cost as well gain higher product quality and having a portfolio, which is easier to manage (Rebentisch et al 84-86; Bordley 2003, p. 39). With larger product portfolios, companies have a better chance in answering customer needs gaining higher sales volumes until an "optimal" level is reached (Quelch & Kenny 1994, p. 16-17; Tolonen et al 2015, p. 468; Wan et al 2012, p. 323). PPM helps in finding the optimal harmonized product portfolio and the focus should be kept on delivering customer value (Rebentisch et al 2016, p. 83).



Figure 6 Product Portfolio Management through Product Lifecycles

As Stark (2015) and Jugend and Da Silva (2014) highlight, both of the management methods should include a cross-functional team. Cross-functional

business processes are defined in product lifecycle management as each function shares their information with other functions in the company. As an example sales managers and the research & development function share information with each other and research & development works together with the team responsible for the product's disposal to share information of lifecycle activities and changes. (Stark 2015, p. 3 & 17) In product portfolio management a cross-functional team helps in transmitting the customer needs and requirements through the whole organization, and it improves quality and communication (Jugend and Da Silva 2014, p. 22; Jacobs and Swink 2011, p. 679).

One of the important product lifecycle management and product portfolio management actions is phasing down products. A key activity is recognizing when a product should be phased down. To make the decision of what product to phase down and when, in PPM one can use scoring methods, rankings and checklists when analyzing how a product is performing and whether it is aligned with the business strategy or answering customer requirements (Jugend & da Silva 2014, p. 21; Coldrick et al 2005, p. 187). Also, Trappey et al's (2009) PPM analysis process, which main focus is deciding which new product development projects should be included in a portfolio by using Fuzzy Hierarchical Analysis, could help in deciding what products should not be included in the portfolio anymore. The focus could be on using Fuzzy Hierarchical Analysis to determine which of the products in the portfolio are most competitive and which are not. Also, the profits and risks of the current and planned portfolios are evaluated. (Trappey et al 2009, p. 260) In PLM and PPM it is also essential to know how to handle the phased down product's parts and supply chain, as these might need to be phased down also. As an example, toxic waste and poisonous components must be handled accordingly or parts/products possibly remanufactured.

When phasing down products, companies should focus on the how the phase down will affect the customer's business as well as the relationship between the customer and the company. Companies usually consider only the economic costs,

but also the customer's psychological costs must be taken into account to increase the quality of the phase down process and outcome and the customer's satisfaction. Different actions to succeed in maintaining the customer's satisfaction and loyalty are an on-time announcement of the product phase down and allowing the customer to participate in the product phase down process and in product lifecycle and portfolio management as well. (Homburg et al 2010, p. 539-540, 542-546)

Product Data Management is essential in product lifecycle management, product portfolio management as well as in product phase down processes because then can the whole product be managed. Product Data Management should be executed by using digital databases cross-functionally, for example information from the customers is important in PLM and whenever necessary product data should be updated according to the information from the customers. Product's data needs to be updated regularly, whenever changes or updates are made or whenever a product transforms from one lifecycle phase to another. When phasing down products, product data should be marked or locked so each department in the company knows that the product does not exist anymore. In addition, understanding the basics of Project Management and utilizing a Process Group also helps in product lifecycle management, as it is then easier to manage all the different processes in each lifecycle phase. Project Management helps in understanding and knowing the roles and responsibilities and a Process Group's role is to define, maintain and improve the processes, for example the Phase Down process in the decline phase. (Stark 2015)

If product lifecycle management and product portfolio management are new management methods to a company, they can use Organizational Change Management in helping to start using these two methods before developing any systematic phase down processes. OCM helps in transitioning a company from its previous thinking and activities to new ones. When starting to use PLM and PPM, it is important to understand where the company is and what are its characteristics.

Both in OCM as well as PLM and PPM overall, top management involvement is critical to show the lead and in giving reasoning why they have to utilize these management practices. (Stark 2015, p. 129-130)

Top management involvement is also essential for product phase downs as well as in any activity in product lifecycle management and product portfolio management to succeed. However, especially PPM receives none or minimal amount of attention from top management currently (Tolonen et al 2015, p. 471). As in PLM and PPM practices overall, top management must show the desire to phase down products and to take the risk that some customer relationships might be altered or even lost. Top management helps in getting all the necessary resources together for product phase downs and ensuring that everybody is on the same page and ready for changes. There also needs to be a team, which makes sure that the processes are on time and conducted accordingly so the PLM, PPM and product phase down targets are achieved. When deciding on which products to phase down, management needs to evaluate how well each product is aligned with the company's strategy and their customers' requirements. (Stark 2015, p. 129-130) To help the decision of which products to phase down, correct and frequently updated product data and product lifecycle data are important. When this data is up to date, management can efficiently decide on what to do next with the existing products.

Figure 4's model of Decision-making on page 29 can help management in making these decisions also, even though the model focuses on new product developments. Kester et al's (2011) Decision-Making model helps to make sure that in phase down projects managers are having a portfolio mindset and not just thinking of the one possible phase down product as an individual item. There are three areas that make sure the phase down decision-making is effective. Decision-making agility makes sure that managers are able to make quick decisions whenever the environment changes quickly. Managers might have decided that they want to phase down a certain product but if the markets or environment

changes abruptly, with decision-making agility managers are able to evaluate the situation again. With decision-making focus, managers make sure that both in short-term and in long-term conditions, the correct products are phased down and a suitable product portfolio is reached. (Kester et al 2011, p. 647-649)

Overall in product lifecycle management and product portfolio management, the aim is to maximize the value-added work, and Reberich et al (2016) emphasize the importance of providing customer value within the product portfolio. In PLM to find the value-added work, the product lifecycle needs to be analyzed regularly. Markets and technology change rapidly, which results in constant changes in product lifecycles. (Stark 2015) When implementing product lifecycle management, Stark (2015) recommends using Lean approaches as Lean helps in recognizing and utilizing only value added work. Hines et al (2005) demonstrated how Lean can be used in new product development. The same thinking can also be applied in product phase down processes. The basis of Lean is to understand customer needs and requirements, and one reason to conduct product phase down is that the current product and product portfolio is not what the customer wants. To help in improving the actual product phase down process, the managers and rest of the team can visualize how the current process is conducted and analyze this. During the analysis, the team can map out the future phase down process as they see what is wrong with the current one. Thinking what should be included in a product phase down, even if there is not a current product phase down process available, can also create a future process. Once the activities and involved functions have been thought of, Hines et al's (2005) final step can be conducted, the creation of a complete process standard. In product phase downs it is easier to conduct phase downs and learn from the previous phase down processes when a complete phase down process standard is created and the phase down process is visualized for everybody.

The decisions done in product lifecycle and product portfolio management when phasing down products have notable effects on customers. The supplier's

individual management of the products affects customers more. When a company conducts PLM efficiently and on a regular basis informs the customer's installed base's possible lifecycle changes to the customer, customer can more plan their own operation: for example if a customer is an OEM, the customer can more easily estimate when they will need to update their own product as their supplier will not provide the exact same product anymore. If a company decides to phase down a product that is still in their customers use, the company must ensure that they have a correct product to replace it. The product can be in their portfolio already, or the company develops a new product. In this way, customer needs are still answered and the customers can continue their operation smoothly. As Homburg et al (2010) stated, not only should the company ensure they have a correct replacement product but also the psychological cost side is important. If the announcement of the phase down is not given on time, customers will not have time to adapt to the changes. In addition, if the management of the phase down process is not working correctly in the company, the customer can have negative effects of this. The more work and changes the customers have to do, the less satisfied they might be. To improve the quality level of the phase down process, the company could analyze what do its customers wish from product phase down processes overall.

5 RESEARCH METHODOLOGY

In this chapter, the used research methodology in this thesis is described and the interviewees utilized in data collection are presented. Also, the data collection for getting an insight of phase down benefits is described. First, the research approach and method are discussed and then the data collection for the study is covered.

5.1 Qualitative research

The focus of this study was to explore how different customer types perceive a product phase down process and whether there were any differences between the customer types and the industries they operate in. Hence, a qualitative research approach and exploratory study was used to understand the issue deeply and to develop a customer-oriented product phase down process. Product phase downs are not only complex but also quite new to the case company, so by adopting an exploratory study the insights of the phenomenon can be identified and the context can be understood. (Yin, 2003) The purpose is to generate a process for the case company to utilize, which includes the customers' view on the case study's subject.

In this study, a case study method is utilized as the phenomenon happens in a real-life context (Creswell, 2013; Yin, 2003). The case used is a part of a company, by focusing on a specific Business Unit and within that on a specific Product Group (see Chapter 6.1), forming a single-case design for the research. As the focus is on a single Product Group's activity, a product phase down process, a holistic design is used. (Yin, 2003) With this qualitative single holistic case design, it is possible to get a deep understanding of the case company's operation and to find out the important elements in product phase downs in global B2B markets. At the end of this study, the findings from the case are compared to a different Product Group

within the same Business Unit to see how the findings can or cannot be utilized throughout the Business Unit.

5.2 Data collection and analysis

For the literature review data was received from academic articles. Product phase downs are a part of product lifecycle management when a product enters the final stages of its lifecycle, and product phase downs also are considered a part of product portfolio management as then the portfolio is updated by removing products that are not needed. For the theory section, there were not many articles focusing on B2B markets. Thus, as the basics of PLM and PPM are utilized to get an understanding and backbone concerning PLM and PPM's practices and challenges. The utilized journals and book of PLM was found by using the following keywords: (Product) phase down, (product) ramp down, (product) lifecycle management and (product) portfolio management. Some of the references used are original references from articles.

Semi-structured interviews were used and they collected the primary data for this thesis. Both interviews with the case company's customers and with the employees within the case company were utilized. To get an understanding of how product phase downs and product portfolio and lifecycle management are seen and executed in the case company, overall 9 interviews were conducted within the case company with people from Product Management, Service, and Sales. Table 1 introduces a short description of the interviewees from the case company. Appendix 1 shows the interview structure used with case company interviews from Product Management, R&D, and Service. With the interviews with SCM Manager and Operation Manager, one interview question was utilized: "What are the benefits the case company gets from phasing down products?". From the interview with the Sales Manager, the aim was to find out information

from the Simplification program from the Sales perspective and what are the benefits customers can get from the case company's product phase downs.

Table 1 Interviewee profiles of the case company interviews

Job Position	Function / Department	Product Group
Product Manager, product range 1	Product Management	X
Product Manager, product range 2	Product Management	X
Product Manager, product range 3	Product Management	X
Product Management Manager	Product Management	X
Senior Project Manager	R&D Product Development	X
Industry & Application Sales Manager	Global Sales	X
SCM Manager	Supply Chain Management	X
Operation Manager	Operations	X
Strategic Product Manager	Service	N/A
Product Manager	Product Management	Y
R&D Manager	R&D	Y

To gain an understanding of how different customers see product phase downs and how they react to them, 6 different customers, who all operate in global markets, were interviewed. These interviews were either face-to-face or conducted by phone. Customers A to D are all located in Finland, so these interviews were conducted at the customers' offices face-to-face. Customers A to C are all operating in Finland but the companies are a part of a larger global corporation located overseas. Customer D is a Finnish company operating in global markets. Customers E and F operate overseas, so due to easier

accessibility, these customers Key Account Managers from the sales department and from the Product Group were interviewed rather than interviewing the customer directly. The Key Account Managers work on a daily basis with the customers E and F, therefore they have an in-depth understanding of how the customers see product phase downs. In Table 2, a brief description of the customer profiles is given.

Table 2 Interviewee profile of customers

Customer	Interviewee's job position	Customer type	Size of the company	Industry
Customer A	Material Buyer &/ Spare parts Buyer	OEM	Large	Diversified machinery
Customer B	Product Manager, B2B	Wholesale	Large	Electrical material
Customer C	Strategic Buyer & Operative Buyer	OEM	Large	Industrial engineering and manufacturing
Customer D	Head of Supplies	End-customer	Large	N/A
Customer E	Sales Key Account Manager & Product Group Account Manager	OEM	Large	Heavy industry
Customer F	Sales Key Account Manager & Product Group Account Manager	OEM	Large	Industrial equipment

The case company has different types of customers and the aim of this thesis was to get an as comprehensive customer view as possible with the resources available. The interviewed customers were identified by asking the employees of the case company who they thought should be interviewed, so a snowball sampling strategy was used (Creswell, 2013). The case company sees that product

phase downs can possibly affect the identified customers as the customers buy products on a regular basis and that the identified customers would give the best insight on the research topic. Once possible customers were identified, each customer's daily contact, the Account Manager for example, was met to make sure that the customer can be interviewed and that the customer is suitable for this case study. Customers E and F are large volume customers of the case company and the customers put in orders every day, thus it was thought that product phase downs would affect tremendously on these customers. The volume of end-customers is smaller than OEMs, but it was identified that customer D would give good insight concerning product phase downs as an end-customer. Customer B to C are affected a lot by product changes so it was thought that these two customers would give valuable insight, especially as Customer B is a different type of customer than others interviewed. Customer A is the same type of customer as Customer E, but smaller in volume. However, customer A was easy to contact, gave a deeper view of customers and is also affected by the case company's product changes. The interviews were either organized by the interviewer or by the customer's contact in the case company (sales person etc). For customers A to C and E and F, the case company is a primary supplier and/or preferred partner.

Two sets of interview structures were used as there were three different customer types interviewed to find out how they perceive a product phase down. OEMs, wholesale firm and end-customer each are concerned and affected by specific issues and one set of interview questions would not be applicable for them, but the same structure can be used for the end-customer and wholesale firm. These two interview structures are found from Appendix 2 and 3.

All interviews were recorded and transcribed. For the analysis, the interview data was coded by implementing an open coding system. The coded data was after that classified to different categories and major themes were found: replacement product, communication, required work at the customer site and how the product phase downs should be conducted through the customer's eyes.

To understand what are the benefits received from product phase downs, each case company interviewee was asked what they thought were the possible benefits of conducting product phase downs. In addition, a few case company representatives were asked to fill a matrix developed by researcher and instructor to have some visualization of the issue. Table 3 shows who were asked to fill the matrix. With the matrix, the aim is to understand in which processes benefits can be seen when products are phased down and in which functions these processes' benefits can be seen. Four representatives returned their matrix. Appendixes 5-9 show the responses received.

Table 3 Profile of respondents for Benefits matrix

Job position	Function / Department	Product Group
SCM Manager	Supply Chain Management	X
Sales Director	Sales	X
Industry & Application Sales Manager	Global Sales	X
Product Manager	Sales	X
Operation Manager	Operations	X

In addition to interviews, the case company's databases and documents were utilized to gain an understanding of the case company's background and how other areas in the company see that product phase downs should be conducted. The case company's databases and documents were also used to get a deeper understanding of the case company's Simplification program and to understand the phase down steps within it.

5.3 Research quality

Qualitative research can be seen to be sensitive to different interpretations, so in this chapter the quality of this research is demonstrated. Using a single holistic

case design gives a deep understanding on the subject product phase downs in the global company. By interviewing different types of customers who operate in different industries, the robustness of the research improves as well as it makes the research more generalizable. To address the construct validity and external validity of the research, multiple sources of data was used and theory was used and brought together with the findings from the different customer types and the case company interviewees (Yin, 2003).

Within this research, illustrative charts were used to give an understanding how important customers see different aspects in product phase downs, which improve the objectivity of the research. To improve the reliability of this research, interview recordings were taped and transcribed (Creswell, 2003). The interview data was coded further by using coding tables. However, the transcription and analysis was done manually, due to previous practice and the fact that some interviews were conducted in Finnish, which would have led to poor quality of the transcriptions as some automatic transcribers have difficulties with transcribing Finnish.

6 PRODUCT MANAGEMENT IN ELECTRICAL INDUSTRY

Product Management is the managing function of product phase downs in the case company and this chapter describes how product lifecycle and portfolio management is conducted in the case company within the Product Management function. The main focus is, however, describing how all of the case company interviewees see a product phase down process should be conducted and what are the challenges in it.

6.1 Case company introduction

The case company was established in late 1980's. Overall the company has around 135 000 employees and the company operates in about 100 countries. The company is a global leader in industrial technology and has customers in manufacturing, energy, transport and infrastructure businesses.

The case company's current organization structure was established in the early 2010's. The structure has four levels and the levels have different functions. These levels and functions can be considered as global but when going deeper within each level and function, local roles are also present. The first level is the Group level, and after the Group level comes the Division level. The Division level is followed by the Business Unit level and the structure ends with Product Group level. Each Product Group consists of different products in the Business Unit.

This Master Thesis is executed on one of the Business Unit levels, where the company operates in electrical industry. The customer markets, where this company operates, are marine, mining, oil, gas and petrochemical, power, water and food and beverage. This study focuses on one of the Product Groups within the Business Unit, Product Group X but at the end the findings will be shortly

compared to another Product Group, Product Group Y, to demonstrate the finding's generalizability. Product Group X has three different ranges of products, product range 1, product range 2 and product range 3. Within these ranges the products can be standard products, which have stock, or customer specific products that are custom-made. Project specific products are also available. Product Group Y's business focuses mainly on making customer specific or project specific products.

6.2 Product portfolio and lifecycle management in the case company

Each Product Group has its own Product Management function. The current global Product Management function has been in operation since the current global Product Groups were established. Product Group X has a Global Product Manager, who is responsible for managing the case company's offering through its lifecycle stages according to customer needs and case company's strategy and targets. A Product Management Manager works for the Global Product Manager and the Product Management Manager's task is being able to see early when something must be changed in the portfolio and leading the Product Management team to meet the targets of the local units. The Product Management Manager is also responsible for the communication with customer teams, marketing, and sales managers. Each of the three product ranges has its own Product Managers, who work in the Product Management team.

One of the main role Product Managers have is making sure that the products answer to customers' current and future expectations and requirements. Also, Product Managers manages their team by having a focus on operational execution. They are responsible for managing products and lifecycle from launch to phase down. Within the case company, product lifecycle management has been conducted in the case company before the current organization structure was

established. The current product portfolio management process was established when the current Product Management function was also initiated.

Product lifecycle management within the case company

The case company uses term Life Cycle Management when meaning product lifecycle management. The company's Product Management is conducted by managing the products from the idea to design to manufacturing and ending when the product's sales are ended. LCM focuses on the phase of products while they are sold and to the service phase of products. The product lifecycle model in the case company and in the company overall has four phases: Active, Classic, Limited and Obsolete, as seen in Figure 7. Comparing to the lifecycle models in chapter 2, the case company's differs from them as the case company refers to available services of the product when the models in Chapter 2 refer mostly to the sales volumes of the product (Stark 2015; Terzi et al 2010).



Figure 7 Product Lifecycle Model in the case company

During the Active phase, the product is released to the market and it is actively promoted. The Active phase product is also available to all customers. During the Classic phase, the product is not actively promoted anymore, has limited sales and will be phased down. However, the product has all services and spare parts available, as the case company is responsible for providing spare parts for ten years once the product transitions to Classic phase. Here it is important to keep all the tools and materials needed in Active phase available also during the Classic phase. When the product has reached the Limited phase, the customer has a “Last Buy” opportunity of the complete equipment, the manufacturing of spare parts is

guaranteed but there is no new development for replacing obsolete materials. Once the product is in its last phase Obsolete, the product's manufacturing capability is no longer available and spare parts are available only upon request but there is no stock for spare parts. The products will be recycled or disposed either by customers or by the case company.

In the case company's Life Cycle Management, products in the Active phase are the Product Group's responsibility. The latter three phases (Classic, Limited and Obsolete) are Service's responsibility. During the Active phase and in product range 1, the LCM processes consist of collecting data through meetings, where the market, countries, certifications, demands, quality and other product measure data are collected. The data is then consolidated and analyzed by simultaneously following documents concerning products and markets as well as roadmaps. Interviewees from the Product Management function shared that other functions within the Product Group X are utilized and informed as well. Finally, decisions are then made concerning the future of the products and they are communicated throughout the functions in the case company.

LCM's data is all the data in the operational system. Lifecycle plans for products are updated every year. Electronic drawings, which are a part of LCM's data, must be available all the time and updated whenever changes are occurring to the product. Continuous maintenance activities are also included in LCM to improve product quality and productivity even more. Product ranges 2 and 3 use only the lifecycle plans as a systematic LCM process. Product data exists in many systems, which is seen as a challenge in the case company as it must be ensured that all systems have correct and updated data. Product Data Management is thus conducted in the case company on a regular and consistent basis to help in working with multiple systems, which was seen as a lifecycle management activity by Stark (2015). The transitions between different lifecycle phases are decided at product range reviews. However, the durations of each lifecycle phase are not decided from the beginning in a systematic manner in the case company

rather during product's Active phase (Tolonen et al 2010; Trappey et al 2009). When a product transitions from phase Active to Classic, Product Group X's Product Management informs Service that they must check the stock of all products and components and supply the needed parts. Once Service has informed that all parts are secured, the lifecycle plans are updated and the customers and markets will be announced of the transition. Overall, the amount of lifecycle management for a product depends on the type of product, as customer-specific products require more cooperation with the customer.

Product portfolio management within the case company

Product portfolio management process within the Product Group X manages and monitors the portfolio according to the Product Manager of product range 1. The portfolio can consist of different aspects; the products, the manufacturing locations and for example support function. In Product Group X, product portfolio management decisions are mostly conducted at Product Council meetings. The Product Management team has meetings where they decide on new business opportunities, new projects, product phase downs as well as on other matters related to the product portfolios. Product Council meetings are held every second month to review the current situation and what needs to be done in the future to meet the strategic decisions of PPM. On the other hand, according to the Product Manager in product range 3, product portfolio decisions are based on data and discussions with local Product Managers by having monthly meetings and by discussing also with Regional and Segment Sales Managers. These are top-level decisions in the portfolio and through a proposal channel, the Product Management gets information concerning product characteristics suitability at the customer site. Because the Product Group X's products are manufactured in multiple locations, whenever a decision is made the manufacturing locations must execute according to the made decisions.

In the case company, another aspect, which is utilized in PPM, is a product roadmap. With the roadmap, the case company checks they have products available for the markets they want to target. If certain products are not already available, a roadmap for R&D is developed to fill the gaps. With this roadmap, R&D designs new products for the case company. Product roadmap also makes sure that the product portfolio and product roadmap are aligned to the case company's strategy and the set financial targets, and it is updated once a year. Product range 2's Product Manager emphasizes that road maps should be created and specified for each function in the company, as R&D can have a different roadmap than Product Management, but the roadmaps must be consistent. However, in product range 2 they only have one road map and also other product ranges' Product Managers only described one product road map. Concerning product ranges 1 and 3, the product road map's role has been decreasing as other activities' roles are increasing. But still, in product range 2, the product road map and its utilization is the main strategic work used in Product Management. From the interviews with Product and R&D Managers in Product Group Y, it is also highlighted that PPM may also concentrate on updating or creating product features, not only on whole products.

Product lifecycle and portfolio management challenges in the case company

Interviewees from the case company's Product Management described few challenges, which were related to product lifecycle and portfolio management. Each interviewee from the Product Management function in the case company, Product Group X, brought up one challenge. Product Group X has a very large and not completely harmonized portfolio with thousands of product IDs. This makes portfolio management more challenging. Another challenge is that since the global Product Groups were formed, the Product Group X has had difficulties in finding the roles and responsibilities for the Product Management function. There has been a continuous improvement in the definition of roles and responsibilities, but there is still some room for improvement and in finding out

how product phase downs should be a part of PPM. For example, product range 2's Product Management should do strategic work according to the Product Manager, but it has not been so efficient as the details of roles are still improving. In addition, the Product Group X has multiple locations where the product is manufactured and before the global Product Groups were formed, the manufacturing locations had ownership of managing products. Here also the misunderstood global roles and responsibilities have caused that building trust between the Product Management and the manufacturing locations has not fully happened due to manufacturing units not understanding what the Product Managers can do to help them.

These challenges result in difficulties of deciding when products should transition between phases and it is also a difficulty to keep decisions according to the interviewees from the case company. Kester et al (2011) brought up trust's importance in NPD projects but here it can be seen that it is also essential for product management overall. The involvement of top management and their decision-making are essential in defining who is responsible for what and building trust within functions and units. Utilizing and improving Organizational Change Management is one practice that could help the case company build trust in between Product Management function and sites, and thus in product phase downs.

Another challenge in the Product Group X's Product Management function is ensuring that all three product portfolios have the resources they need for their different projects. For product phase downs, the components and materials must be secured so they are as available in Classic phase as they were in Active phase, especially in Product Group X. It is also important to have the correct tools available both in Product Group X and Y as some products might require specific methods and techniques.

Product Management Manager described a triangle of challenges (see Figure 8) and these challenges are present in the top-level of the Product Group X and its Product Management. In PPM and PLM it is essential but also a struggle to decide where the company should operate, how they should operate and what products to provide to the market. Where the company should operate focuses on recognizing what countries and which markets the company should be in or not to be in. How the company should operate means from which manufacturing location should the case company provide a product to the customer. What to play comes to the core of product portfolio management: a challenge is to know and recognize what products should the company offer to the market and customers, and understanding market needs were raised as a challenge by multiple interviewees both in new product development and in product phase downs. What to offer to the customers must also be aligned with the case company's own values and how they want to differentiate themselves. What to provide is essential for example when analyzing what products to develop and what products to phase down. The case company must make a correct decision business wise so they keep providing a product that answers customer requirements but that may exceed them as well. When deciding these, the case company has to evaluate where they want to focus their offerings and are they still focusing on the same markets and countries.



Figure 8 Where, How and What to play triangle

7 PRODUCT PHASE DOWNS IN THE CASE COMPANY

In the case company, product phase down is a process when a product transitions from Active phase to Classic phase. A product phase down process should be an essential product lifecycle and portfolio management activity in the case company. However, products have not been phased down in the case company since the establishment of the current organization structure about five years ago with the exception of a few cases in product ranges 2 and 3. According to the case company interviewees, there is a clear need for more guidance from management to conduct product phase downs efficiently and in a controlled manner, as currently there are unclear roles & responsibilities within the Product Management function. A vital reason why phase downs have not been conducted is the way of thinking within the case company Product Group X, as well as in other Product Groups in the Business Unit. The focus has previously been on filling the gaps in the product portfolios by adding new products to fulfill customer needs and requirements. At the same time, it is not considered what should be done to the older products in the product portfolios that do not answer to the customer needs anymore. This has led to large portfolios in the product ranges in Product Group X, as in other Product Groups within the Business Unit also. The focus in Product Group X has now been shifted towards making the portfolios more harmonized and easier to manage, and this results in the need to start phasing down products that are not needed anymore.

7.1 A product phase down process

The case company does not have an existing systematic process for phasing down products, as phase downs have not been conducted since the latest organization structure was deployed. However, as the focus within Product Group X has been put towards harmonizing the portfolio through a Portfolio Simplification program,

interviewees from Product Group X's Product Management have defined the main steps and characteristics in future product phase downs, a so-called first version of a product phase down process. The Simplification program focuses on making the portfolio overall more competitive and harmonized. This requires commitment and leadership from the case company to make the possible tough decisions of phasing down products. Within this program, project management and a Process Group are utilized to define clear targets, scope and roles, which are seen as part of PLM by Stark (2015).

According to the case company's Product Management Manager, the product phase down process starts from making sure that the market agrees on the process and that there is a need to phase down a product (see Figure 9). The next step is to communicate with Operations and Supply Chain Management about the upcoming changes in these functions and to find out what might be the possible effects and challenges when conducting product phase downs. Once the markets, Operations and Supply Chain functions have been analyzed and involved, management will finalize the decision to start the phase down. Once the decision has been made, the product phase down will be communicated to Sales and internal functions before the actual product phase down process' execution starts. This is a step that needs much attention, as internal communication makes external communication possible. There is a need for a more systematic internal communication process that ensures regular communication and all the needed information to different functions is given.

Handling possible excess stocks, both of complete products and components, is one of the first steps in the execution. Product phase down process might come to halt, if the stocks are too difficult to handle, or the process will be delayed or it will continue on schedule, if stock does not disturb the process. If the process is stopped due to stock, the case company must analyze whether the decided product was the right product to phase down. However, the case company aims to have no excess stock by the time the product is phased down. This requires exact

estimation of the consumption of the phase down product and to do this the case company must find out from the customers how much they will need the phase down product until the replacement product is available. Here the communication between the customers and sales is essential. It is important that the estimation of the needed stock levels is done before the management finalizes the decision to continue with the phase down. Also the possible buffer stock levels must be taken into account. This way the case company can then ensure that they have enough stock of the replacement product when they begin to sell it, or if they encounter some challenges within production during the transition from phase down product to replacement product.

The next step is agreeing with customers that the phase down can continue as planned, everything is executed well so far and that customers will make the necessary changes to their systems and operation as well. In this step it is important for the case company to show their support to the customers and the case company should remind the customers what are their added value from the phase down. With this step, the case company can ensure that they have done everything to make customers satisfied. This will remind the customers that even though they have to do some changes they will gain from it as well. Once this has been agreed on, the product will be phased down.

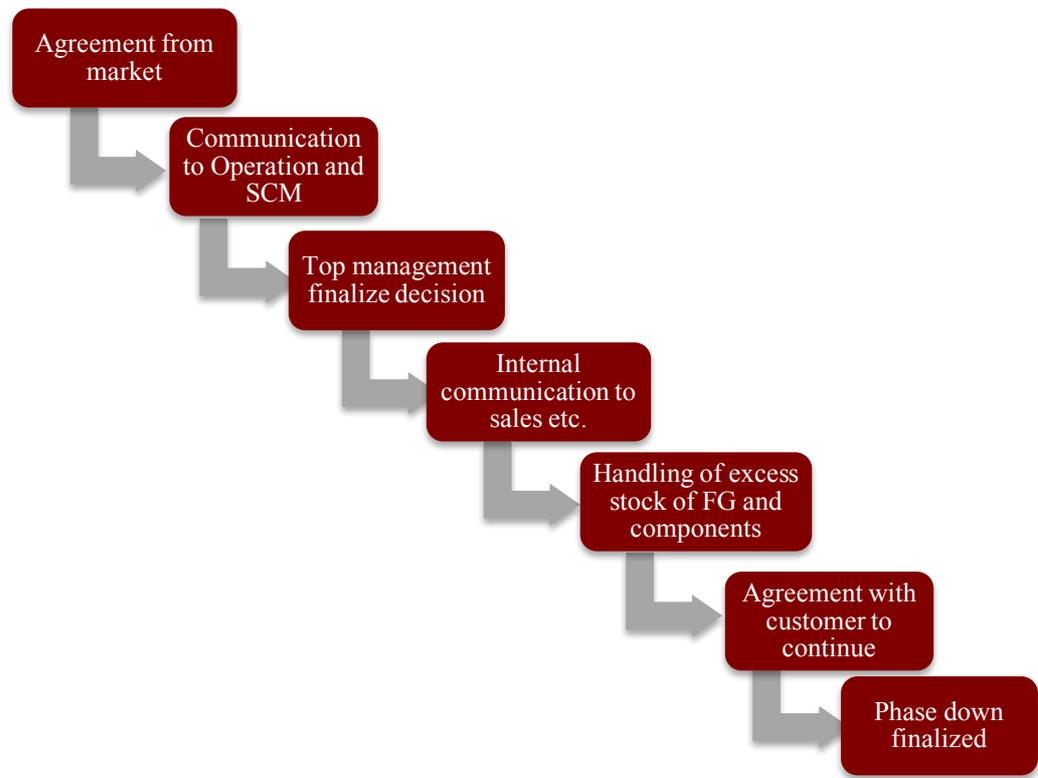


Figure 9 The current product phase down process

An important part in the early steps of the analysis process is to recognize the factories that manufacture the phase down product to make sure the factories have time to implement the changes. Product Manager of product range 1 also highlights that in the first phases of product phase downs, the affected customers should be recognized and it should be found out how much the customers buy the product that will be phased down. This will require close co-operation with the sales team. Finding out if there is a replacement product already available in the case company's offering must also be found out. If there is not, then a replacement product must be designed, which will then require extra time. Also, it must be ensured that spare parts are secured for ten years after the product has been phased down as the case company has agreements with markets and customers that they must provide spare parts for at least ten years since the last product has been sold. With some customers there might be some agreements that

the case company provides a certain product for a set time period. This might then make it not possible to phase down a product the case company has first thought of. All of these require a deep and careful analysis and the team must devote time to this.

As described, the stock levels of the phase down product affect the schedule of the phase down process. Manager from product range 3 also brought up the need to consider the overstock of components and decide what to do with them. By considering these, the case company fulfills complete lifecycle thinking for its products. To ensure that the overstock is handled, the case company must communicate future lifecycle plans throughout the company. If it is not communicated, for example SCM function might not understand to stop buying components and materials that are not needed in other products than the phase down product and the stock levels for those components are then too high. When the whole case company understands and is aware of what are the current lifecycle phases of products, the case company can achieve cost savings and minimize extra work when phasing down products.

Before Product Management starts making decisions of what products to develop and what to phase down, strategic portfolio decisions are made about what the targets are for the upcoming years. These targets can include what markets to be in or how much funding is given to NPD projects, and these determine what can the Product Management function do. To decide what products to keep in the portfolio, Sales Manager, who has over 500 sales persons globally, is invited to the decision-making meetings. Representatives from Product Management and the Sales Manager meet to decide on what product type to analyze; whether or not it should be phased down (see Figure 10). The Sales Manager then analyzes with his Sales team and Sales representatives on different levels how the customers would be affected if that product will be phased down and how the customers will react. Phasing down a product might also affect the targets the Sales function has set for itself. This might result in Sales having different opinions of the renewal of the

portfolio, as Sales might not then reach their target. Product Management and Sales must find a unitary opinion on how to move forward with the phase down.

The Sales Manager will communicate to the Product Management if they see that the product can be phased down or if it should not be phased down. Also the interviewed Senior Project Manager from the case company reminded that a product cannot be phased down and marked in the systems as phased down before the sales team has stopped selling the phase down product. These should be conducted early in the analysis phase of the phase down process, possibly as a part of or even before the agreement from market step, so the customers can be informed from the start what product will be phased down. Product Management must recognize importance of analyzing with Sales what is the correct replacement product as Sales works most closely with the customers and markets.



Figure 10 Including Sales department to the phase down process

7.2 Important elements in product phase downs

Each interviewee highlighted the necessity of communication in product phase downs to let everybody know of the upcoming changes and what do they must do to that. Customers must be communicated on time about the product phase downs and internal functions must also be communicated of what will happen and how the product phase down will affect them and what is the schedule of the phase down process. Interviewees state that the communication with the customer is necessary to secure the business and to ensure customer loyalty. The communication to the customer should happen ahead of the product phase down to tell which product will be phased down, what will be the replacement product and above all what are the benefits of the product phase down in question to the customer to show the customers what they will get from it. Comparing to Sales' interviewees and Product Management interviewees, the opinion of when the communication should be done differed. Interviewees from Sales see that the communication should be done earlier than what Product Management sees.

However to execute external communication at all, the case company must communicate internally to functions early enough and on a regular basis and give them all the information they need. These will then enable the understanding on what will the customers gain and enable the communication to customers. Communication needs improvement efforts in the case company to make the internal communication consistent and to ensure everybody who needs the information will receive it. In addition, it is important to consider the form of the customer communication whether it is face-to-face, by phone, by email or by some other form. Overall communication with customers is needed to understand the customers' needs in the future according to for example product range 1's Product Manager and Senior Project Manager, but it should be kept in mind that internal communication is an enabler for external communication.

Value propositions are used to present to the customers their added value and to decrease the resistance customers might feel of the product phase down. The Sales Manager of the case company describes how the value propositions differ depending on the phase down product and also depending on the customer types and to whom the case company is communicating within the customer company. Also where the company operates changes the content of the value proposition as customers in Europe highlight different issues than customers in Asia for example. So far value propositions are not used that systematically within the case company and with the Simplification program the company is aiming to utilize them to get the customers onboard. A lot of analysis and learning must be done by Sales to understand what is the most efficient way to use value propositions and what possible benefits different customers and customers' stakeholders can receive.

In the interviews with the Product Management Manager and product range 3's Product Manager, it is brought up that the customers must also do different tasks within their own company. These tasks can be updating own systems to include the replacement product and marking the phase down product as unavailable or removing it from the whole system. As the case company's product phase downs require effort from the customer, value propositions are needed to demonstrate that the customers will also gain something from the required changes. Overall the case company's aim is to maintain the customers they have and to secure business, as for example Product Manager from product range 1 brings up. Value propositions help in keeping the customer open to changes, making the customers more willing and ready for the changes within the case company and within the customer itself and building customers' satisfaction. But, the case company must also be willing and able to support their customers to show the appreciation of the customers' businesses.

Every function within the case company will be involved in a product phase down, but according to the interviewees, some functions have a more important

role in the process than other functions. Product Management is the managing function of product phase downs. Sales department will give a customer and market view to the process and work as the communicator towards the customer. Operations are responsible of giving input of the challenges concerning a product phase down, estimating how the manufacturing and inventories are affected, handling stock and possible parallel process. SCM is responsible of communicating about the product phase down's changes to the supplier as some of the components will not be needed anymore possibly and to give insight of how the SCM function and supplied materials and components will be affected. But it must be kept in mind that the phase down process will not work effectively if the functions are not committed to work towards the phase down, as it will require their time and effort. Guidance, clear roles and responsibilities must be given from the phase down process' management to have everybody involved at the needed steps. Internal value propositions can also be utilized. If the customer is a key account customer for the case company and if the phase down product is a customer specific product, customer must be more involved in a product phase down to make sure the replacement will not affect the functionality of the customer's product, otherwise customers will only be communicated of the phase down.

The Sales Manager and product range 3's Product Manager highlighted the importance of having proper management in a phase down process especially due to the case company's globally spread operational environment. By having proper management, the Sales Manager believes that phase downs will be conducted more eagerly in the future. When the management in a process is in good shape, the process' team has a good spirit and the management moves the process forward by making decisions by force when needed and the process will more likely perform well. With a standardized and controlled process, the decided schedule is kept and it is easier to handle a possible parallel process between the phase down process and ramping up the replacement product. This is an area that the Product Management and the case company overall should focus on, as the

case company interviewees see that proper management has been partially lacking in some processes in the past.

As highlighted by Product Managers from product ranges 2 and 3 and also by Operations Manager, the management team must include a person who has an end-to-end viewpoint as the person can see the whole affected chain of the product phase down. Finding a correct person is something Product Management function should concentrate on. This way they ensure that they do not consider only their own operation but they consider all needed parts of the phase down process and that every function conducts its tasks as planned at the needed steps. Proper management also ensures that the set results are achieved and that the process overall is executed well. Stark (2015) also emphasized that in product lifecycle management activities, where a product phase down is one of them, management is needed to understand what are everybody's roles in product phase downs and to conduct product phase down's on time and on budget. Overall management's involvement is important to help in steering the phase down process in the right direction and top management's involvement is needed to show the case company's dedication to conducting phase downs as the case company's Sales Manager states and as also stated in research such as in Jonas' (2010) study. The case company can utilize the guidance from the Business Unit level to help in finding committed management and the right person to lead the phase down process.

The interviewees from the case company as well as from the Product Group Y highlight that it is important when a product is phased down and there is a replacement product needed, that the replacement product has the same features and that it should have better functionality than the phase down product had. By having a replacement product with same features, the interviewees mean that it fits with the customer needs at least the same way as the phase down product did. If the case company does not provide a replacement product that answers to customers' needs, it opens the door to competition, which the case company does

not want. The replacement product should be known early enough as the case company's Product Management Manager described that when customers are communicated of the product phase down, not only does the phase down product need to be known but also the replacement product should be introduced, as it will start bringing value to the customer.

Concerning the replacement product, especially when the replacement product is a new design, the product phase down should be included in new product developments according to the product range 3's Product Manager. By having a simultaneous process with the product phase down process and NPD process, a better and more harmonized portfolio can be ensured as whenever new products are added, the ones that do not bring value to the case company and its customers can be removed. If the ramp up process and phase down process are conducted simultaneously, there should be a management team who can understand the whole combined process and who can make sure that they are conducted in a controlled manner. This might require compromises, as the products might need the same tools in the production. It is important to evaluate which parts of production can be conducted simultaneously, when manufacturing the phase down and replacement product at the same time for a certain amount of time.

By harmonizing the product portfolio and phasing down products in the case company, the Senior Project Manager and the Product Manager from product range 3 demonstrate that the case company can use even more common parts for different kinds of products due to improved modularity. This will enable easier management and handling of materials and production. Product Managers also brought up that in phase downs, it should be ensured that the replacement products are available globally. Thus, if the replacement product is modular, the case company must ensure that the common materials and components are also available globally to all manufacturing units. Here it is important to have product data available at all plants and that each manufacturing units' systems are integrated with each other.

From the case company interviews, the business-oriented way of thinking in product lifecycle management can be seen, as product phase downs are one PLM activity. The case company will utilize in product phase downs, especially in the Simplification program, cross-functional teams and processes. Information and data will be shared across functions and feedback from the customers will be utilized also, so it must be ensured that all the systems are giving the correct information, everybody is using and updating them in the same way globally and that communication is executed. By doing this, the case company ensures that not a stone will be left unturned and all vital elements are considered. (Stark 2015; Terzi et al 2010; Kiritsis et al 2003) In addition to having a cross-functional organization in the product phase down processes, the case company utilizes financial measures to evaluate the value of the portfolio and which products should be possibly phased down (Jugend and Da Silva 2014).

7.3 The perceived challenges of product phase downs

The interviewees from the case company are able to identify different challenges in phasing down products. One of the most important things in the case company's business is their products' certifications. Some of the case company's customers operate in markets where certifications are needed. If a phase down product has a certain certification, the case company must make sure that the replacement product will have the exact same certification. This is seen as a challenge, as products have had certifications for regional needs only in the past and getting the correct certification in place takes some time.

Product Managers from product ranges 2 and 3 and the interviewed Sales Manager recognize that it is important to have proper management of the product phase down and this is a challenge for the case company as there are many functions and locations globally involved in the phase down process and it can be difficult to find one person who would be in charge. Having proper management

is also mentioned as a challenge in PLM. In the past, the management activity has not been that efficient as wished as manufacturing units have worked quite independently. As described earlier, having support from the Business Unit level might help the case company to find a correct leader and management team for the phase down process.

A challenge identified by almost all interviewees, especially all Product Managers, from the case company is that having multiple manufacturing units is a challenge in phasing down products also. The manufacturing units work currently in a quite localized way according to the Product Managers of product range 1, 2 and 3 and this leads to similar products being different between the case company's units and that they are certified only for regional needs. Also each manufacturing unit might have their own production targets for the year. Having changes in the product portfolio can lead to the units not reaching their targets, and this might cause resistance to conduct the phase downs. Getting all the required people involved and aligning people, information and processes is also seen as a product lifecycle management challenge by Terzi et al (2010). The management team of the phase down process must ensure they are utilizing the functions and people in the most efficient way possible, and they also must demonstrate internally what benefits are achieved.

Product Manager from product range 3 sees that the tools and systems can generate challenges in product phase downs. When products are phased down and replacement products might be designed and added to the offering if not already available, not only does the case company need to take care of stock and availability of materials and components, but also tools and systems must be managed. The case company must ensure that the manufacturing tools of the phase down product are available as long as spare parts are available to ensure maintenance.

The systems must be updated so that the phase down product is also phased down in the systems and the replacement product is added, if it is a new product to the portfolio. The systems include sales and engineering systems as well as data drawings for example. Product range 3's Product Managers sees that the engineering systems may cause notable challenges as systems require much manual work which may result to not updating all old data as not to be used anymore and there are many different engineering systems used that need to be updated. SCM Manager of Product Group X sees also the management of materials and components as a challenge in product phase downs. When a product will be phased down, for that product materials and components are not needed anymore. However, a different product manufactured by the case company might need the same materials and components the phased down product needed. Hence, it is important to recognize when materials and components are needed elsewhere to ensure that they are still purchased from suppliers and to recognize the impact for overall volumes and related consequences like volume dependent prices.

Overall most of the challenges have a similar cause demonstrated by the Senior Project Manager. Product phase downs are complex in such, but especially as the case company operates globally in a wide network. There are many individuals that must be considered before the actual execution of the product phase down can start. Everything in product phase downs must be done in the right order. Here the Figure 8's triangle (see page 62) is relevant, as How to play is important to determine. The Senior Project Manager in the case company sees that product phase downs should be kept as simple as possible in the complex environment. Every department affected and involved in the product phase down must be taken into account. The process itself should be clear and simple even though some steps might be conducted simultaneously, for example Operations' analysis of the phase down product's stock levels and production effects might be done at the same time as R&D is possibly designing a new replacement product.

Also some steps might have to be executed and issues analyzed before the start of another step. These all have to be considered so time must be put towards making the phase down process as efficient and simple as possible and making sure every step and milestone is in the right order. This shows that the described phase down process by case company interviewees is only the first version of it and improvement actions will be needed. Not only should the Product Management agree on the process, but it must be checked and analyzed with each function whether they see the steps in the phase down process are in the right order. Product lifecycle management's complexity is also brought up by Stark (2015) and Terzi et al (2010) as PLM overall must consider many different aspects concerning products. A challenge might also be finding a correct replacement product that will fit customer requirements in all possible ways, so what to play must be analyzed carefully (see page 62, Figure 8).

7.4 The perceived benefits of product phase downs in the case company

Product phase downs cause a lot of challenges to the case company so the focus should also be on the benefits of conducting product phase downs. Overall 4 case company representatives were asked to give their view on which processes within the case company will benefit from conducting product phase downs and in which functions the benefit can be seen. Researcher and instructor developed the base of the matrix, but respondents were asked to add processes or functions if they thought important ones that would also gain possible benefits were missing. Respondent's matrix can be seen in Appendixes 5-8, and below they are more closely described. As the case company is currently conducting the Simplification program to harmonize their portfolio, the received responses concentrate mostly on the product phase down benefits that are received within the Simplification program. In addition, it is important to acknowledge that the type and monetary amount of the benefit depends on what product is being phased down. If it is a

product that has had small sales volumes for a longer time, the effect is smaller than with a product that's volume is larger and maintenance and production costs are higher. And also the benefits volume is bigger if multiple product types are phased down from Active to Classic than if one product type is phased down.

Overall the respondents see that 18 process areas within the case company will benefit from product phase downs. There are two processes within Product Management, product portfolio and lifecycle management, which will receive benefits. Product Management is one function, which will experience the benefits as the product portfolio is easier to handle with fewer products and the portfolio is more harmonized, and PLM will improve by updating the portfolio on a regular basis by conducting NPD and phase down processes. Marketing, Sales and Sales support will also get benefits from better PPM, as not needed products are removed from the portfolio and the portfolio is easier to handle and understand. Within Sales, the quotation process' speed and quality will improve as the process is leaner due to having fewer products and when the current portfolio answers to the customer needs better. Also, the marketing of existing products will improve, as the portfolio is easier to understand and handle.

Once the portfolio is made more harmonized by removing products that are unprofitable or have limited demand, the case company can receive benefits from modularity, where the same components and modules can be used in several different products. This benefit will become evident through the new replacement products. Several functions and parts in the case company will get this benefit: R&D, SCM, Manufacturing, Inventories, Stock of finished goods and Logistics. NPD and product maintenance will improve overall, as the focus will move to products that have volumes. A few SCM processes can also gain benefits from phasing down products if modularity is achieved with the replacement products. This way the number of suppliers might decrease but essentially the number of different articles bought from one supplier decreases and volumes for individual articles will increase. Suppliers can be then more easily maintained and supplier

quality can be further improved. Updating supplier pricelists and certification process will become faster and easier to manage. Production can also receive benefits such as faster lead-time, faster setup times between components and products and lower inventory levels with fewer product types to handle and by utilizing product modularity. With the Simplification program, an increase in automation within production might also be achieved and this will result in improved productivity in the long run.

The possible benefits that the case company can have from conducting product phase downs will also bring benefits to the case company's customers. These benefits are described in Chapter 8. Overall the case company can gain different kinds of benefits by conducting product phase downs on a regular basis and improving the product portfolio overall. However, all of the possible benefits can be truly received only if the product phase down process is executed well.

8 CUSTOMERS' VIEWS ON PRODUCT PHASE DOWNS

This chapter focuses on presenting the customer point of view to product phase downs. Different themes emerged from the customer interviews, which were communication of the product phase down, the replacement product, required work at the customer site and the product phase down process through the customers' eyes. Each of these themes is described in greater detail further in the chapter. However, it must be remembered that there were two interviews conducted concerning customers E and F, both with the sales unit's Key Account Managers and with the product group's Account Managers, and not directly with the customers.

Customers also mention other aspects a part of product phase downs, which are visible in Figure 11. These are finding the benefits / added value customers themselves will get from product phase downs, support from the case company when customer must do some design work to fit the replacement product in their own product, proper control of the phase down process in the case company and that the product phase down process and replacement product's ramp up process would be conducted at least partially at the same time. All of these will ensure a smooth execution of product phase downs according to the customers.

Additional aspects mentioned

- 
- Support in designing the customer's product to fit the case company's replacement product
 - Control of the phase down process in the case company
 - Parallel process
 - Benefits / Added value for the customer should be found

Figure 11 Additional areas of product phase downs

8.1 Communication throughout the product phase down

Early communication of the product phase down was highlighted in all customer interviews multiple times. This shows the importance of customers getting the information of the product phase downs early enough. Communication must also be active throughout the process to remind the customer of the upcoming phase down and whether there are any changes to schedule or other parts of the phase down process. All of the different areas of communication brought up by customers are visible in Figure 12.

Communication

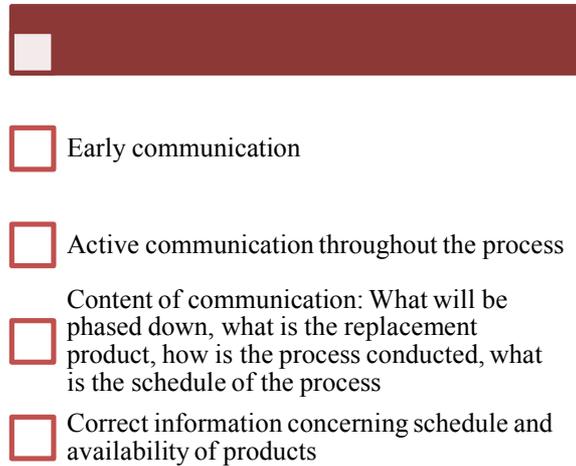


Figure 12 Areas of communication mentioned by customers

Communication must be done early enough so that customers themselves have time to switch from the phase down product to the replacement product. Customers A, B and E stated that the information of the product phase down should be given at least one year prior to the actual phase down happening. Customer C explained that they must know the information six months before and all the data of the replacement product must be informed a minimum one month before orders for the replacement product can be entered. Customers D and F stated that the information is needed two years before the phase down of a product is actually conducted. Customer D needs time to adjust their own operation and factories to the upcoming changes, while customer F must have time to do product tests in addition time to update systems and drawings. The product tests are not only costly but also time-consuming as for the testing of one type of the customer's product with the case company's prototype might take up to two weeks.

Customers wish that the first information of the product phase down would be given to the customers face-to-face. The first information should also be as precise and comprehensive as possible. All of the total eight customer interviewees said that the customers must know from the start what is happening, what will be phased out and what will be the replacement product, how will the phase out happen and when will it happen. Concerning the schedule of the product phase down, interviewed customers want to know from the start when the product phase down will actually occur. It is also important to know when the replacement product will be available. Customers want active communication throughout the product phase down process since the decision has been made. The active communication can be done face-to-face and through possible portals. By receiving active communication, customers will know most likely early enough whether there will be any delays or moves up regarding schedule or any other changes in the process or outcome.

Customers C and D thought that a representative from the case company should deliver the information of the product phase down and changes related to that throughout the customer's company face-to-face. All customers do not need this as customer A thought that a written memo of the product phase down and of the possible visits between the case company and customer would be enough and then that memo would be delivered within the customer. Overall it has to be ensured either by the customer or also by the case company that the news and changes of the product phase down are delivered throughout the customer and that the changes are understood.

8.2 Replacement product's features

One of the first things to be sure about when the case company will be conducting a product phase down in the future is to know whether there will be a replacement product available or not. This is especially important for the case company's high

volume customers E and F as there has been a high need of the phase down product and there will be a need for the replacement product. If there is not a replacement product available, the case company's customers might switch to another supplier. Other aspects of replacement product mentioned by interviewed customers are seen in Figure 13.

Replacement product



Figure 13 Replacement product's features mentioned by customers

Finding an interchangeable replacement product for customers' products in use is essential in the business the case company operates in. The dimensions and shape of the replacement product was one of most highlighted in the customer interviews. The case company's replacement product should fit in the customers' own products (OEM customers) or production lines (end-customers), so the dimensions and shape of the replacement product should be exactly the same size or smaller. Customers own products and production lines are designed with a limited amount of space for the case company's product, so if the replacement product is too big, it will not fit within the customers' product or production line. This is a point the case company has not brought up in interviews, so this should also be focused on. Customers A and E also highlighted the importance of the

weight of the replacement product, but customer E specified that it depends on the customer's product whether the case company's heavier product is a problem. If the replacement product is heavier than the phased down product, it can cause for example vibrations and this affects negatively on the performance of the customers' products. This results in that the replacement product's weight should be the same or lighter when comparing to the phased down product.

The case company and its customers operate in industries where certifications are usually needed and regulations are present. Customers' E and F Key Account Managers remembered how previous changes in the case company's productions resulted in not having the correct certifications for certain products and the customers E and F faced problems due to this. This is also an issue that has to be taken care of in product phase downs from the customer point of view, as having the same certifications and regulations in place is an important aspect for the customers. The case company has factories throughout the world and it must be ensured that from each factory the replacement product has the certifications needed as the customers buy from different factories and they need the case company's products in global markets.

Concerning the replacement product's features, the replacement product should also be electrically, mechanically and technically the same or possibly better than the phase down product. The end-customer point of view was brought up in the interview with customer C as end-customers might require some specific features that were in the phase down product and should be also included in the replacement product. The interviewed end-customer, customer D, sees that having electrically the same product is important, otherwise excessive work and cost is required. Customers B, E, and F state that the replacement product should have better functionality or it should be a cheaper product. Cost efficiency is key in winning customers over in product phase downs. With some customers there might be sales contracts that state when an offer is involved, the replacement product's price should be the same as the phased down product as long as is

determined in the contract, as is the case with customer C. Customer C also pointed out that it should be possible to get the replacement product at the phase down product's price until everything is clear in the phase down process and the replacement product's ramp up process.

Customer B brings up how the markings on the replacement product should be understandable and in the customer interviews it is also brought up that the replacement product should have at least the same quality level as the phase down product had. Also, customer F wishes that the case company's products could be more modular if possible. Because the replacement product is new to the customers, there is a lot of uncertainty in place and the customers want the case company to acknowledge this.

8.3 Required work at customer site

Customers must do different tasks when the case company phases down a product, and all of the mentioned tasks by the interviewed customers are listed below. Customers A and B introduced the need of management of the phase down process and replacement product's ramp up process at the customer site. Proper management ensures that the customer also does all necessary actions and a smooth transition from the phase down product to the deployment of replacement product is secured. The product phase down and especially the changes occurring because of it must be communicated throughout the customer company. As an example, customer F has with previous changes notified their sales department of changes in product offerings and how this should be acknowledged in their work.

Updating all necessary systems and materials was one of the most highlighted actions in the customer interviews. Companies are highly dependent of their systems as they operate in global environment and there are many different data related to the components they use and their own products. To the ERP system in

use, the phase down product must be updated as unavailable once the ordering of the replacement product can be started. The replacement product and all data related to it must be added to the ERP system. Phase down product's bill of materials (BOM) must be deactivated and replacement products BOM must be created. The customer must end the phase down product's ordering on time to switch to ordering the replacement product. Also, the phase down product's stock levels must be minimized. This all has to be done before the customer can order the first replacement product. Customer B must also develop a stock level for the replacement product. Customers overall must help in forecasting their consumption of the replacement product so the case company can plan their production schedule. Customer C reminded also that order backlogs must be updated, as the original product will not be available anymore.

Required work from customers' once the case company phases down a product:

- Management of the process at customer site
- Communicating the changes of product phase down throughout customer site
- Notifying sales department of the phase down (Customer F)
- Update systems (ERP, BOM etc.)
- Update product drawings
- Update all order backlogs
- Update other materials (marketing, maintenance etc.)
- Minimizing order quantity of the phase down product
- Minimizing stock levels of the phase down product
- Bringing up stock levels of the replacement product (wholesale)
- Setting a consumption forecast for the replacement product
- Evaluation by R&D / design team to ensure that the replacement product will fit in the customer's product
- Evaluation with the end-customer how the replacement product will work
- Possible redesign of customer's product if the case company's replacement product is not interchangeable

- Different tests together with case company's replacement product and customer's product (Customers E and F)
- Evaluate the market and competitors' offerings

Customers E and F also have to do test work concerning the replacement product. This was an action most highlighted in interviews with customers E and F. The case company must develop prototypes of the replacement product for customers E and F to test in their own products. The tests are costly as they can cost overall tens of thousands of dollars and they are also time-consuming as one prototype test for one customer product with the replacement product may take up to couple of weeks. The time of the tests depends on whether the prototype works smoothly and correctly with the customer's product and if not, how much time it takes for the case company and customer to develop a prototype that works without errors with the customer's product.

When a product in use is removed, the customer's R&D or design team must evaluate what they believe what kind of product would work in the future with the customer's product. If the replacement product is not interchangeable with the phased down product so that the replacement product is too big or too heavy, the customer must do some R&D work to design a product where the replacement product fits in. Also if the replacement product is different electrically, technically or mechanically, R&D work is required from the case company's customers. Sometimes the customer must discuss with their customer how the replacement product will work, especially if it is not an interchangeable product. If the product phase down process and replacement product does not satisfy the customers enough or it brings too much uncertainty, the case company's customers will evaluate the market and what the case company's competitors offer and whether it suits with the customer's product and strategy. Especially according to Account Managers of customers E and F, these two customers remind the case company on a regular basis that they are not the only suppliers in the market.

8.4 Product phase down process in the eyes of customers

Customers wish that the case company would perform the product phase down processes in a certain way in the future. The customers see a proper control of the phase down process in the case company as a significant factor. Found out from the interview with the product group's Account Manager for customer F, the Account Manager would want that in the case company, there would be one person in charge of the whole product phase down process. This person should be able to see the whole picture of the process, both the customer view and the view of the case company. The Account Manager referred to the case company's production changes where the actual process was difficult but it was executed well and in a control matter due to having proper management. The customers acknowledged that it was managed well and gave positive feedback to the company.

Another feature the interviewed customers would wish to see is a parallel process between phasing down a product and ramping up the replacement product, described as a parallel process. Customers A, E, and F would like to see that the replacement product should be ramped up before the phase down product is completely removed from the offering. This way it can be ensured that the customers would not be irritated so much with the changes and products are available as needed. With parallel production, it can also be ensured that the replacement product is as it should be: BOMs are correct, the replacement product's quality is good, correct certifications are in place and customers have time to switch to the replacement product and be sure that they can work with the replacement product. However, customer F's Account Manager from Product Group X recognizes that it might not be possible to conduct parallel processes, at least in full production. Part of the production line might be in use in the phase down product and it might be also needed with the replacement product. If there is not enough capacity and equipment, the parallel process will not be executed. Customers C and D did not bring up specifically the control of the process or

whether they believe the phase down process should be conducted as a parallel process. Customer D only referred to phase down process being an important element in lifecycle planning and that the process should be given enough time so that customers have time to switch their operation from the phase down product to the replacement product.

Product availability is also seen as an important aspect in product phase downs as all interviewees except Customer D mentioned it. Customers brought up different issues of product availability and they are all listed in Figure 14. The most important part concerning availability can be seen as the replacement product's availability. Customers' opinion is that when a product is being phased down and it would have demand, it is important to get the replacement product to fill the demand, and the replacement product's delivery should be on-time, especially according to Customers E and F as they utilize JIT manufacturing. Customers B, E and F also state that the phase down product should have a buffer stock in case the replacement product is not available as originally planned. Customers E and F highlight the need to have the replacement product globally available as they purchase the case company's products from multiple locations.

Product availability

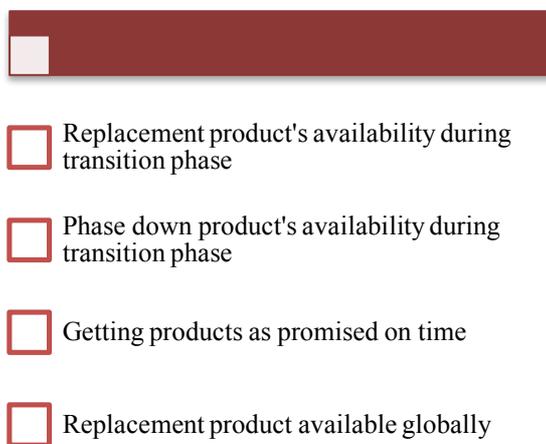


Figure 14 Areas of product availability mentioned by customers

In addition, customers mentioned additional aspects that should be utilized in product phase downs, as presented in Figure 11. As the replacement product is new to the customers, they would like support in designing their product, if the replacement product does not fit in the customers' product or they are facing some other challenges with the replacement product. The support is needed for example with customers E and F, as they must conduct a range of tests with the replacement product and their own product together.

Companies in B2B industries do not accept changes easily on a regular basis. When the case company decides in the future to conduct product phase downs, the company must find what are the product phase down's added values or possible benefits to their customers. This means that the case company must utilize value propositions. By doing this, the customers will be more co-operative with the product phase downs. All of the interviewed customers found a few possible benefits for themselves and what could bring the added value. The value propositions must include why the product phase down is being conducted. The benefits are a replacement product that has better functionality than the phase down product, or the replacement product is cheaper than the phase down product. Customers, like customer E, have their annual saving's targets. If the replacement product is cheaper than the original product, customer E will more gladly accept the occurring changes as they will themselves get closer to their saving's targets.

Concerning the functionalities of the product, customer C brought up the fact that new products from the case company can bring added value to the customer if the product succeeds. This shows the importance of highlighting the better functionalities of the replacement product in the value proposition. A lighter or smaller product can also be a benefit for the customer, as stated by customers C and F. Customer F's Account Manager from the product group also pointed out that an added value for customer F would be if the replacement product would be available globally and the quality, BOM and certifications no matter where the product is bought and manufactured would be the same.

According to customers' E and F Account Managers, the case company's sister Business Unit 's product phase down is an excellent example of how a product phase down should be conducted from the customer's view. In the first steps of this Business Unit's phase down process, the customers who are affected by the product phase down are identified. During the next steps, the bigger and major customers are considered by finding out how commitments made to them can be kept during and after the product phase down. After that, a plan is created on how to cover the customers' specific needs and how to fulfill commitments given to them. Also, a communication plan to customers is defined before the execution of the phase down begins. Once the process begins, the phase down is communicated to all customers and the plan to fulfill commitments to major customers is implemented.

During the execution phase, the case company's sister Business Unit performs according to the plan to fulfill major customers' needs and the customers are continuously communicated and the phase down product is phased down from serial production. Once the phase down process is almost completed, it is made sure that all customer needs are fulfilled and taken care of. Also throughout the Business Unit's phase down process, the effect on the components and production are considered and this ensures the correct stock levels of the phase down product and the replacement product. Overall the case company's sister Business Unit's phase down process takes into consideration the effects for the customer since the beginning of the process by defining the effects on customers, by analyzing how production must be handled and by communicating on a regular basis to customers once the product phase down process begins.

9 A CUSTOMER-ORIENTED PRODUCT PHASE DOWN PROCESS

The case company will have to phase down products from different product ranges to make the portfolio more suitable with the case company's strategy and to answer customers' needs and requirements in an efficient way. With the case company interviews, the current version of a product phase down process is found. With customer interviews, the customers' opinion on how product phase downs should be conducted can now be utilized in the development of a more customer-oriented product phase down process for the case company.

Referring to the case company's product phase down process that will be utilized in the Portfolio Simplification program, there are few key milestones in it. These are analyzing and deciding with the Sales department whether the selected product should be phased down, recognizing the affected customers and what is the volume of the phase down product these customers have bought. Also, the possible commitments to customers of supplying products for a certain amount of time must be acknowledged. In addition, milestones are finding a correct replacement product, communicating internally with Operations and SCM of the product phase down and analyzing how these functions will be affected and ensuring that spare parts are available for ten years for the phase down product after the last piece has been sold. The whole product phase down process according to the case company's view can be found from Appendix 4.

Communication during a customer-oriented phase down process

Communication to all involved functions and participants in product phase down processes is an aspect brought up by both the case company as well as the customers. The case company sees that communication in product phase downs should be conducted on time and that the schedule of the process, the replacement

product, and the added value to the customer should be made clear. The interviewed customers highlight more the timing of the communication. Five of the customers want to receive the information of the upcoming product phase down at least one year ahead of the execution; three of them want to get the notice even two years before. If the information of the upcoming product phase down is given too late, the customers must do all of the required changes in a hurry, which might then decrease their own quality and slow their operation down and reduce their perception of the case company. In addition, the case company would then open the door for competition. It is important to find a solution to the timing of the communication that satisfies the customers to maintain customer loyalty and that the case company can execute it time wise.

As described in Chapter 7, the interviewed customers wish to receive the information of the product phase down in time before the execution of the process and they want to know what will happen, at what schedule, why will it happen and what are the added value they will receive. Before these can be communicated to the customer, the case company must do the earlier mentioned internal work to get management's approval to continue the process and to be sure of what will happen so customers are not given information too early (see Figure 9 on page 66). Thus, the internal work must be done at least over two years to half a year before communicating to customers of the upcoming phase down. The time span depends on the customer.

Once the case company has agreed on what product will be phased down and on what schedule, the case company and especially the Account Managers of customers, for example biggest OEM customers, can evaluate whether they should inform the customers that the product will be phased down and more information will be received once internal work is done. It is important to keep Account and Sales Managers up to date concerning the progress of the phase down process, so they can evaluate the time to inform the customers of it, as internal communication is an enabler for external communication. During the step

"Agreement with the customer to continue", all the necessary data concerning the product phase down must be given to customers for them to update their systems. However, before this, it is important to give active communication and support to help customers' transition from the phase down product to the replacement product.

To help in giving the customers the information of the product phase downs early enough, the case company should utilize in a more efficient way product lifecycle management. Design and analysis of product's lifecycles are essential according to Stark (2015). By considering the product's lifecycle changes a few years in advance, the case company could estimate ahead of time when a possible phase down would occur. The product's lifecycle phase's information could then be given to customers on a yearly basis by giving the customer's the information of their installed base's current lifecycles and an estimation how they will possibly change in the upcoming years. Consequently, the customers will be prepared better for the product phase downs.

When giving the first detailed information of the phase down, in addition to getting to know what will happen and how customers wish to know what will they receive from it. The case company also recognizes that value propositions are needed to make the customers more willing to transition to the replacement product. Value propositions are especially needed when the customer is a high-volume customer for the case company and when the customer requires custom-made products. Value propositions depend on the customer as each customer values different things. Also, each stakeholder within the customer values different things, for example the value proposition for customer's design manager will be different than for customer's sales manager. As presented in Chapter 6.4, the case company can receive multiple benefits from conducting product phase downs and from their Simplification program, and customers will be able to see the benefits in their operation as well. If the case company is able to manage their product lifecycle management more easily, customers can get lifecycle

information earlier and with less effort from the case company and this helps the customer to plan their operation and purchases better. By having a more harmonized portfolio, the customers get faster responses to quotations and in the markets the case company operates, this is becoming a more important element in winning orders. With a more harmonized and modular portfolio, the customers will get their orders faster and on time, as the case company's lead-time and punctuality improve. In addition, the price of the products may become more competitive, as the case company optimizes its cost base and by having a more modular portfolio.

Incorporating customers' perception to the case company's perception

Customers and the case company see that the actual execution starts at different times. The case company sees that the actual execution of the product phase down begins when stock handling process starts, while interviewed customers see that the execution starts when the product is removed. Within Figure 15, the actual execution is considered as the point when the customer switches to the replacement product. This is because while both the case company and customer must do executive work to implement the phase down, these can happen at different stages.

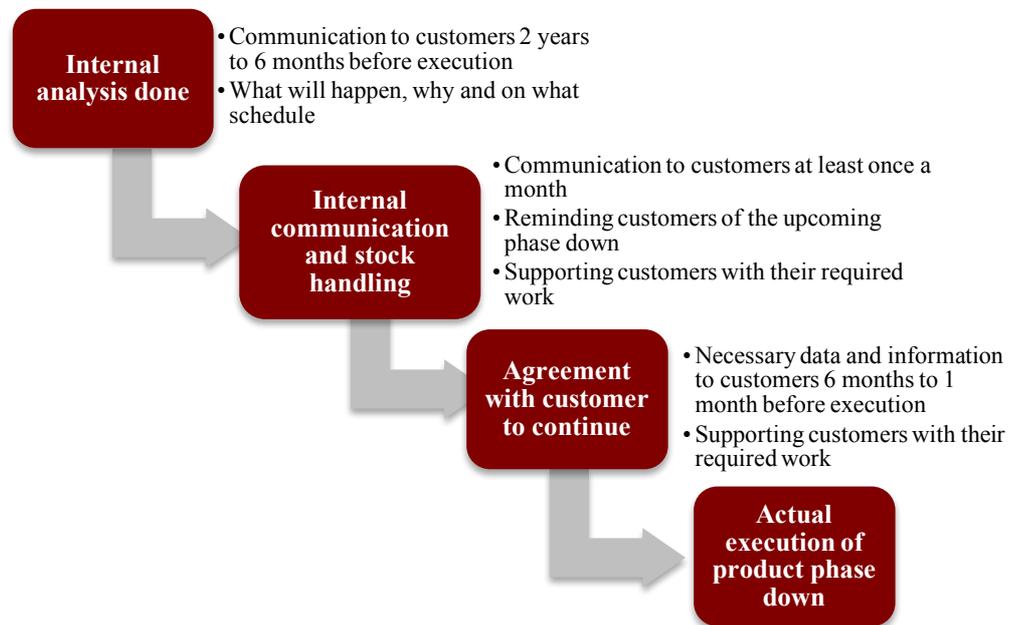


Figure 15 Customer communication combined with the case company's phase down process

The support to give to the customers depends on the customer itself. Each interviewed customer must update their ERP system before any orders of the replacement product can be put in. Customers E and F also have to test the replacement product and this requires a lot of time as well as money. Customers like interviewed customers E and F are the type of customers who need the information preferably two years before execution, but latest immediately once some correct information can be given. Customers like interviewed customer C require the information of the phase downs 6 months before execution, especially if the only work to be done is updating systems. All customers need R&D support if the replacement product is not interchangeable. Because of these, it is also important for the case company to consider each customers' requirements and internal activities when doing internal analysis work and deciding when to communicate to customers.

The replacement product is also brought up multiple times both in the case company and customer interviews. The case company interviewees see that it is

important to find a replacement product when there is demand for it, and the aim is that the replacement product would be functionally better than the phase down product. However, customers expand this by requesting that the replacement product's dimensions must be the same or smaller, as if it is bigger or heavier, customers must do excess R&D work to fit the replacement product into their products or production lines, and this requires then more time and money from the customers. The case company must take this into consideration during the internal analysis as if they do not offer an interchangeable product, it would then result in a decrease in the quality of the phase down process and customers will most likely consider what the case company's competitors are offering and possibly switch to a new supplier. If the case company estimates that the replacement product might be a different size than the phased down product, the case company must communicate this and possibly ask measurements of the OEM customers' products or end-customers' production lines. This way the case company ensures they are doing their best to fit the replacement product with the customers' requirements.

Also, certifications and other regulations must be the same for the replacement product as they were for the phase down product. If not, customers cannot operate in their markets and to get the correct certifications in place would require unexpected work and money both for the case company and customer. In the future, as the case company will have a more harmonized portfolio, maintaining certifications will be easier. In addition when the case company is deciding what will be the replacement product, the case company must consider how the entire product portfolio will then fit with the company's strategy, is the entire product portfolio then more balanced and harmonized and whether the value is maximized (Tolonen et al 2015).

In product phase downs, the case company must understand what is their customers' value. All of the required work customers must do due to the case company's product phase downs and the added value they get can be considered

as customer value (Rebentisch et al 2016). By doing this the case company can aim for affecting the customer value positively also with product phase downs. Referring to Homburg et al's (2010) research, both the customers' economic and psychological costs from product phase downs are aspects the case company should consider. Communication affects strongly on the psychological costs and the replacement product on economic costs. Even if the customer will receive some excess work, the way and the time the case company communicates this will affect more on the relationship between the case company and the customer than the amount of work needed by the customer. The better the communication, the higher the satisfaction of the customers and the higher customers' loyalty is.

Customers wish to have a smooth transition from the phase down product to using the replacement product. One way to possibly ensure this is to have an at least partially simultaneous process between the phase down and the ramp up. Customers demand to receive the ordered products on time on a global level. With a parallel production, stock levels of the replacement product can be brought up to ensure on time delivery of the replacement product, while the last orders of the phase down product are still placed in. Having enough stock is particularly important for interviewed customers E and F who order dozens of products from the case company on a daily basis because they conduct JIT manufacturing. Delivering products on time globally also ensures customer satisfaction, improves the case company's brand and brings up the quality of the phase down process, which are seen important issues to consider by Homburg et al (2010) when a company phases down products.

Stark (2015) and Jonas (2010) highlighted the importance of top management in PLM and PPM. Also, both interviewees from the case company and the customers recognize that having the appropriate person in charge of the product phase down process is essential for the product phase down to succeed, especially if the phase down process is conducted simultaneously with the replacement product's ramp up process. Overall this person should be able to see the whole picture, not just

focus on internally the case company. The person who manages the product phase down process must ensure that all functions involved communicate on the needed level and conducts everything on time as agreed. A good spirit should be built within the participants of the phase down process, needed decisions must be made and milestones agreed on so the schedule is kept. Proper management also ensures that customers are communicated on time and with the necessary information and that the quality levels of product phase downs are met (Jonas 2010). Also, top management must be able to make decisions quickly as product phase downs take a lot of time and things might change in the case company's business (Kester et al 2011). The management of the phase down process should be from the Product Management function as they are the owners of the process but also because that function operates on a regular basis with other functions.

The case company's tasks in a customer-oriented phase down process

For the case company to conduct phase downs in a customer-oriented way, especially R&D, Product Management, Operations and Sales functions must do certain tasks, and they each might face certain challenges. These tasks and challenges are concluded in Table 4. In addition, the improvement areas are given. Product Management is responsible for the whole phase down process, and there are a couple key tasks that help the function ensure the process is customer-oriented. Product Management must find together with R&D and Sales a replacement product that is interchangeable. When a replacement product is not found from the existing portfolio, R&D must design a replacement product that is interchangeable, but this might be a challenge. To overcome this, R&D should work closely with the customer to ensure the replacement product is interchangeable and accepted from the customer.

Product Management is responsible for ensuring communication is occurring internally effectively. Each function must know their own tasks, they need to know what other functions are doing and they need to know what will happen

next in the process. Product Management might face challenges of maintaining control of the complex process and in managing it with an end-to-end point of view. Proper internal communication helps in this and communication processes are presented in Appendixes 9-10 to help in improving it. An important note is that as a background process for the communication process, the case company should inform each customer's installed bases lifecycle plan for the next five years on a yearly basis.

Appendix 9 demonstrates the communication process within the internal analysis of the product phase down process and Appendix 10 presents the communication process within the execution of the phase down process. Within the internal analysis phase Operations, SCM and Sales give input to the Product Management function for them to analyze how to execute the phase down and what needs to be considered. This all must be done at least 1 year before products are actually phased down and the customers can start ordering the replacement product. Yet, higher volume customers need the information earlier as found out from customer interviews.

Table 4 Tasks for functions in customer-oriented product phase downs

Function	R&D	Product Management	Operations	Sales
Task	Designing a replacement product	Ensure proper internal communication	Ensure needed FG stock levels	Execute customer communication
		Finding a replacement product	Executing a parallel process	Finding a replacement product
				Communicating customer feedback
Challenge	Having an interchangeable product	Having control of the process	Having stocks at multiple factories	Getting information internally on time
		Managing with an end-to-end view	Products using the same tools	-> Communicating customers early enough
What to improve	Teamwork with customer in the design phase	Internal communication between functions	Conducting a parallel process smoothly (production and stock to be handled)	Actively asking for information of product phase down

An important step in the execution phase is when Product Management informs the details of the phase down process to all functions and units. The main

elements in the communication during the execution phase occur between customers, Sales and Product Management. Customers inform what support they might need, what are the challenges they might face and if they see that the phase down process should be conducted somehow otherwise. Sales function informs the customers of the decided phase down process. This information should be given face-to-face and the case company should deliver the information throughout the customer company. Sales also delivers customer feedback to the Product Management, and they also remind customers of the phase down on a regular basis by email or portals or if time even face-to-face and give them all the data of the replacement product. Here it was important to give the data early enough so customers have time to update systems, and the higher volume customers the earlier they need the data. In addition, Operations and SCM inform Product Management if everything is going smoothly and what are the possible dilemmas and needed changes in these. With the feedback from different functions, Product Management ensures that everything is going as planned and manages the situation if difficulties occur.

Operations is responsible for ensuring that there is enough stock for the replacement product and phase down product so the customers will continue to have a smooth operation. Operations must also conduct a parallel process between the phase down and ramp up. Having enough stock can be a challenge if production experiences complication from for example not having enough components. Operations must focus on having a smooth parallel production for a set time period. SCM must help in this by ensuring there are enough components and materials. Operations will have to ensure if and at which step the replacement product and phase down product will need the same tools to know which product's production to conduct and when.

The Sales function is responsible for communication information of the product phase downs to the customer, and they also help in finding the correct replacement product. Getting internal communication might be for Sales as if they

do not receive the information early enough, they cannot communicate the information to the customer. Sales has to ensure they are giving their information from markets and customers on time and doing their tasks to support the internal communication.

Each function has different tasks that they must do to conduct a customer-oriented product phase down process. A couple of R&D's, Product Management's, Operations' and Sales' tasks are described in Table 4, and the challenges and improvements related to these tasks are presented. Product Management is responsible for internal communication and Sales is responsible for communicating to the customers. These can be difficult due to globally located units and customers, and internally getting the information early enough must be improved in the case company. Product Management and Sales also must find an interchangeable replacement product. R&D must then design the replacement product if it is not available in the existing portfolio. To ensure that the replacement product is interchangeable, R&D must work together with the customers, or at least Sales, to ensure that it answers customers' needs. Product Management is also responsible for managing the whole phase down process. Here the globally spread units and having an end-to-end view on the process are also challenges, but having proper internal cross-functional communication process helps in overcoming these challenges.

Operations is the function which the on time deliveries are dependent on, so it must ensure that needed Finished goods stock levels are in place during the possible parallel process and when the replacement products ordering starts. Operations conducts also the possible parallel production, so they must ensure that the tools are in place and that everything is conducted in the right order. Buffer stocks might also be needed if the phase down or ramp up process faces challenges. Customers' satisfaction decreases if they do not receive the ordered products on time, so ensuring FG stock levels is an important task in a customer-oriented phase down process.

To operate in a customer oriented way in product phase down processes, it is important to acknowledge how customers are affected, how to ease their work and to communicate regularly the lifecycle plan of their products. Decreasing customers' psychological costs should be highlighted more to reduce customers' uncertainty and unwillingness towards product phase downs. In addition, not only does the replacement product have to be interchangeable, but also the constant availability of products must be ensured to offer a smooth transition to customers. Stock handling should thus possibly begin earlier than what the Product Management Manager described on page 66 (Figure 9). All in all, a well-conducted and customer-oriented product phase down process enables an undistruptive transition for the case company's customers.

10 CONCLUSIONS

Product phase downs are complex processes as they affect many functions, both internal and external, and work from multiple functions is required. In B2B markets, product phase downs are mostly nonexistent in scientific research and overall they are quite neglected due to the possible negative impact on business and customer relationships (Homburg et al 2010). Yet, product phase downs should be made an active part of the product lifecycle and portfolio management to ensure phase downs are conducted as a constant activity and that they are conducted in a systematic manner to improve the quality of the company's product portfolio.

As a part of the Simplification program, the case company sees that product phase down process consists of the analysis of internal functions to cover all the affected units and to ensure the correct product is being phased down and a correct replacement product is found. The case company utilizes evidence-based decision making when conducting product phase downs. The case company bases its decisions on market information and financial and technical data and facts. The process is conducted through cross-functional cooperation by involving all necessary functions in the phase down process, and the product phase down process is based on understanding and answering market and customer requirements. (Kester et al 2011)

However, the case company recognizes that product phase downs should not focus only on internal work and on the effects internally. With this thesis, the aim was to find how to make a product phase down as customer-oriented as possible and to improve the quality of the process in the eyes of the customers. Research question "*How to conduct product phase downs in a customer-oriented way?*" helps the case company to conduct phase downs in a way that satisfies the customers and ensures the case company's targets are reached.

RQ1, “*How does the case company perceive a product phase down process?*”, presents the starting point of the phase down process (see Chapter 7). Results of RQ2, “*How do different customer types of the case company perceive a product phase down process?*”, show the case company what is the customer view to product phase downs. From the interviews with customers, early communication of the product phase downs can be seen as the most important element overall. Other areas are the content of communication, finding a replacement product that is interchangeable to the phase down product, excellent availability of products during the product phase down and ramp up of replacement product and proper management and control of the phase down process in the case company. Top management involvement is also highlighted in articles of PLM and PPM (Stark, 2015 & Jonas, 2010). These help the case company to alter their current product phase down process to a more customer oriented one.

There are two key aspects the case company has to focus on to ensure that the phase down process is as customer-oriented as possible. These are:

1. Proper management and control of the phase down process
2. Early and active communication internally and externally

The number one aspect secures that every possible units contribution, processes and challenges are considered in a phase down process. Functions must do different tasks to conduct a customer-oriented phase down process, and having proper and controlled management helps in ensuring that these are executed correctly and smoothly. In Table 4 (see page 101), key tasks are presented to help the case company recognize what should be done. As described earlier, internal and external communications are important tasks. In addition, R&D must design a replacement product with the help of Sales and Product Management. A prerequisite, and also a challenge, is that the replacement product must be interchangeable functionally and by physical measures. Operations must conduct parallel production for a set period of time and they must ensure that FG stock levels are good to ensure on time deliveries. SCM, which was not presented in

Table 4, must ensure that Operations has the needed amount of components and materials when they need it. A challenge here is ensuring that suppliers deliver the components and materials on time and that the qualities of these are excellent in every delivery patch.

To operate in a customer-oriented way, the case company should provide yearly communication to customers concerning their installed base's lifecycle plan to give customers a warning of upcoming changes. Once the product phase down is officially communicated it is important to inform how the phase down will affect customer's operation, what the customers must do and what are the benefits each customer will achieve. As phase downs require work from the customers' side also, giving information regularly before the phase down happens gives customers time to prepare, and informing the added value makes the customers more acceptable towards the product phase down. As the current communication process, both internal and external communication, needs improvements according to the case company and customer interviewees, a communication process in Appendixes 9 and 10 was created to demonstrate the essential steps and stakeholders in it.

The last research question "*What are the benefits of conducting product phase downs in the case company?*" finds the motivation for top management and executive units to conduct product phase downs in the future. It is also important to consider the positive sides of product phase downs, not just on the negative ones for example possibly losing some customers. The case company can receive multiple benefits from product phase downs, especially from the phase downs of the Simplification program. Some of these benefits are faster lead time, a decreased amount of stock and inventory levels, easier product portfolio management and faster certification and quotation processes, overall ease of doing business improves. The benefits the case company gains may affect also positively their customers. But it is important to remember, benefits can only be achieved if the phase down process is conducted well.

Product Group Y offers more project based and custom made products to their customers than Product Group X does. Due to this, product phase downs mean that when Product Group Y's customer does not need that product anymore, it is practically phased down. However, if Product Group Y decides to conduct a product phase down, the findings from Product Group X's customers can be generalized here, as different customer types were interviewed for the research. Having information early enough will give time to the customers to change systems and the replacement product will have to answer their needs exactly and will need to be interchangeable. R&D Manager from Product Group Y also highlights that all the necessary materials and tools must be in place after the phase down to secure needed spare part availability. In Product Group Y, a challenge is defining what an individual product exactly means due to the fact that products are created from platforms. However, the same aspects can be seen in both Product Groups, but within Product Group Y the customers have an even bigger role and their effects have to be considered more carefully.

In general customer needs and requirements must be understood first before starting to conduct product phase downs (Hines et al 2005; Trappey et al 2009). The case company must make sure that the phase down process is conducted in a way that satisfies their customers and themselves, and that the replacement product fits within the customers' operation and in the case company's portfolio. By keeping the focus on improving the case company's operation and conducting phase downs in a way that its quality is good and that it harms the customers as little as possible, the case company ensures that they will be kept as a preferred supplier in the future.

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APPENDIXES

Appendix 1 Interview structure for the case company interviews

General Information

1. Your name and role in your company
2. What is your product group's offering?

Product portfolio and lifecycle management

3. How is product portfolio management conducted in your product group?
How long has product portfolio management existed in your product group?
4. What is a product road map? How often is a product road map updated?
5. What are the biggest challenges in product portfolio management?
6. How is product lifecycle management conducted in your product group?
How long has product lifecycle management existed in your product group?
7. What are the biggest challenges in product lifecycle management?
8. How are current portfolio products phased down in the case company?
When was the last time a product was phased down in your product group?
9. What are the challenges in phasing down products?

Customers

10. Are the customers involved in portfolio or lifecycle management processes currently?
11. How should the customers be involved in product phase down processes?
What does ' need from the customers? What would help the customers?
12. What should the value proposition include, when products are phased down?

Finishing

13. Do you have any suggestions who I should interview to gain further knowledge of phasing down products?

Appendix 2 OEM customer interview questions

General information

1. Name and role in your company?
2. Background of the cooperation between your company and the case company?

Operation with the case company currently

3. What criteria affect your company's buying decisions?
4. Does the case company's product upgrades affect your company's business nowadays?
5. Does your operation affect the case company?

Product lifecycle

6. How long do you believe the case company's products are sold (Active)?
7. How long do you believe the case company's products' spare parts are available?
8. Do you wish cooperation with product lifecycle planning between yourself and the case company?

Product phase downs

9. How do you see a product phase down?
10. Has the case company phased down products that have been in your use?
 - a. How did it affect your business?
11. What kind of actions do you wish from the case company when they are phasing down products?
12. What kind of features do you require from the replacement product?
13. What kind of work is required from you and your company when the case company phases down a product and you begin to use the replacement product?
14. What are the most critical issues in your company's business that the case company needs to consider when phasing down products?
15. Does a supplier's product phase down bring your company new opportunities?
16. Do you have any examples of a good product phase down process? Or examples of bad ones?

Finishing

17. What would you like to highlight to the case company concerning product phase downs?

Appendix 3 End-customer and wholesale customer interview questions

General information

1. Name and role in your company?
2. Background of the cooperation between your company and the case company?

Operation with the case company currently

3. What criteria affect your company's buying decisions?
4. Does the case company's product upgrades affect your company's business nowadays?
5. Does your operation affect the case company?

Product lifecycle

6. How long do you believe the case company's products are sold (Active)?
7. How long do you believe the case company's products' spare parts are available?
8. Do you wish cooperation with product lifecycle planning between yourself and the case company?

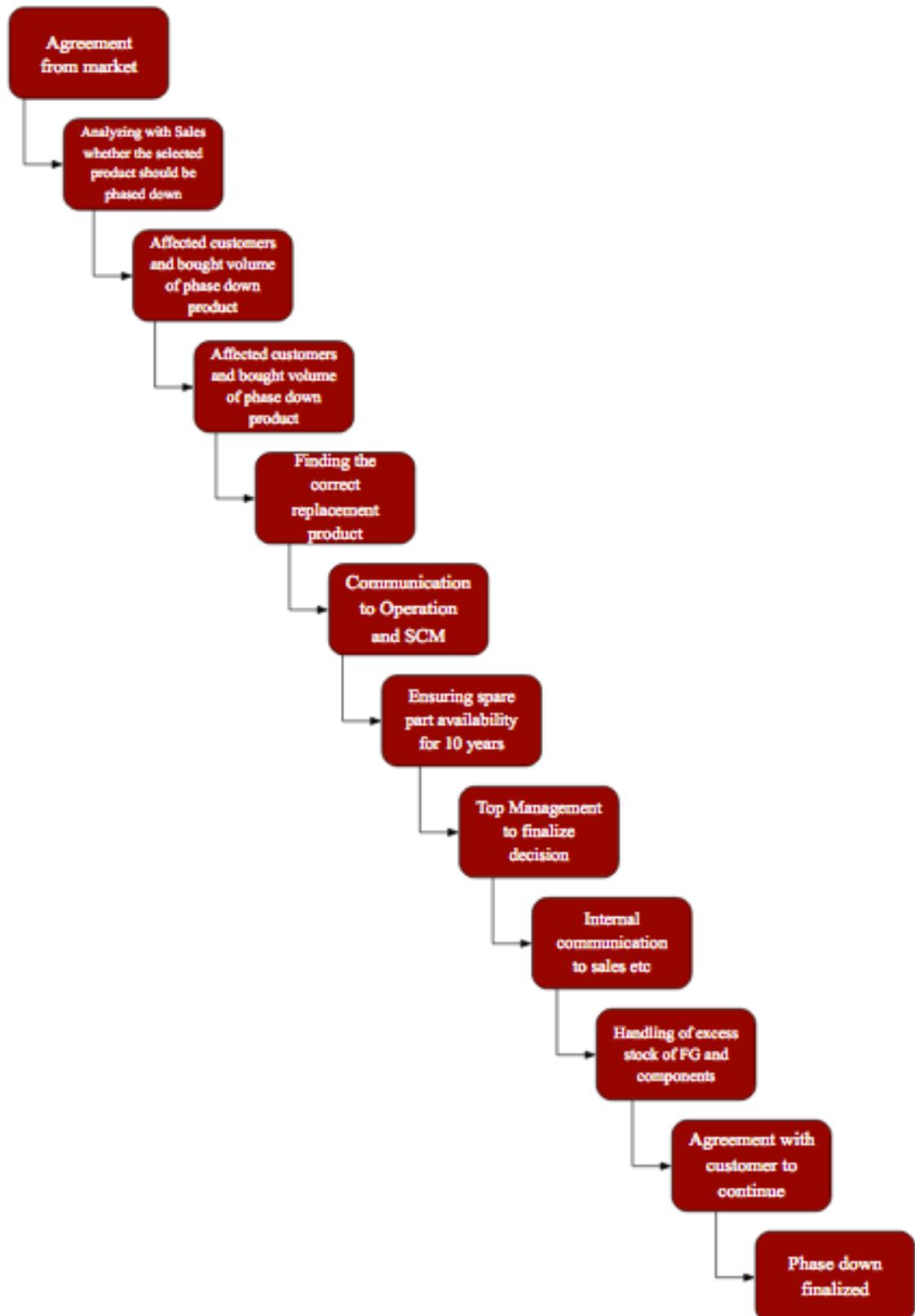
Product phase downs

9. How do you see a product phase down?
10. Has the case company phased down products that have been in your use?
 - a. How did it affect your business?
11. What kind of actions do you wish from the case company when they are phasing down products?
12. What kind of features do you require from the replacement product?
13. What kind of work is required from you and your company when the case company phases down a product and you begin to use the replacement product?
14. What are the most critical issues in your company's business that the case company needs to consider when phasing down products?
15. Does a supplier's product phase down bring your company new opportunities?
16. Do you have any examples of a good product phase down process? Or examples of bad ones?

Finishing

17. What would you like to highlight to the case company concerning product phase downs?

Appendix 4 The case company's product phase down process



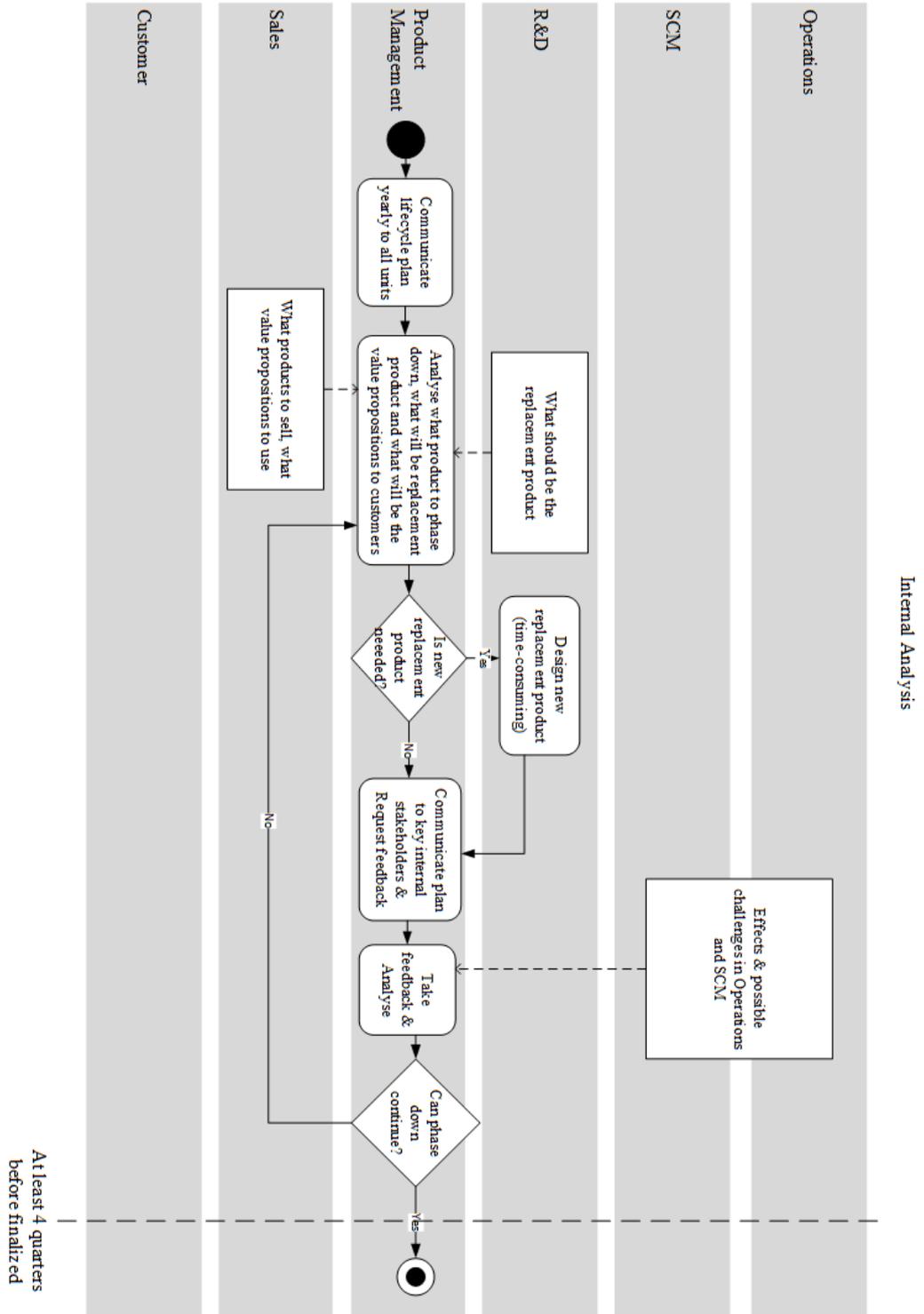
Appendix 7 Product phase down benefits matrix by Sales Manager

Processes/Functions	Customer	Product mgmt	Marketing	Sales	Sales support	R&D	Engineering	SCM	Manufacturing	Inventories	FG Stock	Logistics
PM: Products portfolio mgmt	x	X	X	X								
PM: Lifecycle mgmt	x	X						X			X	
Sales: Quotation process (speed&quality)	X			X	X							X
Marketing of existing portfolio	x	X	X	X	x							
X-functional architecture mgmt												
Components re-usability (modularity)									X	X	X	
R&D: Product creation												
R&D: Product maintenance						X	x					
SCM: Supplier maintenance								X				
SCM: Supplier pricelist update								x				
SCM: Certification process								X				
SCM: Purchased components/supplier								X				
SCM: Supplier quality								x				
Production: Footprint		x		x					X			
Production: Lead time									X			
Production: Inventories										X		
Production: Set-up times									X			
Production: competencies/training									x			
Production: automation									x			

Appendix 8 Product phase down benefits matrix by Product Manager in Sales

Processes/functions	Customer	Product mgmt	Marketing	Sales	Sales support	R&D	Engineering	SCM	Manufacturing	Inventories	FG Stock	Logistics
PM: Products portfolio mgmt	X	X										
PM: Lifecycle mgmt	X	X										
Sales: Quotation process (speed&quality)	X			X	X							
Marketing of existing portfolio			X	X								
X-functional architecture mgmt												
Components re-usability (modularity)						X			X	X	X	
R&D: Product creation						X						
R&D: Product maintenance		X				X						
SCM: Supplier maintenance		X										
SCM: Supplier pricelist update		X										
SCM: Certification process	X	X										
SCM: Purchased components/supplier												
SCM: Supplier quality	X			X					X			
Production: Footprint												
Production: Lead time	X		X	X					X			
Production: Inventories	X			X								
Production: Set-up times									X			
Production: competencies/training									X			
Production: automation									X			

Appendix 9 Communication process during phase down's internal analysis



Appendix 10 Communication process during phase down's execution

