Accessory Portfolio Planning Model at Axis Communications

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Abstract

Background

Axis Communications is a Lund based company which specializes in network cameras. In addition to the cameras, the company has a wide range of accessories that ensure their customers receive complete solutions. While the company has had significant successes by investing heavily in R&D, increased competition from low-cost competitors is now placing higher demands on cost-efficiency.

Problem

The high introduction rate of new cameras and solutions have resulted in an ever-expanding portfolio of accessories. As the number has grown they are starting to cause problems in the company's operations. For example, the increased complexity is making it more difficult to balance supply and demand. Further, it is a challenge due to the administrative complexities it introduces. By making more informed decisions early in the development process, it is believed the inflow of new accessories can be more controlled.

Purpose

To design a practically viable decision support model that enables more informed decisions with regards to accessory development at Axis Communications.

Method

The study has used a constructive research approach. The construct is a decision support model for Axis to use when developing accessories. The study started with a literature review to gain insight into the current body of knowledge. A multiple case study was used to contribute with empirical data on how companies work with the selection of projects in practice. Interviews and workshops at Axis were then conducted to see what construct would fit the company and product context. The final model was constructed and tested with key stakeholders at the company to ensure its validity.

Theory

In the literature review we have looked at areas which are deemed important for the problem at hand. Product portfolio management is a broad field and a literature review by Jugend & da Silva (2014) was used for the initial structure. To further structure the selection and development process, Michael Cooper's work around the Stage-Gate process has been used. By combining the stage-gate perspective with portfolio management an input-output framework was developed. This framework has then been the basis to which we have formulated 26 theoretical propositions.

Empirical research

Axis' camera development was used as a test case, this enabled fine tuning of the case study protocol ahead of the main cases. The companies which participated were Sony Mobile, Thule Group, Husqvarna Group and Alfa Laval. Companies were chosen to ensure a wide perspective on the contextual aspects of life cycle length, company size, profitability and technology sophistication. The study contributed with ways of practically working with selection of projects and methods of maintaining data integrity.

Analysis

Many of the theoretical propositions were supported by the case study findings. Several empirical propositions were also developed and evaluated for generalizability. Theory and empirics were then combined to form a generic decision support model which companies can use to improve development decisions. It starts with choosing criteria that are aligned with company strategy and goals of the product portfolio. These criteria then dictate the input deliverables and decision makers needed to make the decision. After the decision, a formal decision and goal setting for the ensuing work should be performed. Finally, a post-launch review should be conducted to follow-up on deliverables and decisions made at the decision point. This to ensure a learning process.

The construct

It was decided that the focus of the model would be accessories developed within camera projects. Criteria and methods were developed in order to reach the strategic goals of increasing structure, priority and data integrity of accessories. Nine suggestions were proposed to Axis. They were fitted into four different points of the current camera development structure. In short, they serve to increase early awareness of accessories within camera projects. This through requesting that certain deliverables are presented before an accessory is released for development. We also suggest the decision to order tooling receives more focus as it results in the most significant investment for an accessory. Finally, a post launch review is suggested in order to follow-up on assumptions made at the decision point. This way the process will receive continuous feedback and learning. As a result, Axis will be able to make more informed decisions regarding accessories and thus increase control over their product portfolio.

Keywords: *Decision support model, Accessories, Product development, Stage-gate process, Portfolio management*

Sammanfattning

Bakgrund

Axis Communications är ett lundabaserat företag som är marknadsledande inom nätverksvideokameror. Utöver deras kameror har de även tillbehör för att tillgodose kunders behov av helhetslösningar. Företaget har rönt stora framgångar tack vare deras satsningar på forskning & utveckling. På senare år har dock konkurrensen ökat från lågkostnadstillverkare vilket ställt högre krav på kostnadseffektivitet.

Problem

Den höga introduktionstakten av nya kameror har lett till en stadigt ökande tillbehörsportfölj. I takt med antalet nya tillbehör har även komplexiteten ökat vilket har börjat skapa problem i företagets verksamhet. Ett exempel är svårigheten att balansera tillgång och efterfrågan när antalet säljartiklar blir allt fler. Den administrativa bördan blir även den en utmaning i och med detta. Genom att ta mer informerade beslut tidigt i utvecklingsprocessen tros det vara möjligt att kontrollera inflödet av nya tillbehör.

Syfte

Att utforma en praktiskt gångbar beslutsmodell som stödjer mer informerade beslut vid utveckling av tillbehör på Axis Communications.

Metod

Studien är baserad på en constructive approach som använts för att utveckla en beslutsmodell för Axis tillbehörsutveckling. Studien började med en genomgång av relevant litteratur och följdes sedan av en multipel fallstudie för att bidra med empirisk data till modellen. Slutligen anpassades denna modell till Axis specifika kontext och utvärderades av nyckelpersoner på företaget för att säkerställa modellen.

Teori

Portfolio management har studerats med utgångspunkt i ett ramverk av Jugend & da Silva (2014). Detta ramverk har givit en initial struktur som sedan utvecklades med hjälp av Michael Coopers teori kring Stage-Gate processer. Detta för att ge mer inblick till urval-och utvecklingsbeslut samt för att ge kunskap om hur företag bör strukturera sina utvecklingsbeslut. Genom att kombinera Stage-Gate processen med portfolio management så togs ett ramverk fram. Detta ramverk har sedan konkretiserats och med hjälp av ytterligare litteratur formulerades 26 teoretiska påståenden.

Empiri

Fallstudien började med Axis kameradivision för att säkerställa vårt case study protocol innan studien fortsatte. Sedan intervjuades Sony Mobile, Thule Group, Husqvarna Group och Alfa Laval utöver Axis. Företagen valdes för att få en bredd gällande kontextuella aspekter såsom längd på produktlivscykel, företagsstorlek, lönsamhet och teknologinivå. I intervjuerna diskuterades hur företagen arbetade med produkturvalsbeslut, detta med utgångspunkt i vårt teoretiska ramverk. Studien bidrog med insikter i hur företag arbetar med dessa beslut samt gav nya förslag till en förbättrad teoretisk modell.

Analys

Flera teoretiska påståenden kunde verifieras genom fallstudien och ytterligare empiriska påståenden utvecklades. Teori och empiri användes sedan för att utforma en generisk beslutsmodell som företag kan använda för att ta bättre utvecklingsbeslut. Det börjar med att välja urvalskriterier som är i linje med företagets strategi och målen med produktportföljen. Dessa bestämmer sedan vilken information som behövs och vilka beslutsfattare som bör ta beslutet. Efter ett formellt beslut tagits bör nya mål sättas för projektets framtid. Slutligen bör en uppföljning göras genom ett formellt möte för att jämföra de antaganden och beslut som tagits vid beslutspunkten, detta för att införa kontinuerlig inlärning i processen.

Konstruktion av beslutsmodell

Fokus för modellen blev tillbehör utformade inom kameraprojekt. Här togs kriterier och metoder fram för att nå de strategiska målsättningarna att öka struktur, prioritet och säkerställa datakvalitet för tillbehör. Nio förslag gavs till Axis och de introducerades på fyra olika platser i den nuvarande utvecklingsprocessen. I korthet syftar de till att synliggöra tillbehör tidigare genom att efterfråga särskilda leverabler innan ett tillbehör får godkänt för att utvecklas. Beslutet att beställa verktyg föreslår vi lyfts fram och tydliggörs då det är det utgör den enskilt största investeringen. Slutligen föreslås ett uppföljningsmöte för att ge en återblick på projektet och ge kontinuerlig feedback och inlärning till processen. Med dessa förslag kommer Axis kunna ta bättre beslut gällande sin tillbehörsportfölj och på så sätt kontrollera den på ett bättre sätt.

Contents

1 Introduction

This chapter introduces the report, presenting basic theory and Axis as a company. It will then motivate and lead up to the problem formulation and purpose of this study.

1.1 Theoretical background

All companies who develop and sell products face decisions about which products to include in their portfolio. More products drive both costs and revenues and it is seldom clear which level of variety is optimal and which products to develop or phase out. This chapter will introduce theory concerning these decisions.

1.1.1 Product Portfolio Management

Deciding which New Product Development (NPD) projects to undertake is an important part of portfolio decision making. Product portfolio management (PPM) is one important toolset that can help companies connect company strategy with the product portfolio (Cooper, et al., 1999; Kaiser, et al., 2015).

Cooper et al (1999) describe the purposes of portfolio management in four points:

- *Strategic choices*. Deciding which markets, products and technologies the company should pursue.
- *Resource allocation*. Deciding where the limited R&D and marketing resources should be deployed.
- *Project selection*. Deciding which of the many potential development projects should be chosen.
- *Balance*. Deciding how the company should balance the number of projects to their resources and capabilities.

There is a lot of literature on how to conduct PPM and NPD projects for companies main products (Cooper, 2011; Cooper, 2014; Ulrich & Eppinger, 2012; van Oorschot, et al., 2010; Krishnan & Ulrich, 2001; Martinsuo & Poskela, 2011). However, accessories have had less focus in this field of research.

1.1.2 Periodic Portfolio Reviews

Periodic portfolio reviews are a commonly used tool within PPM. It can be explained as a point in time where the current product portfolio is reviewed together with planned products. These reviews are necessary since the market and technology dynamics of strategic planning need to be captured during shorter periods of time (Jugend & da Silva, 2014). According to Patterson (2005), how often the portfolio reviews are conducted depends on the company and the life cycles of its products. Cosner et al. (2007) suggest that companies in innovative environments need to do this more often. Often, PPM is undertaken together with a Stage-Gate process (van Oorschot, et al., 2010; Chao, et al., 2014; Cooper, 2008) and if used successfully this leads to

better portfolio planning. The criteria used in the Stage-Gate process are suited for conducting these portfolio reviews, the difference being that periodic reviews are comparing a set of projects and are not evaluating each project individually.

1.1.3 Product Development and Idea-to-Launch Systems

Product development (PD) has been defined as the transformation of a market opportunity into a product available for sale (Ulrich & Eppinger, 2012; Krishnan & Ulrich, 2001; Wheelwright & Clark, 1992). It is a critical activity and a source of competitive advantage for many firms in today's business environment (Brown & Eisenhardt, 1995; Krishnan & Ulrich, 2001; Balachandra & Friar, 1997; Wheelwright & Clark, 1992). At the same time, it is one of the riskiest endeavors that a company can undertake as a majority of new product development projects fail to deliver commercially (Page, 1991; Cooper, 2011).

To mitigate and control this risk many companies apply a structured idea-to-launch system. An example is the Stage-Gate process proposed by Cooper (1990). He proposes a development project should consist of stages and gates. In this process, stages and gates serve to structure the product development project and increase its chance of success. Each gate sorts out projects that do not fulfill the necessary criteria to proceed to the next stage. The main objective of this setup is to focus the company's resources on projects which are in line with the overall strategy and the portfolio.

1.1.4 Decision making and decision support

Herbert Simon pioneered the field of decision making with his seminal work about the decision making process (Simon, 1948). In his later work, Simon (1960) introduced the four steps of this process named intelligence, design, choice and implementation. As seen in *Figure 1*, the intelligence step consists of collecting data that helps identify and understand the problem. The design step consists of generating solutions or courses of action. The choice step of actually selecting one of these alternatives and finally, the implementation step of testing the chosen solution.

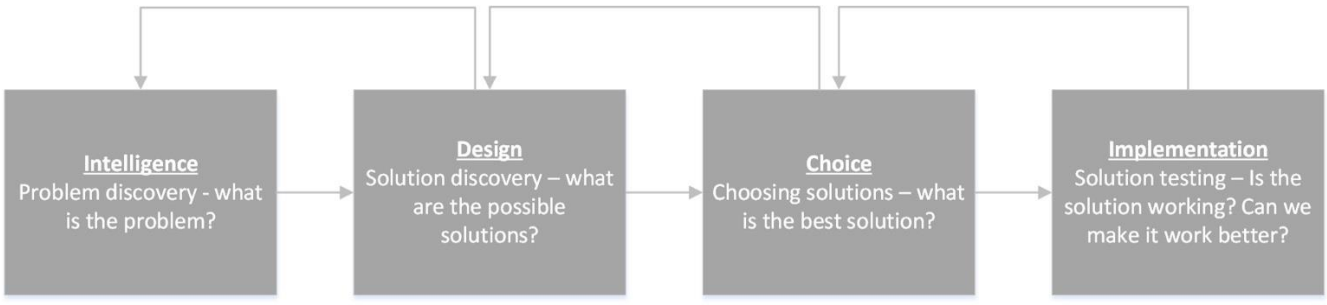

Figure 1 – Decision making process, adapted from Simon (1948)

Laudon & Laudon (2014) further distinguish between structured, unstructured and semi structured decisions. Unstructured decisions are where the decision maker must provide their own judgment, evaluation and insight where there is no agreed upon way of making the

decisions. Structured decisions, on the other hand, are repetitive and routine and can be treated using a standardized way of solving them each time. Many decisions are however semi-structured, meaning that they contain elements from both.

Finally, Simon (1948) argues that the main limitation of human decision making is our limited capability to take in and process all information required to make the best decision. This is why there is a need for using decision support models and systems to help the decision making.

1.1.5 Contextual factors

As a company decides on how to filter its development opportunities and manage its current products they need to take internal and external factors into account. While there is not much written on the topic, a few contextual aspects have been found relevant to discuss.

- *Company size*. Jugend & da Silva (2014) stress the organizational dimension and information sharing in their framework for portfolio management. The larger the organization, the more difficult it is to achieve functional integration (Kaiser, et al., 2015) and inclusive decision making (Cooper, 2004).
- *Company profitability.* Companies that apply formal criteria to all projects will financially outperform their competition (Cooper, et al., 1999; Cooper, 2011).
- *Product life cycle.* Patterson (2005) states that the product life cycle decides the frequency of portfolio reviews. Cosner et al. (2007) suggest that companies in innovative environments need to do this more often.
- *Technology sophistication.* As Ettlie & Elsenbach (2007) found, incremental innovation and less sophisticated technology development is more favored by a standard Stage-Gate system.

1.2 Axis Communications

Axis Communications is a non-manufacturing company selling network solutions, mainly within surveillance. It was founded in 1984 and invented the world's first network video camera in 1996. It has since been a world market leader within network video and surveillance. The company takes pride in research and development (R&D) and invests 15% of company turnover in new products and solutions. These products are manufactured mainly by electronic manufacturing services (EMS's) and other suppliers. Axis only have final assembly for select products, which is done at their configuration and logistics centers (CLCs). Historically the company has been able to drive both growth and profitability, much because of successes within R&D. Lately however, increased competition has come from low-cost firms in Asia.

1.2.1 Axis' Products

Axis has a wide range of products for surveillance and security applications. Their main product is network surveillance cameras but they also have related products such as video encoders. Recently they have started to sell a new range of security applications within physical access

control stations. Their camera range can be divided into four product families – fixed box cameras, fixed dome cameras, thermal cameras and pan-tilt-zoom cameras as seen in *Figure 2*.

Figure 2 - Axis range of cameras. Fixed box (A), fixed dome (B), thermal camera (C), pan-tilt-zoom (D)

1.2.2 Axis' Product Accessories

To increase the usability and range of application of their cameras, Axis are developing product accessories. Some examples of these accessories are mounts, housings, lights and different cables as seen in *Figure 3*. The purpose of the accessories is to allow for customization for applications and to satisfy different customer needs. Mounts are an especially important accessory group in this regard since they enable their cameras to be used in a variety of settings.

Figure 3 - Axis range of camera accessories. From left to right: camera mount, dome housing, lighting and cable

While some accessories carry their own costs, there are many which exist to support camera sales. In recent time, the accessory product portfolio has seen double-digit sales growth. However, this growth has not necessarily meant more units sold of a select range of best sellers. Rather through an expansion in product variety and the portfolio as seen in *Figure 4*. In the last year, the company has tried to discontinue more accessories which explains the increased gap. There has not however, been any large effort put into stemming the inflow of new accessories. Product Managers and other employees believe there is lots of potential on this side of accessory portfolio decisions as well. Ideally, increased revenue would not have to be driven by an inflated portfolio but rather by increased sales of existing products.

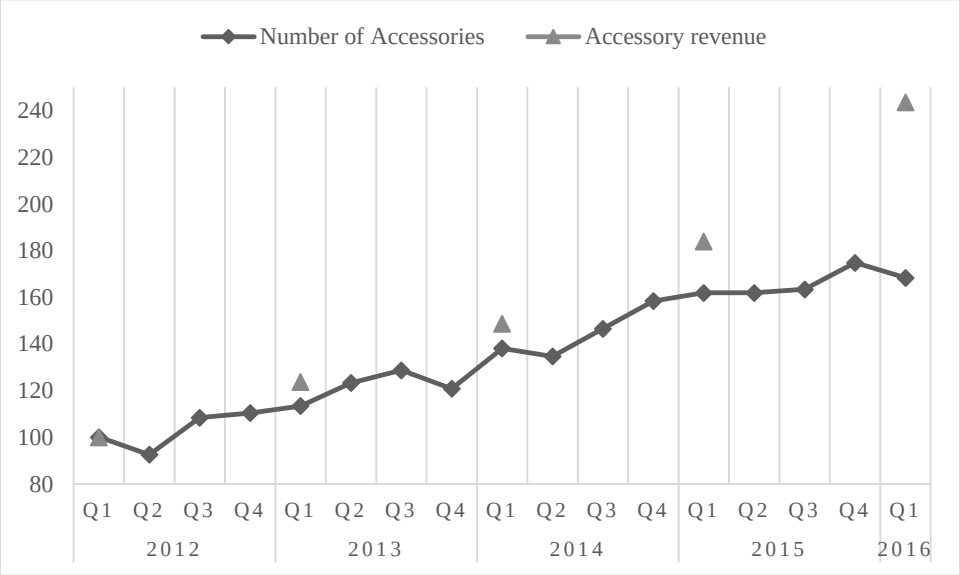

Figure 4 – Development of number of accessories and their revenue (index 100 = 2012)

1.3 Problem formulation

The process of developing accessories follows the regular development process for cameras at Axis to various degrees. When a new camera is developed, the camera team is responsible for the essential accessories for that particular camera. *Essential accessories* are defined by the Product Manager for that specific camera. They are accessories deemed to be needed for the camera to be sold. In addition to these essential accessories, there are *complementary accessories* developed to existing cameras. These need to be properly motivated before they can be released for development and are then developed by a designated team.

1.3.1 Parallel processes for complementary and essential accessories

Essential accessories are rarely ran through a decision gate before released into development, as depicted in *Figure 5*. This means that an accessory can be deemed essential by a Product Manager, even though a nearly identical accessory already exists for another camera. A consequence of this is that too many new accessories are developed as there is little synchronization and alignment of the accessory portfolio (Mårtensson, 2016).

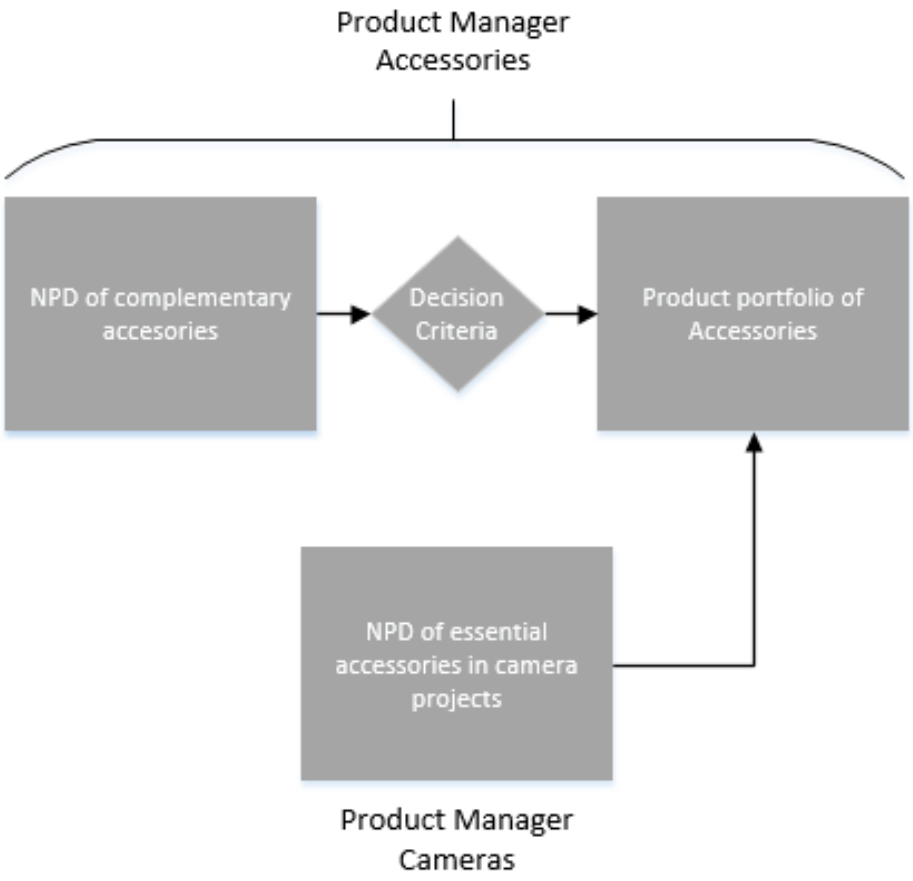

Figure 5 - Description of accessory development at Axis

1.3.2 Need for a decision support model

There is a need for a decision support model that helps to decide what accessories should be developed based on projected sales and other relevant criteria. This decision support model should align the separate processes for complementary and essential accessories. Complementary and essential accessories should be more equally evaluated. This will greatly improve and harmonize the accessory portfolio and make sure that Axis develops the right accessories and spend their resources in a better way. To do this, the right information of the right quality needs to be available. This way, Axis can make more informed decisions.

1.3.3 System of study

The studied system can be seen in *Figure 6*. The point of interest is the decision point where a product is allowed to proceed into development. It is contained within the areas of NPD, portfolio management and contextual aspects. The decision is taken early on in the product development process and is the “point of no return”, as a majority of resources are consumed after this point. Allowing the right product to pass this decision point is therefore critical for a successful product portfolio.

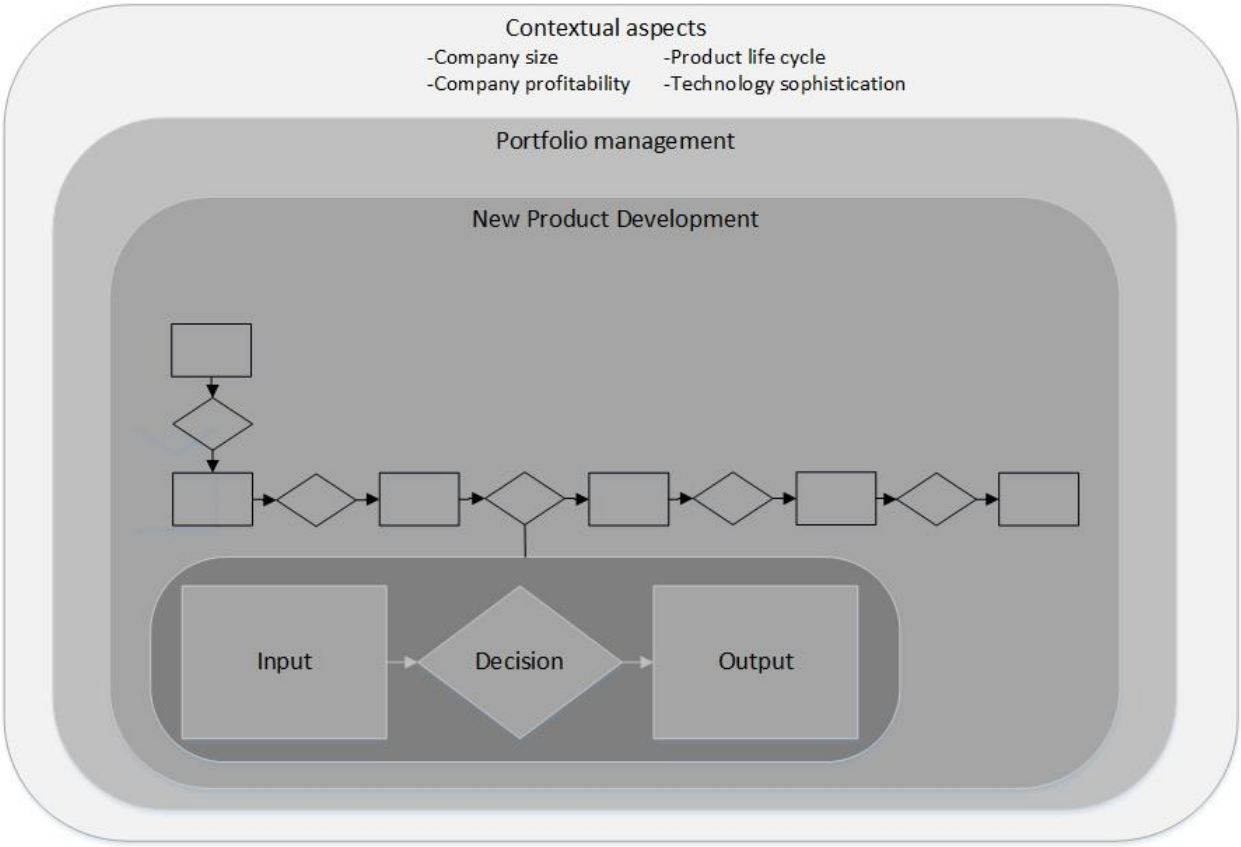

Figure 6 – The studied system

1.4 Purpose

To design a practically viable decision support model that enables more informed decisions with regards to accessory development at Axis Communications.

1.5 Research questions

RQ_1 What does the decision point look like according to theory?

RQ_2 What does the decision point look like in practice?

RQ_3 How can these findings be implemented in the context of Axis' accessories?

1.6 Focus & delimitations

The study has looked at the decision point where the decision is made if a project should be allocated R&D resources and proceed to development. If a Stage-Gate process is not specifically used, the corresponding decision point has been identified and studied.

The empirical focus has been on this decision point through a multiple case study. The main interest has been how companies base their decision on input and then create an output, or decision, based on set decision criteria.

The second phase of the empirical study was conducted at Axis with the focus on applying the proposed model. People involved in day to day work with accessories and the decision making were involved in this stage. This part of the study was focused on accessories and did not cover other products such as spare parts.

When conducting interviews at Axis it became apparent that the focus for the final construct should be on accessories developed in camera projects, named essential accessories in *Figure 5*. This since these accessories accounted for majority of the problems found.

The result of the study was to provide a decision model which could fit into Axis current structure for camera projects, the implementation will be left to Axis to conduct.

1.7 Structure of the report

The report is structured into seven main parts following the introduction.

Theoretical framework where a foundation for the project is provided. It looks into research areas which have been judged relevant for the research questions at hand.

Methodology where the working process of the project is described and motivated.

Empirical study describes the data collection at the case companies.

*Analysis and Findings w*here the empirical data is analyzed through single and cross-case analysis. The outcome of this analysis is then used to improve the theoretical decision model.

Modified Decision Model describes a generic decision support model based on the theoretical framework and empirical study.

Construction of decision support model deals with the adaption of the model to Axis Accessories. Data collection in form of interviews and workshops are described followed by analyses of how the model should be modified to fit Axis' operations better. The chapter also contains a verification step of the model at Axis.

Conclusion and Contribution examines how the final model relates to the theoretical propositions. It also examines how generalizable the empirical findings are and how the study has contributed to the body of knowledge.

2 Theoretical Framework

The theoretical framework is divided into three sections which are described, including interdependencies, in Figure 7. The framework is based on a number of key articles that provide its structure. The decision point, the unit of analysis, was used as a starting point and areas deemed important to explain and understand this point are examined. The theoretical findings are finally summarized in a conceptual model, consisting of a number of theoretical propositions.

Figure 7 describes the theoretical framework. The area of portfolio management is important to lay the groundwork for portfolio decision making. To structure the product development process a stage gate framework is used. The findings from these two fields is then used to describe the decision point which is the point of interest. Theory has been used to describe it using the components input, decision and output. Contextual aspects found to affect the decision making are also included. Finally, our view of the decision point will be condensed into 26 theoretical propositions.

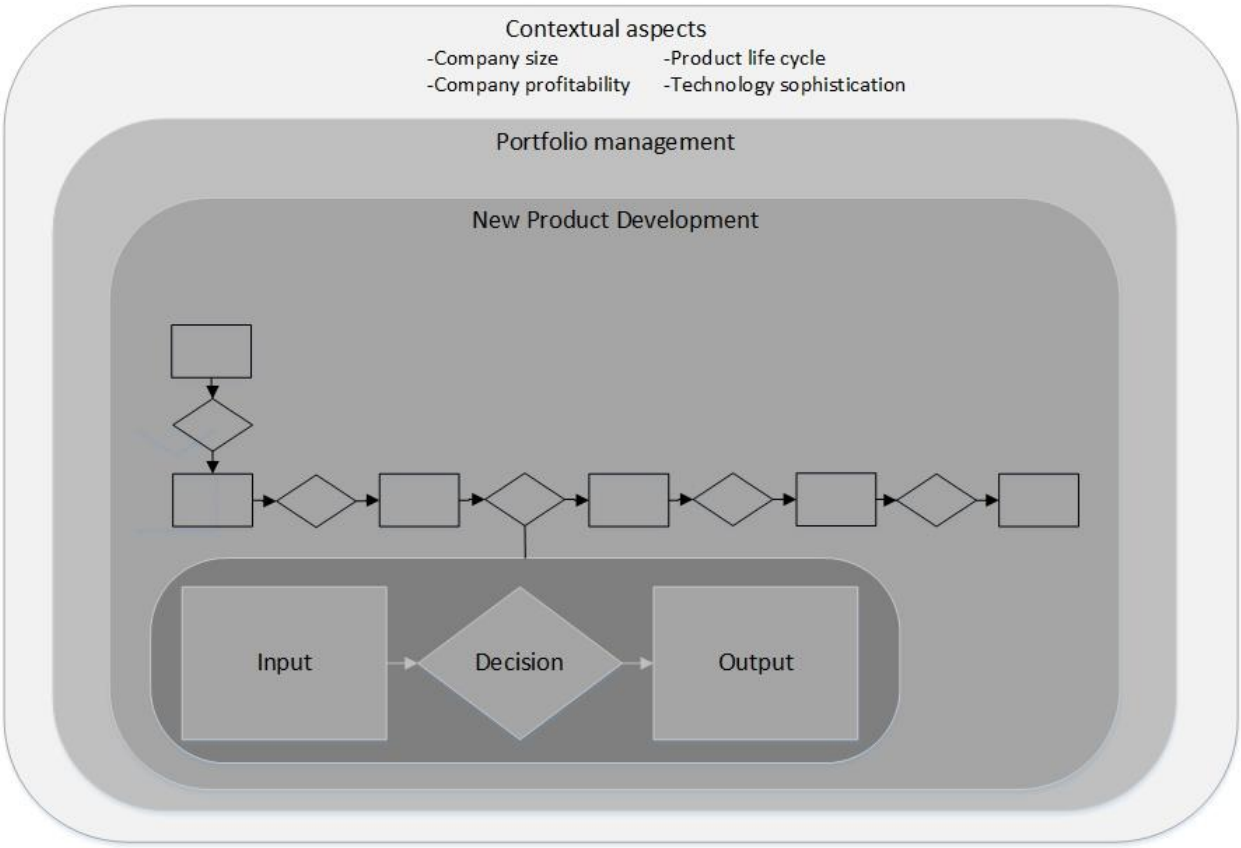

Figure 7 - Structure of the theoretical chapter including connections and interdependencies

2.1 Portfolio management

Portfolio management is a term referred to in several different contexts. It has been used when assessing financial products, customers, suppliers, projects and products. We examine the general thinking of portfolio management with a focus on product portfolios and implications on R&D.

Portfolio management is not a new idea. Researchers and consultancies have been investigating and selling the concept as business-unit matrices for some time, the BCG-matrix being a famous example (Mikkola, 2001). The primary focus is on strategic aspects and resource allocation among business units (Cooper, et al., 1999).

Cooper et al (1999) describe the purposes of portfolio management in four points:

- *Strategic choices*. Deciding which markets, products and technologies the company should pursue.
- *Resource allocation*. Deciding where the limited resources within R&D and marketing should be deployed.
- *Project selection*. Deciding which of the many potential development projects should be chosen.
- *Balance*. Deciding how the company should balance the number of projects to their resources and capabilities.

To structure the area of research, Jugend & da Silva (2014) have developed a framework based on a literature review which is depicted in *Figure 8*. The dimensions suggested as the most impactful in the field are strategy, organization and methods with two or three sub-categories. This chapter is based on their framework.

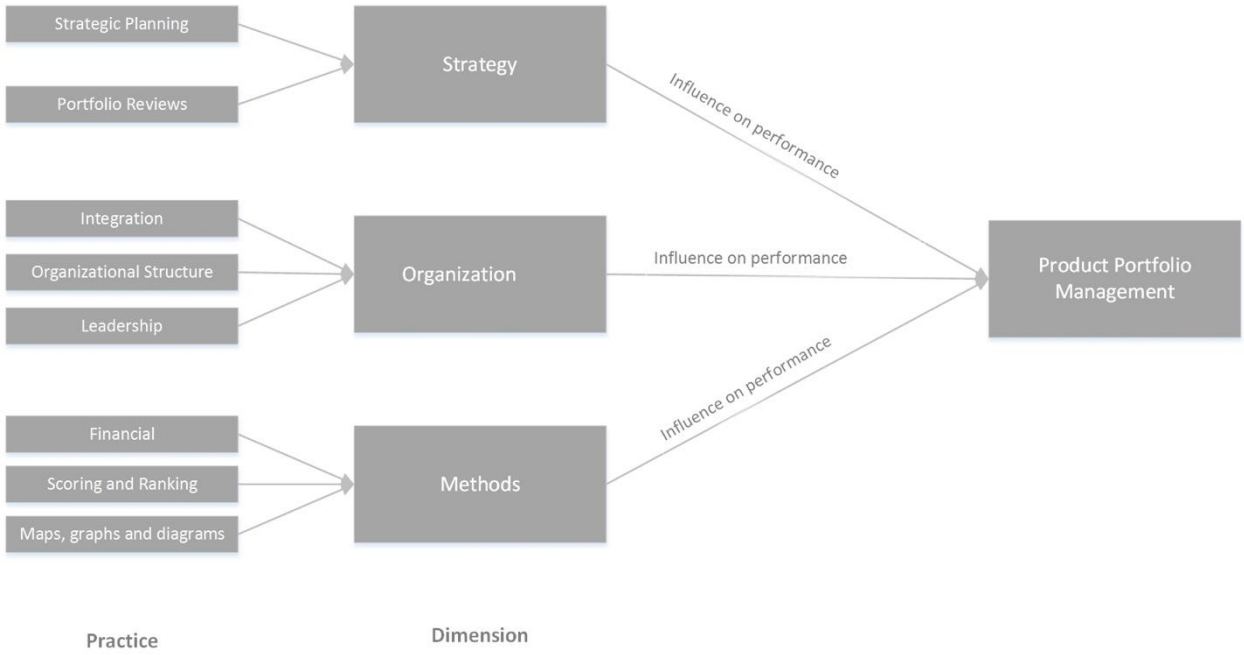

Figure 8 - Product portfolio framework, adopted from Jugend & da Silva (2014, p. 20)

2.1.1 Strategy

There is much focus on the connection to strategy within the field of portfolio management. Jugend & da Silva (2014) discuss how companies focus on individual projects and products, missing the bigger picture and the company strategy. Additionally, functional objectives are deciding which projects are proposed and approved, which leads to a lacking holistic view. Cooper et al. (1999) explain how portfolio management is one important route by which senior management can execute company strategy in terms of prioritization of products, markets and technologies. Product development decisions drive what type of business the company should rely on in the upcoming years. Kaiser et al. (2015) argue that the main purpose of portfolio management is aligning the product portfolio with strategic goals of the company.

2.1.1.1 Strategic Planning

Strategic planning deals with long term aspects of portfolio management. Medium and long term decisions are usually integrated into this phase. Planning of platform shifts and more radical innovations are usually included as well (Jugend & da Silva, 2014). Jugend & da Silva (2014) suggest that an innovation strategy can be an alternative connector between strategy and product planning, bridging the gap and guiding decision making.

Cosner et al. (2007) suggest integrated roadmaps, starting with strategy, should drive the planning of products. The integrated roadmap consists of four sub-parts which intersect to connect company strategy with the products.

Strategic Roadmap consists of the long-range objectives of senior management.

Market Roadmap describes the customer needs, regulatory environment, substitute products and other factors. Strategic goals and market targets are stated as milestones in this roadmap.

Product Roadmap show how the company will evolve with new products and services.

Technology Roadmap describes R&D activities with availability dates and driving factors. Product and technology roadmaps are often described with completion dates for key activities.

The integrated roadmap presents the contents and intersections for these roadmaps and describes how the company wide objectives will be reached (Cosner, et al., 2007). Their interdependence can be seen in *Figure 9*.

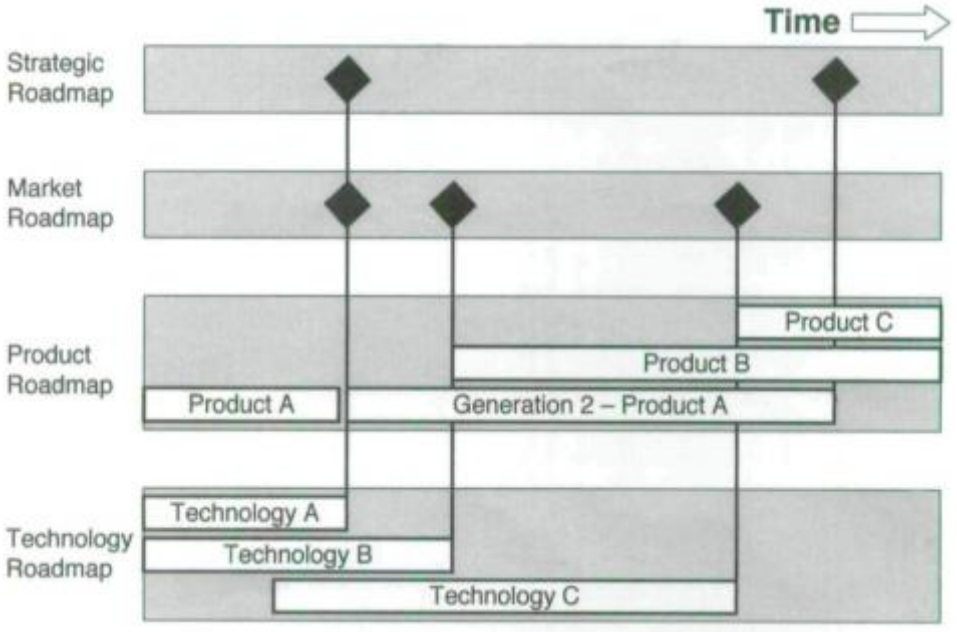

Figure 9 - Roadmaps and their hierarchical relationships (Cosner, et al., 2007, p. 33)

2.1.1.2 Portfolio Review

A portfolio review is a point in time when a company looks over its entire portfolio of products or projects. Jugend & da Silva explain it as *"systematic evaluations of strategic planning results as well as more timely analyses of new product development opportunities and needs or the discontinuation of products currently being produced and sold"* (2014, p. 23). Cooper et al. (2001) stress the importance of periodic portfolio reviews and describe it as a time when the entire set of projects is looked at simultaneously.

Patterson (2005) suggests a model which relates product portfolio management to strategic planning and its review stages. As seen in *Figure 10*, strategic planning can be further divided into portfolio planning and portfolio assessment. Portfolio reviews are part of the ongoing portfolio assessment. They are necessary since market and technology dynamics of strategic planning need to be captured during shorter periods of time (Jugend & da Silva, 2014).

According to Patterson (2005), portfolio review frequency depends on the company and product life cycle. Cosner et al. (2007) suggest that companies in innovative environments need to do this more often, for example every 2 months.

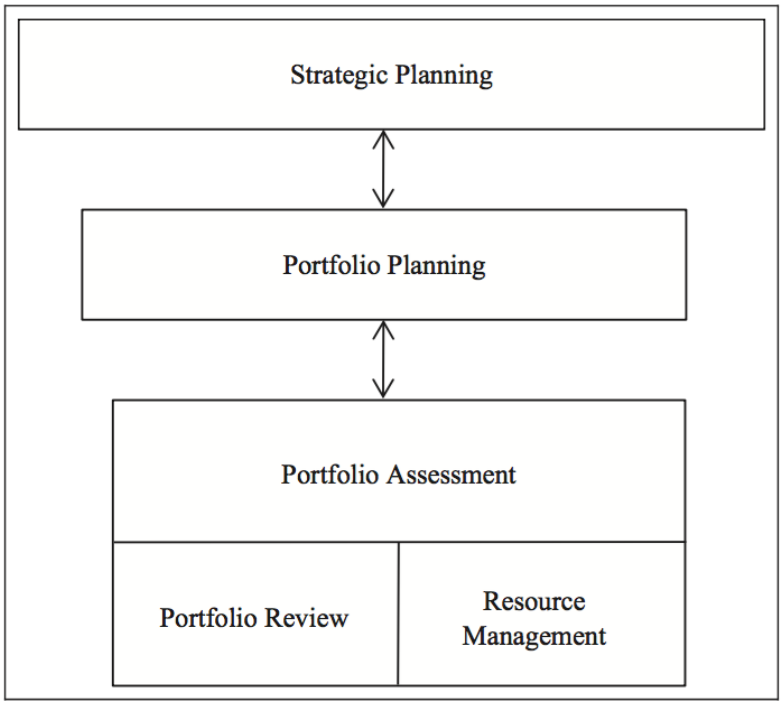

Figure 10 - PPM and its review activities, adopted from Patterson (2005)

2.1.2 Organization

Organizational aspects are important when making analyses and recommendations to specific companies (Jugend & da Silva, 2014). An aspect of importance is the ability of the organization to provide the necessary information. Decision making and portfolio management can only be as good as the information it is based on (Kaiser, et al., 2015).

2.1.2.1 Integration

Functional integration and cross functional teams are, according to Jugend & da Silva (2014), some of the most important aspects of portfolio management. They emphasize, in line with Kaiser et al. (2015), the importance in terms of information sharing and common decision making. In a well-functioning portfolio management practice, knowledge is used from more than the function directly involved. The need for information from functions is based on the criteria used in the decision making. The organizational integration must be good enough to support such information sharing in an efficient way. This to get the most out of portfolio management (Kaiser, et al., 2015).

2.1.2.2 Organizational structure

Kaiser et al. (2015) describe implementation of portfolio management and argue that it should, in project based organizations, shape the entire organizational structure. They believe that the structure of the organization should be aligned with portfolio management goals to enable greater success for the company by increased informational flow. A structure is considered aligned with portfolio management goals when *"it warrants the timely and efficient delivery of high-quality information required by portfolio management"* (Kaiser, et al., 2015, p. 135).

Studies have indicated that matrix organizations and cross functional teams are the most suitable for implementation of portfolio management (Jugend & da Silva, 2014). This is contributed to the information and knowledge sharing enabled by these structures. When employees from different functions are involved in the same projects and day-to-day work, it is natural that communication increases.

2.1.2.3 Leadership

For successful implementation it is important to have the organization's leadership on board. It is a critical success factor in portfolio management as well (Cooper, et al., 1999). Kaiser et al. (2015) argue that portfolio management leadership must stimulate different functions to work together. McNally et al. (2009) and Cooper et al. (2004) believe a more democratic leadership style, delegation of day-to-day activities and inclusive decision making, increase the performance of portfolio management. McNally et al. (2009) suggest the reason is increased communication and information sharing which occurs in organizations with democratic leadership.

2.1.3 Methods

Methods and tools of portfolio management can be divided into different categories. Depending on the company's need and strategy, combinations of these methods should be used in product management decisions.

2.1.3.1 Financial methods

The most commonly used methods for evaluating products and projects are financially based. They are also the most dominant in cases where companies use several methods (Cooper, et al., 2001; Cooper, 2011). Categories of financial models have been proposed by Cooper et al. (1999):

- *Financial models and financial indices*. Examples being net present value, internal rate of return and pay back methods.
- *Probabilistic financial models*. Include advanced models as Monte Carlo simulations, simulations with a stochastic feature, or a simple decision tree.

- *Options pricing theory.* Treats each project like an option on a future investment. An early investment is viewed as buying an option on further investments in the future, enabling use of option pricing models.

Jugend & da Silva (2014) suggest these methods present a quantitative value that make projects easy to analyze, compare and prioritize. The authors do however warn that some companies rely too heavily on the financial measures. There is a risk of misjudging the possible return on riskier projects, leading to selection of safe projects and limiting innovation. There is a heavy reliance on the numbers going into the models, which can limit strategic aspects of development decisions. However, as a complement to other methods, financial metrics are suitable for analyzing the return on resources going in to a project or product (Cooper, et al., 1999; Jugend & da Silva, 2014).

2.1.3.2 Scoring, ranking and checklists

Some popular methods, which compare projects or products in a quantitative way without being financial measures fall within the category of scoring, ranking and checklists. Relative comparisons look at a given set of products and then rank them. A downside of this method is that it has to be remade entirely if a new product is added to the set (Lin & Hsieh, 2003). An alternative idea is to use a set system of scoring or ranking which can be used for one product at a time. It is not dependent on other products in the set which is more time efficient. It is however disregarding the interdependencies among products (Jugend & da Silva, 2014). An example of a simple scoring spreadsheet with weighted criteria is presented in *Table 1*.

.

Table 1 - Example of weighted criteria model (rating of product from 1-10)

	Product A	**Product B**
Market risk ***(Weight 0,4)***	7 out of 10 *7*0,4 = 2,8*	5 out of 10 *5*0,4 = 2*
Market potential ***(Weight 0,3)***	8 out of 10 8*0,3 = 3,2	9 out of 10 *9*0,3 = 2,7*
Project cost ***(Weight 0,3)***	4 out of 10 *4*0,3 = 1,2*	3 out of 10 *3*0,3 = 0,9*
Total	2,8 + 3,2 + 1,2 = **7,2**	2 + 2,7 + 0,9 = **5,6**

Bitman and Sharif (2008) suggest that most ranking methods consist of perspective and criteria. Perspective relates to the company objectives of the portfolio, for example customer satisfaction. These are then broken down into criteria as a measure of the perspective. The criteria could then be given weights that are added up by using an analytical hierarchy process (AHP) or a balanced scorecard (Jugend & da Silva, 2014).

When using checklists as criteria, projects are evaluated based on a number of yes/no questions. The project often has to answer yes to all questions before continuing into next stage. When implemented, checklists are often used as a complement to other methods (Cooper, 2011).

2.1.3.3 Visualization tools

To get a visual view of the product portfolio and product introductions some companies use maps, graphs or diagrams (Jugend & da Silva, 2014). Mikkola (2001) points to the use of product matrices for positioning in various dimensions, examples are the BCG-matrix, the GE-matrix and product roadmaps. Matrices' have been criticized for the simplifications of a two dimensional model and the difficulty of measuring proposed dimensions. Mikkola (2001) proposes matrices are a strong tool when aligning company strategy to long term goals and day-to-day R&D decisions. She continues to argue that competitive advantage and benefits to customer are the two most important dimensions when analyzing potential projects.

A product roadmap, seen in *Figure 11*, is a visual tool used to map out products and technologies to be developed over time. It can be used to allocate resources and plan deadlines for example (Jugend & da Silva, 2014).

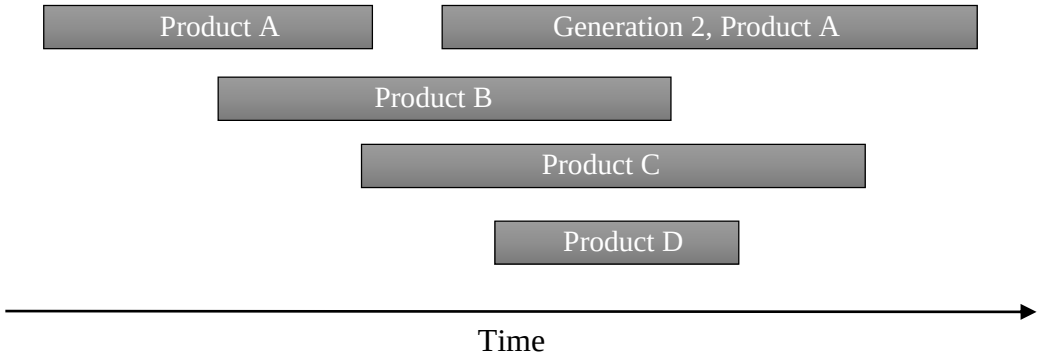

Figure 11 - Example of a product roadmap, adapted from Cosner et al. (2007, p. 33)

To add an additional dimension to a two dimensional graph or matrix, some companies use bubble diagrams where the size of a bubble and the color can add information, seen in *Figure 12*.

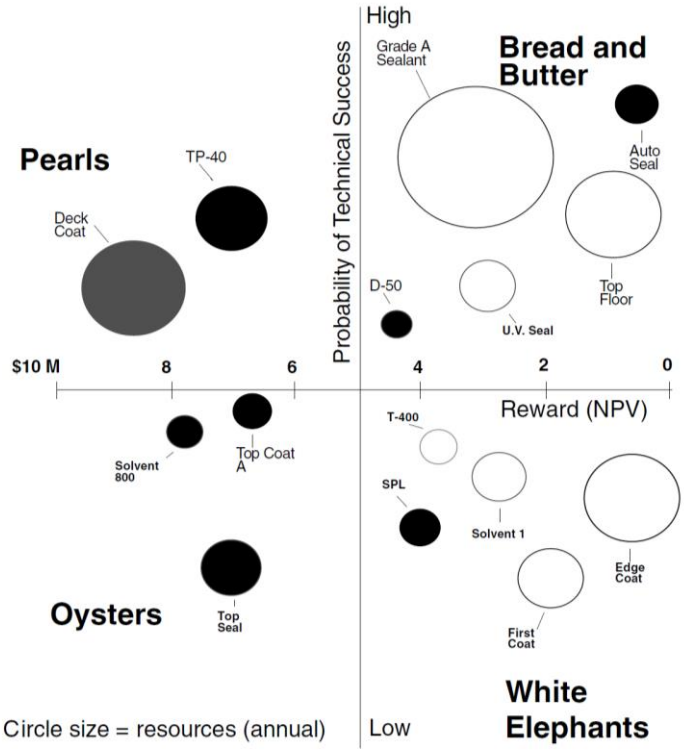

Figure 12 - Typical risk-reward bubble diagram (Cooper, et al., 2001, p. 369)

2.1.3.4 Business strategy models

Cooper et al. (1999) mention business strategy models in addition to the methods from the portfolio management framework. This category of models has a direct link to the strategy of the business. The business units are divided into categories, or "buckets", which are given a set budget based on strategic prioritizations. The prioritization within these categories is based on a

different method, the most common being financial measures. An example of strategic buckets is depicted in *Table 2*.

Table 2 - Example of a strategic bucket plan, adapted from Cooper et al. (2001, p. 368)

Product Line A **Target budget SEK 3.4 M**	**Product Line B** **Target budget SEK 2.8 M**	**Product Line C** **Target budget SEK 10.4 M**
Product A (SEK 1.2 M)	Product C (SEK 0.6 M)	Product F (SEK 4.6 M)
Product B (SEK 2.2 M)	Product D (SEK 1.4 M)	Product G (SEK 2.4 M)
	Product E (SEK 0.8 M)	Product H (SEK 3.4 M)

To achieve the best results, the tool should align the portfolio with company strategy (Jugend & da Silva, 2014). Cooper et al (2001), suggest that the combination of strategic models with any other method gives the most beneficial results for companies.

2.1.4 Impact of portfolio management

Portfolio management is said to optimize overall benefits of a product portfolio in terms of operational and strategic goals. It is a critical factor of success in new product development (Cooper, et al., 1999; Jugend & da Silva, 2014; Kaiser, et al., 2015). A vital part of the practice is to control the inflow of new products into the portfolio. This to match the company's goals with the resources available and get the most out of development efforts (Cooper, et al., 2001).

Companies who succeed in the field of portfolio management, in terms of fitting management and being rated as high quality by management, get numerous advantages (Cooper, et al., 1999):

- Higher economic value for the firm's development projects.
- Higher degree of strategic alignment. Development projects match company strategy and spending mirrors strategic priorities.
- Higher degree of project balance.
- The number of projects match the resources available.

Another purpose discussed by Tolonen, et al. (2015) is the possibility to manage the portfolio to create a healthy in-and-out-flow of products. Portfolio management can be a key tool to limit the portfolio size and keep it from expanding to unwanted levels (Tolonen, et al., 2015).

2.2 New Product Development

Product development has been defined as the transformation of a market opportunity into a product available for sale (Krishnan & Ulrich, 2001; Wheelwright & Clark, 1992). The wide scope of this process means it encompasses several company functions – research & development, marketing and operations to name a few. New Product Development (NPD) is critical for many companies to sustain competitive advantage (Brown & Eisenhardt, 1995; Krishnan & Ulrich, 2001; Balachandra & Friar, 1997; Wheelwright & Clark, 1992). At the same

time, it is one of the riskiest endeavors that a company can undertake as many NPD projects fail commercially (Page, 1991; Cooper, 2011).

2.2.1 Characteristics of Successful Product Development

Ulrich & Eppinger (2012) use five dimensions to assess the performance of a product development project:

- *Product quality* – End product quality and customer need satisfaction. Reflected in market share and the price that customers are willing to pay.
- *Product cost* – Includes cost of equipment, tools needed and variable costs for each produced unit. Determines profitability of the product.
- *Development time* – How responsive the firm can be to competition, technological developments and payback time for development efforts.
- *Development cost* – The funds spent to develop the product, usually includes a large portion of the investment required for the product.
- *Development capability* – How the development team use previous experiences to develop products more effectively and economically in the future.

High performance in these dimensions lead to economic success. However, important criteria can be decided based on other stakeholders as well. Examples can be environmental performance, a products job creation abilities or if it's an exciting product to develop (Ulrich & Eppinger, 2012).

2.2.2 Functions Involved in NPD

Ulrich & Eppinger (2012) mention three core functions central to a product development project:

- *Marketing* – Act as mediators between the firm and its customers to help identify new opportunities and customer needs. Marketing are usually responsible for product launch and promotion.
- *Design* – Define the physical form of the product to meet customer needs. It includes mechanical, electrical and software as well as industrial design aspects such as aesthetics, ergonomics and user interfaces.
- *Manufacturing* – Primarily responsible for operational aspects and production of the product. Includes supply chain activities like purchasing and distribution.

Product development is carried out by a product development team which can consist of a core team and an extended team. The core team is small enough to meet in a conference room and includes representatives from the core functions. The extended team can include a wide range of people from other areas of the company as well as external resources and suppliers (Ulrich & Eppinger, 2012).

2.2.3 Stage-Gate perspective of NPD

One way of managing NPD process difficulties is to implement an idea-to-launch system. The purpose of such a system is to structure the innovation process and connect development stages of products to portfolio management. One such idea-to-launch system, the Stage-Gate process, has been designed by Cooper (1990). It is a perspective widely used for managing the product innovation process in portfolio management (van Oorschot, et al., 2010; Chao, et al., 2014; Cooper, 2008). The Stage-Gate process as seen in *Figure 13* consists of a series of guiding stages and gates.

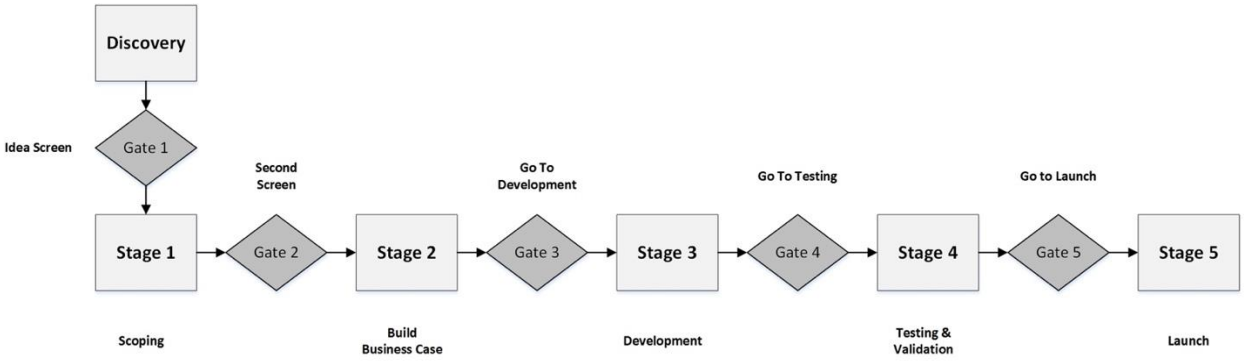

Figure 13 - Stage-Gate process, adopted from Cooper (2011).

The idea is to have several stations where a project has to motivate its existence. The purpose is to limit the number of bad development projects. Project Managers have to argue for a project to executives at each gate, called a go/kill decision (Cooper, 2011).

2.2.3.1 Stages

The stages are where the actual work is carried out. To progress to the next gate, a set of activities need to be completed. In addition to the actual development, there are activities to gather information used as a basis for decision making at the subsequent gate, see *Figure 14*.

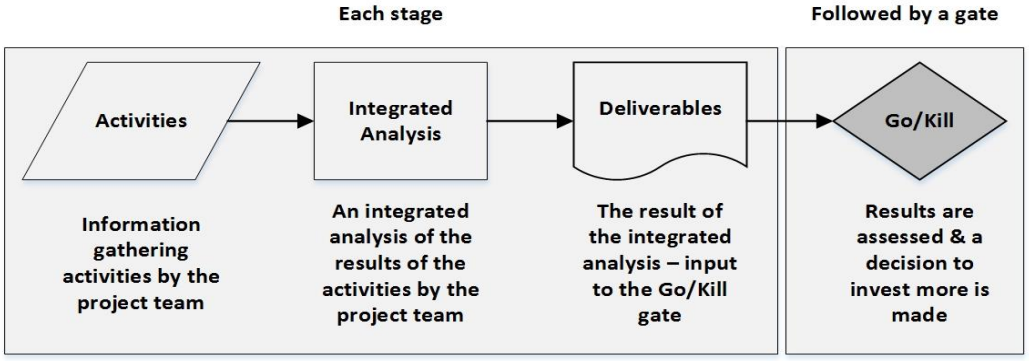

Figure 14 - Description of the sub-parts of the Stage-Gate process, adopted from Cooper (2008).

Each stage is more expensive than the next explaining why the information gathered is critical to manage project risk. The stages build on continuous, cross-functional cooperation since no single department owns the stage (Cooper, 2008).

2.2.3.2 Gates

The gates are check points of the process where a decision is made to proceed or kill projects. Each gate consists of deliverables, criteria and outputs. Deliverables are what the project team should bring to the gate, decided at the previous gate. Criteria can be in the categories of must-meet, which decides whether the project should be allowed to continue, and should-meet where the project is prioritized against other projects. Output consists of the decision whether to continue or kill the project. If the project continues, the output should state the deliverables at the next gate and a deadline for completion (Cooper, 2008).

The criteria most commonly used in the gates have strong parallels to portfolio management. Cooper (1999) divides them into seven categories similar to the methods proposed in the portfolio management framework in chapter 2.1:

- Financial models and financial indices.
- Probabilistic financial models.
- Options pricing theory, treats each project like purchasing an option on a future investment.
- Strategic approaches.
- Scoring models and checklists, often qualitative measures.
- Analytical hierarchy approaches.
- Behavioral approaches, tools designed to reach a consensus among managers which is useful when only qualitative information is available.
- Mapping approaches or bubble diagrams.

Jugend & da Silva (2014) point to the importance of having criteria and methods which are easy to understand for people involved in the project. This to ensure the selected measurements are driving the operations in the desired direction. Additionally, information required for the decision must be collected correctly. Jugend & da Silva (2014) suggest highly complex mathematical methods are often not used due to their complexity. They also have unclear connection between input in terms of workload and improved decision making for the project.

Criteria used in a selection process should be aligned with information collection. Kaiser et al. (2015) describe how choice of criteria decide what information is required for the decision. The information need has to be aligned with the organizational structure. It includes aspects such as systems, processes and organizational units which can create, process and deliver the necessary information to the decision point.

2.2.3.3 Modifications

The Stage-Gate perspective of product development and its connection to portfolio management is a strong motive for practical use. There are however limitations with a standardized system. The Stage-Gate process can provide a solid base for a company wanting to implement a way of working with portfolio management in NPD. There is criticism to the concept regarding the linearity, rigidness and limitations in innovative projects (Cooper, 2014). Propositions regarding modifications have been suggested by researchers to improve the process based on company specific context.

Ettlie & Elsenbach (2007) have investigated the difference in practice between breakthrough- and incremental innovation in terms of Stage-Gate modifications. They found that incremental product development projects are well served by a standard system. When dealing with radical new technology however, a version modified for the specific company could improve project efficiency without negative trade-offs.

A large variation in project types while using a "one size fits all" thinking like the Stage-Gate perspective is not optimal. It risks leading to too little time is spent on the high-value and too much on the low-value projects. To increase the efficiency of the development there should be a project specific customization. If done right, companies are able to reduce wasteful activities without reductions in decision making quality (Cooper, 2008).

To adapt to new business threats from competition and internal development of the organization, companies have to adapt how they work. Concerning the Stage-Gate perspective several improvements to the original idea has been proposed:

Use of fuzzy numbers as a means to quantify qualitative data. Lin and Hsieh (2003) suggest the lack of complete information at the beginning of projects, which reduces the usefulness of quantitative models, can be mitigated by using fuzzy numbers. Fuzzy numbers can be seen as a set of possible numbers with various weights which can incorporate risk and uncertainty in a more sophisticated way than regular numbers. The idea is to use decision makers' confidence in their view, as a weight for their impact on the final decision with the purpose of improving total decision certainty.

Digital decision support systems. To keep track of data and simplify mathematical decision models, some authors suggest use of digital decision support systems (Lin & Hsieh, 2003; Cooper, 2014; Cooper, 2008). They can vary from advanced mathematical modelling to simple AHP software which weighs decision makers' opinions of criteria.

Increase level of flexibility in project start. As a way to improve the dynamics of complex projects, van Oorschot et al. (2010) argue that companies should increase investment in the beginning of projects to improve the dynamics of project execution. They suggest a project ramp-up focus in the beginning will increase the product success rate when there is a large degree of built in uncertainty.

Scale depending on project risk. To be more efficient in product development it is suggested that companies adapt the rigor of the Stage-Gate process to project risk. If a project is of low risk, a lower number of stages and gates can be applied (Cooper, 2008). Three proposed examples are depicted in *Figure 15*. The first gate in the idea screen will decide which version to use. Large, high-risk, platform projects go through the full process. Small, low-risk, projects such as extensions and modifications go through the shorter versions consisting of fewer stages and gates (Cooper, 2008).

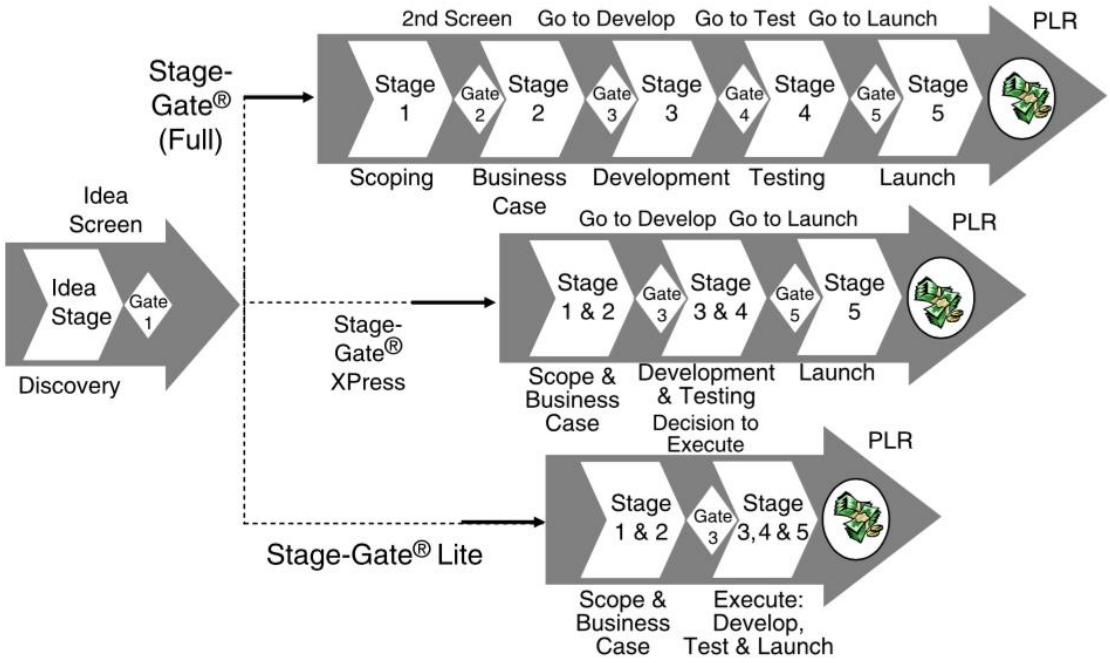

Figure 15 – Modifications of the Stage-Gate process adopted from Cooper (2008)

2.3 Decision point

The decision point is studied based on the format suggested by Cooper (2011, p. 281) to be used for the gates within the Stage-Gate process. He states that each gate should consist of deliverables, criteria and an output. These have been extended into a model including input, decision and output. Deliverables have been extended into the input component of the model. The information and the people responsible for gathering it are described. Criteria is extended into the decision component where both criteria and decision makers are described. The output is then divided into the sub-parts of execution and implementation. The model which will be discussed more in-depth in this section can be seen in *Figure 16*.

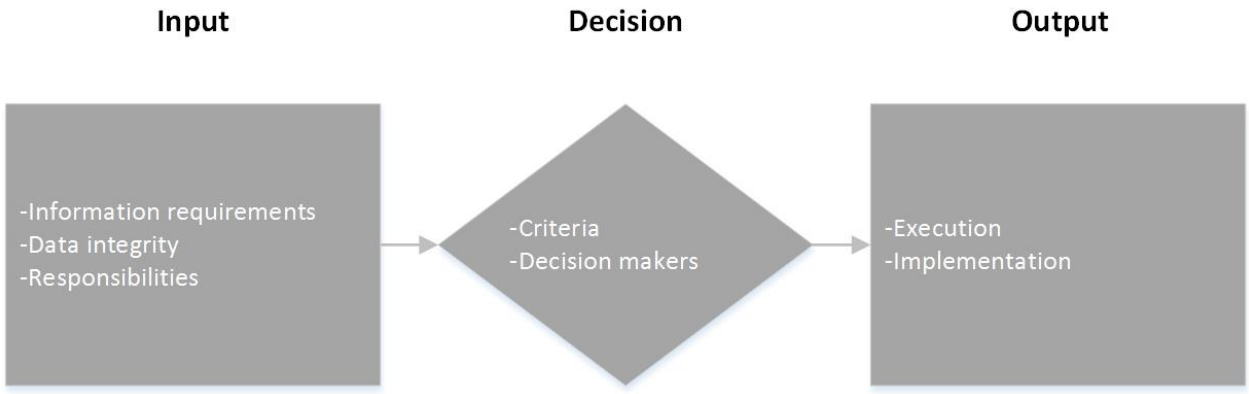

Figure 16 - Conceptual model of the decision point before NPD

2.3.1 Input

Kaiser et al. (2015) describe how choice of criteria decides the type of information required in the decision. The implication of increased sophistication of decision criteria is increased information need. In line with portfolio management, the information gathering needs to be supported by the organization. This includes systems and processes which can create, process and deliver the necessary information.

Cooper et al (1999) discuss how the project team must gather and structure information before each gate. The team should distill the information into deliverables used by decision makers in their go/kill decision for the project. The gathering is described in its steps in *Figure 17*.

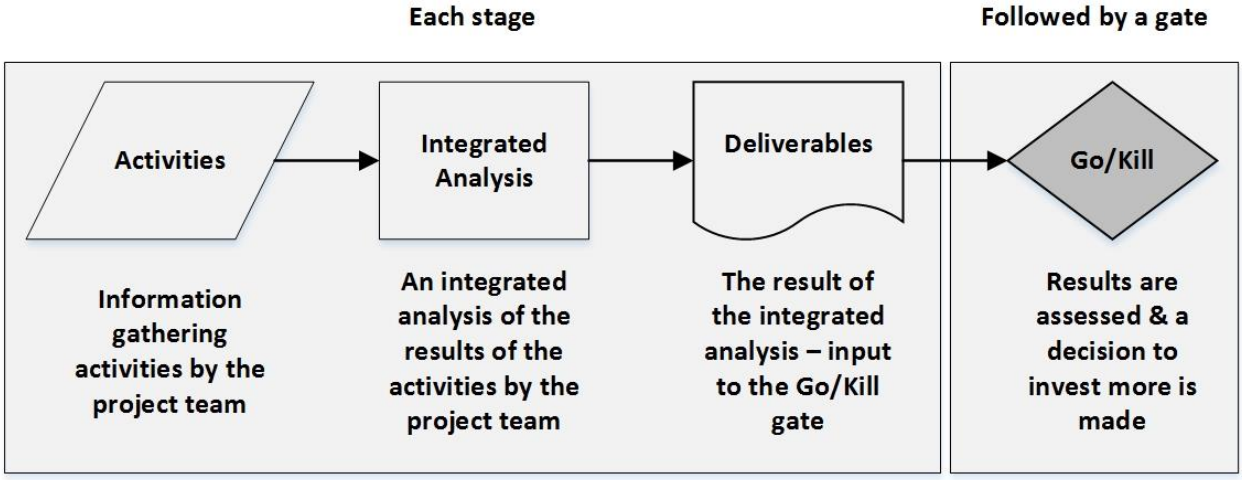

Figure 17 - Information gathering for each gate (Cooper, 2008, p. 214)

A problem proposed by Chao et al. (2014) is misalignment between Project Managers collecting information and the decision makers at the gates. The Project Managers could have an incentive to give misleading or incomplete information if their project risks being killed. Decision makers on the other hand try to optimize the portfolio in its entirety and must have complete information to do so. Chao et al. (2014) suggest that the risk is greatest at the beginning of the development

process when information is most uncertain. The proposed solution for this information asymmetry is to employ a high level of tolerance for failures to decrease the incentive to hide uncomfortable information.

The focus on killing bad projects early in the process, when the information available is at the lowest point, has been criticized as it risks killing good ones as well. This has been investigated by van Oorschot et al. (2010) who found that projects characterized by information uncertainty risk this destiny. An underestimation of workload in the beginning of the project, in combination with the Stage-Gate philosophy of low initial investment, can lead to a poor start. This can carry over through the stages and risk leading to an undeserved kill decision.

2.3.2 Decision

The use of formal methods and criteria can be argued for in numerous ways. It is a way of combining different aspects of a decision, such as technology, risk, market and economic return (Jugend & da Silva, 2014). Cooper et al. (2001) argue that one of the most important aspects of the formal criteria is to put discipline into the process and provide a consistent way of dealing with decisions. Using the same criteria enables comparison of project and products. A study of 205 companies implementing the practice suggest those who use formal, explicit, clearly defined methods applied on all projects perform the best (Cooper, 2011).

An important aspect in the choice of decision criteria is the impact they have on the ultimate goal of the portfolio. Some of the common KPIs found by Cooper et al. (1999) are strategic alignment, total portfolio value and portfolio balance. The authors discuss this issue and suggest managers need to align choices of criteria with the KPIs of the entire portfolio to reach long term success.

To conduct successful portfolio management, it has been proposed that several levels of criteria should be introduced. The suggestion is to start at the strategic level for the allocation of resources in different buckets. Other criteria is then used to choose projects and distribute resources within each bucket. (Kaiser, et al., 2015)

To make the correct decision it is of great importance that the right people have the right information. Kaiser et al. (2015) discuss how alignment of an organization’s structure and the decision criteria can help in both aspects. They propose portfolio management and its objectives should decide both how information is gathered and who makes the decisions. Decision makers need to be at a sufficiently high hierarchical level, aligned with the criteria and goals of the portfolio.

Decisions regarding portfolio management and product development need to be well structured and thought out. This formality includes who is involved in the decision making. Chao et al. (2014) discuss how the most common decision makers are executives at a strategic level who come in and evaluate projects.

Seifert et al. (2016) use numerical optimization of a company's resources and profit to motivate how it is positive for a company to implement joint management of products. Their research indicates that decision making on a high hierarchical level is profitable for the company.

2.3.3 Output

In line with having a formal process and criteria when selecting projects and products, researchers propose formality in decision output (Cooper, 2008; Chao, et al., 2014). The main takeaway is to limit the company to binary go/kill decisions and eliminate the grey scale in between.

It can be tempting to let projects live in the grey area in hope of a more advantageous market situation or technical breakthrough later on. However, Cooper (2008) argues strongly on importance of having gates with teeth, meaning that a kill decision really needs to be implemented. He argues for a binary choice of go or kill together with a solid follow-up. This means the project needs to be killed if that is decided.

On the same note, resources must be given to the projects which are considered good enough to carry on to the next stage. Cooper et al. (2008) discuss how a common mistake is not having made a clear decision and not mirroring the decision in resource allocation. They argue that the combination of gates with teeth and resource allocation to the selected projects will focus resources on the most advantageous projects.

2.3.4 Contextual Aspects

The decision point is influenced by a range of aspects depending on the company context. While there is not much written on the topic, a few contextual aspects have been found relevant to discuss.

Company size. Jugend & da Silva (2014) stress the organization dimension in their framework for portfolio management. It is critical in achieving the needed level of information sharing. It is assumed that company size has an effect on this since the larger the organization, the more difficult it is to achieve functional integration (Kaiser, et al., 2015) and inclusive decision making (Cooper, 2004).

Company profitability. Companies that apply formal criteria to all projects will outperform their competition financially (Cooper, et al., 1999; Cooper, 2011). It is therefore assumed that profitable companies contribute their success, at least in part, to having formal criteria and an overall formality in product decisions.

Product life cycle. Patterson (2005) states that the product life cycle decides the frequency of portfolio reviews. Cosner et al. (2007) suggest companies in innovative environments need to do this more often. Portfolio reviews deal with the portfolio as a whole, but product life cycle also has an effect on the frequency of decision making for individual projects.

Technology sophistication. As Ettlie & Elsenbach (2007) found, incremental innovation and less sophisticated technology development is more favored by a standard Stage-Gate system than radical new technology is. Therefore, technology sophistication of the company's products has an impact on the decision point as well.

2.4 Synthesis

Several components have been identified as important when attempting to make difficult decisions regarding product projects. The most important can be seen in Figure 18 which summarizes our view of the decision point into a conceptual model. The components of this model are input, decision, output and contextual aspects that affect the other components. We will now present theoretical propositions that describe each component.

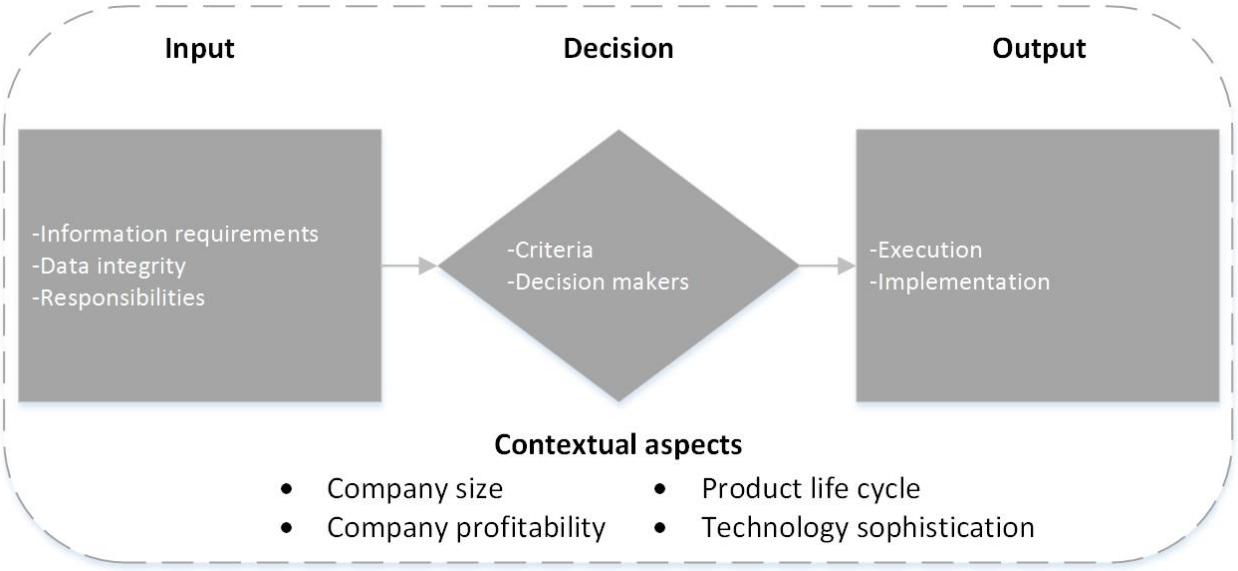

Figure 18 – Decision point description

2.4.1 Input

Input into the decision is divided into required information, data integrity and responsibilities surrounding data collection.

2.4.1.1 Information requirement

1. The information needed for the decision is determined by the choice of criteria, where increased sophistication of criteria increases the information need. (Kaiser, et al., 2015)
2. Information and knowledge from different departments are needed for successful portfolio management decisions (Jugend & da Silva, 2014; Kaiser, et al., 2015)
3. Functional integration and cross functional teams are enablers of this information gathering (Jugend & da Silva, 2014; Kaiser, et al., 2015)

2.4.1.2 Data integrity

Data integrity refers to maintenance and assurance of data accuracy and consistency. That is, to make sure the data used for the decision is trustworthy.

4. Misaligned incentives can cause misleading or incomplete information to be gathered. This risk is greatest at the beginning of the process when information is the most uncertain (Chao, et al., 2014)
5. Decisions made can only be as good as the information they are based on. Therefore, maintaining data integrity is critical (Kaiser, et al., 2015; Cooper, 2011)
6. The risk of ending the wrong project is greatest in the beginning and is especially apparent for projects characterized by poor information and low early investment (van Oorschot, et al., 2010)
7. Many key factors are complex to quantify into financial numbers which can lead to unreliable results if relying solely on that criteria (Ulrich & Eppinger, 2012)

2.4.1.3 Responsibilities

8. It should be the responsibility of all functions to deliver reliable information to the portfolio management decisions (Kaiser, et al., 2015).
9. Organizational integration must be good enough to support information sharing; cross functional teams are one way of achieving this (Jugend & da Silva, 2014). The information sharing will then be spontaneous with increased quality (Kaiser, et al., 2015)
10. Management support for cross functional integration is vital to increase the rate of information sharing (Kaiser, et al., 2015)
11. A Project Manager should be responsible for collecting information on a project and argue for its survival in gate meetings (Cooper, 2011)
12. Marketing, design and manufacturing should be continuously involved in providing information to NPD-projects (Ulrich & Eppinger, 2012)

2.4.2 Decision

The decision can be divided into the criteria which is used to judge it and the decision makers involved in the decision.

2.4.2.1 Criteria

13. The use of formal criteria is important to structure decision making and enable comparison of projects (Cooper, 2011)
14. Companies that use formal, explicit criteria and apply them to all projects outperform the companies who do not (Cooper, et al., 1999; Cooper, 2011)
15. Criteria should be chosen and aligned based on the goals of the product portfolio and company strategy (Cooper, et al., 1999; Kaiser, et al., 2015; Ulrich & Eppinger, 2012)

16. Financial based criteria are the most commonly used and enable comparison between projects. However, relying too much on financial criteria can misjudge riskier projects and thereby limit innovation. Therefore they should be used as a complement to other criteria (Jugend & da Silva, 2014; Cooper, et al., 1999)
17. The most successful combination of portfolio methods is using strategic criteria to sort out the strong candidates, then additional methods to distribute resources among the chosen ones (Cooper, et al., 1999)
    Examples of additional methods to use are
    a. scoring/ranking/checklists (Jugend & da Silva, 2014; Lin & Hsieh, 2003; Bitman & Sharif, 2008; Cooper, et al., 1999),
    b. visualization tools (Mikkola, 2001; Jugend & da Silva, 2014; Cooper, 2011)
    c. business strategy models (Cooper, et al., 1999; Jugend & da Silva, 2014)
18. The criteria used need to be understood by the people that are using them (Jugend & da Silva, 2014; Cooper, 2011)
19. Integrated roadmaps can be a viable tool to connect the company strategy and portfolio planning to new product development (Cosner, et al., 2007)

2.4.2.2 Decision makers

20. Having formally appointed decision makers is vital for the process (Cooper, 2011; Jugend & da Silva, 2014)
21. To ensure strategic alignment of the product decisions, the decision makers should be of a corresponding seniority (Kaiser, et al., 2015; Seifert, et al., 2016)

2.4.2.3 Variations

22. Financial importance of a project, and the resources needed, should determine the length and extensiveness of the decision making process (Cooper, 2008)

2.4.3 Output

The output from the decision is divided into execution of the decision itself and the following implementation in operational terms.

2.4.3.1 Execution

23. Defining a clear and formal output of the decision is important. It should include a clear decision and a plan for the continued work (Cooper, 2008; Chao, et al., 2014)
24. The decision should be clearly defined as a go or kill decision without a grey scale in between (Cooper, 2008; Chao, et al., 2014)

2.4.3.2 Implementation

25. The decision should be reflected in future resource allocation – a project that continues should receive its suggested resources while one that is killed should stop receiving resources (Cooper, 2008; Chao, et al., 2014)

26. If a project gets a go- decision, goals and criteria should be set up to be achieved until the next gate (Cooper, 2008)

2.4.4 Contextual Aspects

The contextual aspects suggested by theory, further explained in 2.3.4 Contextual Aspects are:

- Company size
- Company profitability
- Product life cycle
- Technology sophistication

The study will investigate these contextual aspects and how they can be related to the theoretical propositions.

2.4.5 Areas of investigation

To investigate these theoretical propositions and their use in the cases, *Table 3* is developed as a summary. It includes the components and subcomponents of the theoretical model which will enable comparison within the cases and between the cases.

Table 3 – Areas of investigation for case study

Input	Decision	Output	Contextual Aspects
Information requirement	**Criteria**	**Execution**	**Strategy, Market and Company**
Data integrity	**Decision makers**	**Implementation**	**Product & technology**
Responsibilities	**Variations**		

3 Methodology

This chapter describes how the study has been conducted. Starting with the overall approach, then describing the details of our method and how data was collected and analyzed. To conclude, the measures taken to ensure reliability and validity will be described.

3.1 Overall Approach

When choosing method it is important to not be influenced by tradition (Persson, 1982). The field of logistics typically relies on an analytical view of the world (Mentzer & Kahn, 1995). This assumes that all phenomena can be broken down into smaller parts which can then be solved independently (Arbnor & Bjarke, 2009). We believe that our research area requires us to understand a real world setting which a case study method enables us to do (Yin, 2009). It enables both physical and human elements within an organization to be addressed (Voss, et al., 2002). As described by Jugend & da Silva (2014), portfolio management requires an understanding of company strategy and organization. We believe that this understanding is important to answer the research questions and therefore the case study method was deemed the best fit.

We have adopted the systems view for this study. To find a suitable decision support model for Axis it was important to understand the system as a whole. This to find patterns, behaviors and properties (Arbnor & Bjarke, 2009) that can explain why certain companies make decisions the way they do. The connection between case study methodology and the systems view is clear in literature (Gammelgaard, 2004).

Figure 19 describe the decision point and the system parts. This point is included within a product development process which in turn is a part of portfolio management, affected by contextual factors.

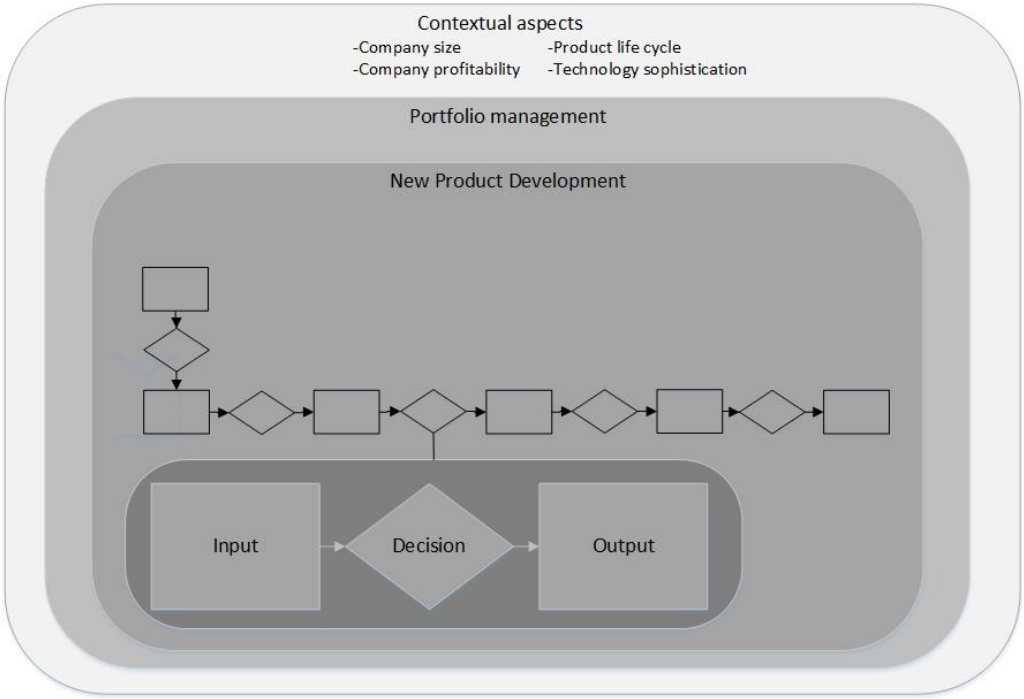

Figure 19 – Description of the studied system

3.2 Research Approach

The constructive approach has been used for this study because of its suitability to solve a company specific problem. Lehtiranta et al. (2015, p. 101) describe the constructive approach and its aim as *"to solve practical problems while producing an academically appreciated theoretical contribution. The solutions, that is, constructs, can be processes, practices, tools or organization charts"*. Kasanen et al. (1993) sum up the approach in a six step process which is displayed in *Figure 20*.

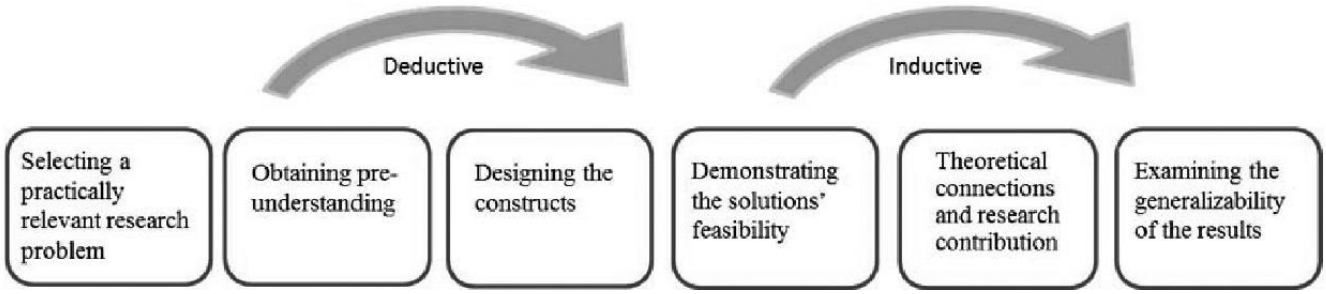

Figure 20 - The six step process for the constructive approach (Lehtiranta, et al., 2015, p. 101)

Bridging theory and practice is essential, therefore the solution must be tied back to theoretical knowledge (Kasanen, et al., 1993). *Figure 21* describes the adapted version of the constructive approach followed in the project.

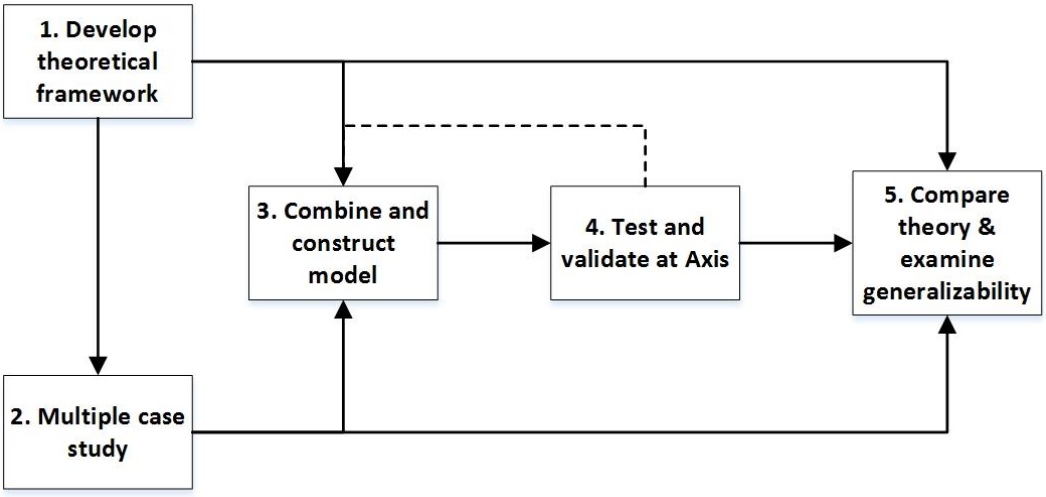

Figure 21 - Project specific research procedure

It was important to lay a foundation in the field of portfolio management. It was done through a literature review and a multiple case study. Limited generalizability when having only one case (Voss, et al., 2002) was the reason for using multiple. The literature review and multiple case study will be described further.

After the foundation had been laid, it was possible to draw conclusions by comparing the theoretical and empirical findings through pattern matching and cross-case analysis. This helped to construct a generic, first version of a decision model. This model was then modified to fit into Axis' context through findings from interviews and a workshop with company stakeholders. After constructing this modified version of the model, it was tested in a second workshop to see how well it fulfilled its purpose.

3.3 Research Question

The master thesis has strived to answer three research questions:

RQ_1 What does the decision point look like according to theory?

RQ_2 What does the decision point look like in practice?

RQ_3 How can these findings be implemented in the context of Axis' accessories?

They were formulated to describe the decision point both from a theoretical and empirical point of view. The third research question strives to answer how a decision support model should be designed to fit at Axis and specifically to their accessories.

3.4 Research Method

As mentioned the research has been guided by the case study method and constructive approach as described in Figure 21. Now, each step will be described more in detail.

3.4.1 Development of Theory

To gain a better understanding of concepts and previous research, the study should start with a review of literature (Rugg & Petre, 2007; Rowley & Slack, 2004; Yin, 2009). The goal is to identify where there is a solid base of literature and theory and where there are gaps to be filled by empery.

A 5 step approach is proposed by Rowley and Slack (2004) to structure a literature review. The steps were used and adjusted to fit the project, seen in Figure 22. While most of the process followed these steps, the review was iterated as additional theory was found, in line with what Brewerton & Millward (2001) suggests.

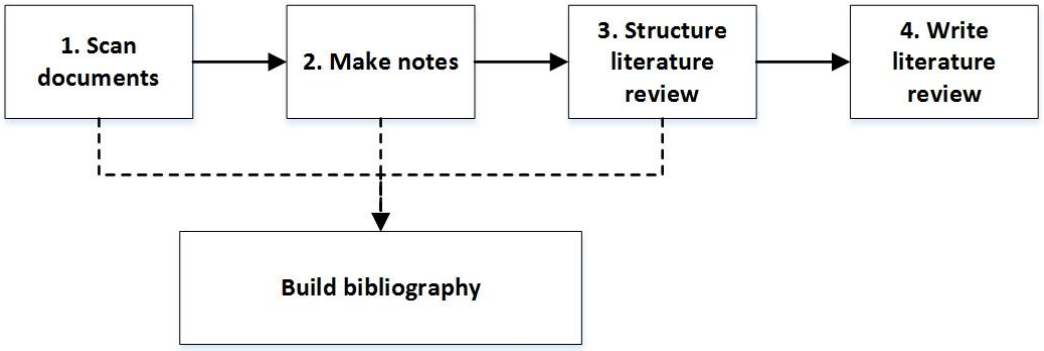

Figure 22 - Literature review method

Scanning documents

Articles were gathered through a variant of the citation pearl growing search strategy. We began with a few articles and then pursued new articles through the key terms used in these articles (Rowley & Slack, 2004). Key terms were used to find articles which could provide the basis for the search strategy. A description of key terms can be seen in the chapter *Structuring the literature review.*

This way it was possible to gather a large set of interesting articles while structuring and building a framework. The articles found were published in a similar set of journals. Some notable authors on the subject had written books which were a valuable addition. These journals and books can be seen in *Table 4*.

Table 4 - Table of scientific journals and books used in the study

Thesis Section	**Journal or Book**

Theoretical framework	• *R&D Management*
	• *Journal of Product Innovation Management*
	• *Research Technology Management*
	• *International Journal of Project Management*
	• *Management Science*
	• *Journal of Product Innovation Management*
	• *Books*
	  ○ *Winning at New Products* (Cooper, 2011)
	  ○ *Product Design and Development (Ulrich & Eppinger, 2012)*

Methodology	• *Qualitative Data Analysis – A Methods Sourcebook* (Miles, et al., 2014) • *Case Study Research - Design and Methods (Yin, 2009)* • *Research Methodologies in Supply Chain Management (Seuring et al., 2005)*

Making notes

During the reading and processing phase, articles were distilled into summaries. Key themes and messages were noted together with the source to enable citations.

Structuring the literature review

The search strategy made it possible to sketch a preliminary structure for the literary review at an early stage. The structure was rough at first and continuously refined as our understanding of the subject grew. Key terms describing the articles and their corresponding authors are described in Table 5.

Table 5 – Key terms and -authors examined in literature review

Key Term	Contributing Authors
Strategic portfolio	(Martinsuo, 2012),(Cooper et al., 1999), (Mikkola, 2001), (Jugend & da Silva, 2014), (Ettlie & Elsenbach, 2007), (Cooper, 2014)1999), (Mikkola, 2001), (Chinho & Hsieh, 2004), (Jugend & da Silva, 2014), (Ettlie & Elsenbach, 2007), (Cooper, 2014)
Decision making	(Martinsuo & Poskela, 2011), (Krishnan & Ulrich, 2001), (Cooper et al., 1999), (Jugend & da Silva, 2014), (Cooper, 2014), (van Oorschot et al., 2010), (Chao et al., 2014)
Decision support system	(Martinsuo & Poskela, 2011) , (Mikkola, 2001)
Project portfolio management	(Martinsuo, 2012), (Kayser et al., 2015), (Cooper, 2008), (Cooper et al., 2001) , (Seifert et al., 2016), (Cooper et al., 1999), (Mikkola, 2001)
Product development/NPD	(Martinsuo & Poskela, 2011), (Krishnan & Ulrich, 2001), (Kayser et al., 2015), (Cooper et al., 2001), (Cooper et al., 2004a), (Cooper et al., 2004b), (Mikkola, 2001), (Jugend & da Silva, 2014), (Ettlie & Elsenbach, 2007), (Cooper, 2014), (van Oorschot et al., 2010), (Chao et al., 2014), (Sommer et al., 2015)
Product Portfolio Management	(Martinsuo & Poskela, 2011), (Tolonen et al., 2015), (Cooper, 2008), (Cooper et al., 2001), (Seifert et al., 2016), (Cooper et al., 2004a), (Cooper et al., 2004b), (Cooper et al., 1999), (Mikkola, 2001), (Jugend & da Silva, 2014), (McNally et al., 2009), (Ettlie & Elsenbach, 2007), (Cooper, 2014), (van Oorschot et al., 2010), (Chao et al., 2014)
Development projects	(Martinsuo & Poskela, 2011), (Krishnan & Ulrich, 2001), (Tolonen et al., 2015), (Cooper et al., 2001), (Cooper et al., 2004b), (Jugend & da Silva, 2014), (McNally et al., 2009), (Ettlie & Elsenbach, 2007)
R&D	(Krishnan & Ulrich, 2001), (Henriksen & Traynor, 1999), (Cooper, 2008), (Cooper et al., 2004a), (Cooper et al., 2004b), (Mikkola, 2001), (Jugend & da Silva, 2014), (Ettlie & Elsenbach, 2007), (Cooper, 2014), (Pero et al., 2010), (Sommer et al., 2015)
Stage-Gate	(Cooper, 2008), (Cooper et al., 2001), (Cooper et al., 1999), (Ettlie & Elsenbach, 2007), (Cooper, 2014), (van Oorschot et al., 2010), (Chao et al., 2014), (Sommer et al., 2015)
Modified Stage-Gate	(Ettlie & Elsenbach, 2007), (Cooper, 2014), (van Oorschot et al., 2010), (Sommer et al., 2015)
Ranking	(Lin & Hsieh, 2003), (Bitman & Sharif, 2008), (Jugend & da Silva, 2014), (van Oorschot et al., 2010)
Scoring	(Lin & Hsieh, 2003), (Bitman & Sharif, 2008), (Jugend & da Silva, 2014), (van Oorschot et al., 2010)
Decision Criteria	(Martinsuo & Poskela, 2011), (Cooper et al., 1999), (Mikkola, 2001), (Jugend & da Silva, 2014), (van Oorschot et al., 2010)

Writing the literature review and building a bibliography

Once the structure was set, writing began. Key concepts and areas were used as sections of the review and related literature added content. The review aimed to include a distillation and understanding of key concepts. It was enriched with selected quotations and theories when applicable. Building the bibliography was an ongoing effort. Authors and citations were added continuously to enable ease of reference.

3.4.2 Case Study Method

Yin (2009, p. 18) describes case study research as *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context"*. A strength of the case study research method is the ability to answer questions of "how" and "why". The research method further

provides flexible data collection which help investigating supply chains and managerial issues therein (Seuring, 2005). Stuart et al. (2002) argue for the use of case studies in operations management for comparing companies in different contexts. They describe how it can provide a way for the researcher to make valid observations and contributions to the body of knowledge. The multiple case study served to answer RQ_2. It also helped to prepare for answering RQ_3 by providing context to practical application.

A process map of the case study method, described in Figure 23, has been proposed by Yin (2009). This process guided the research within the case study and will be described in detail in the ensuing pages. Yin (2009) stresses the importance of utilizing a feedback loop which can be seen as a dotted line in Figure 23. It lets important findings in later steps reiterate the earlier ones. In our study, this was ensured through using Axis as a case and thereby testing and modifying the data collection protocol before the other cases began.

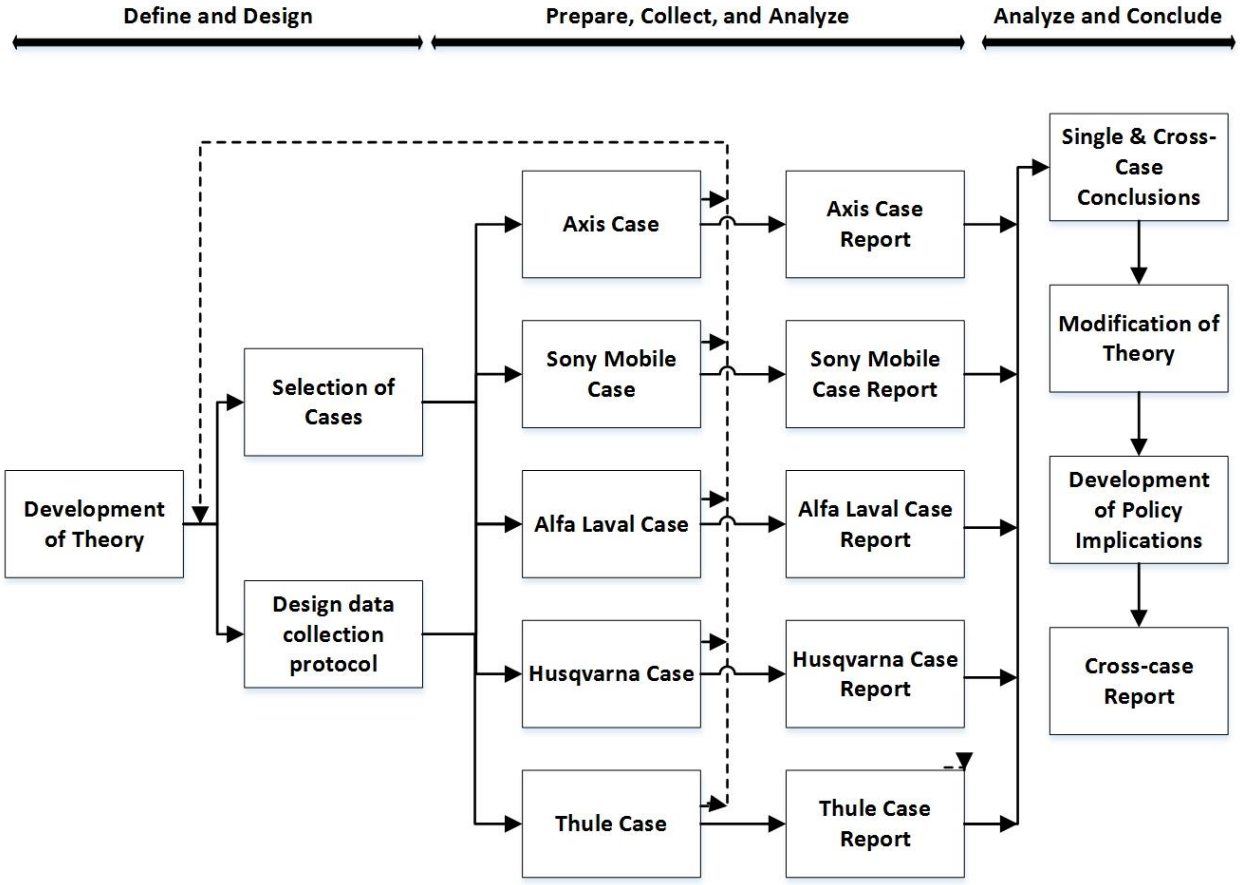

Figure 23 - Case study method, adopted from Yin (2009)

3.4.2.1 Unit of analysis

The choice of single or multiple case study depends on degree of depth versus generalizability the researcher wants to achieve (Voss, et al., 2002). We chose multiple cases, both for the generalizability it provides and since it would give a wider input into the construct for Axis.

Before starting the case study, the research question and unit of analysis must be identified. The unit of analysis is "the case" and can be a person, company, group of people, decision or event (Yin, 2009).

The cases studied were meant to provide valuable insights into how companies work with the selection of development projects. Specifically, selection before a product concept is allocated R&D resources as seen in *Figure 24*. Even though some companies did not have the same Stage-Gate process they did have a decision before a concept goes into development.

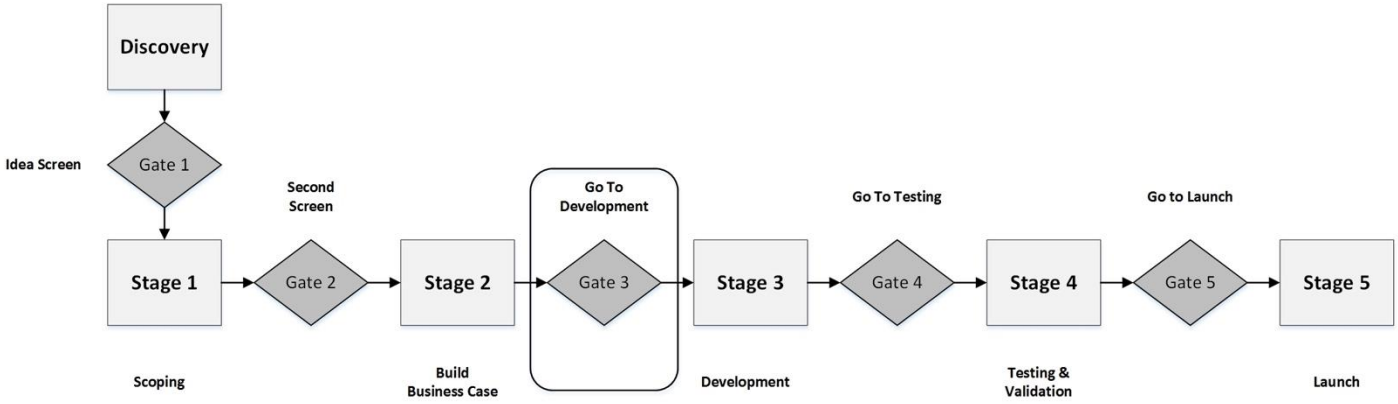

Figure 24 – Positioning of the unit of analysis

The unit of analysis is the decision point itself, including decision criteria, responsible stakeholders and relevant contextual aspects. A conceptual model of the unit of analysis is seen in *Figure 25*.

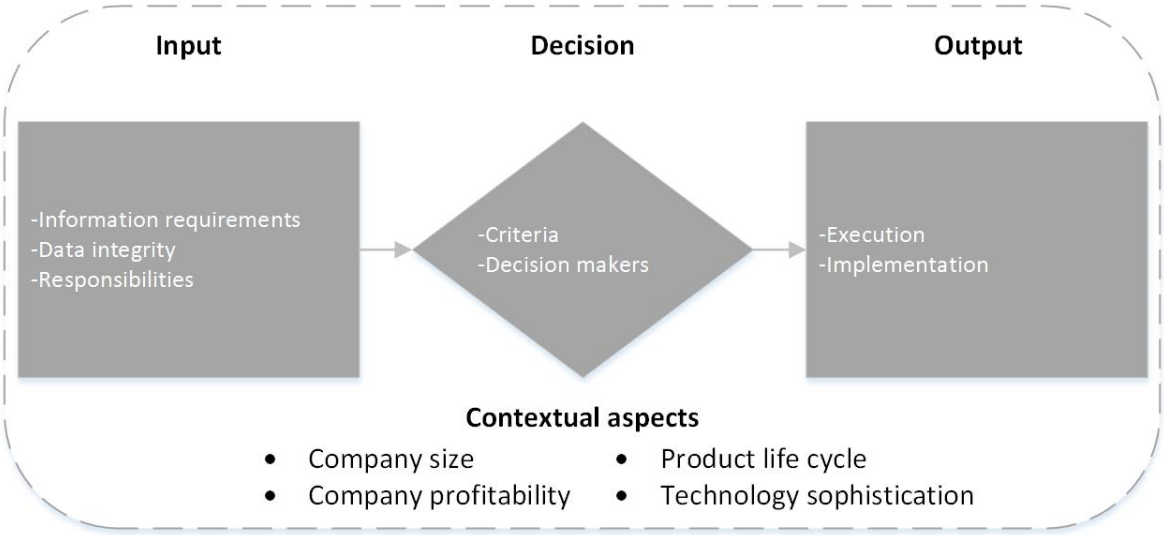

Figure 25 - Unit of analysis in new product development

3.4.2.2 Selection of Cases

The companies used in the case study were selected based on a few core criteria. Given these criteria, the authors and our supervisors at Axis contacted relevant companies.

1. *Access.* The company and relevant interviewees were interested in participating. There was data available about the companies' operations and characteristics. Also, the ambition was to have access to personnel in a senior product management role, or similar. This in order to secure high quality data when using only few respondents.
2. *Internal R&D.* The company had internal R&D and took development decisions in-house.
3. *Sells their own developed products.* In line with the internal R&D criteria, companies which were only trading products were not considered.
4. *Use decision criteria before R&D.* The companies used decision criteria to choose which products to develop. There was a point before development where the decision was made.

In addition to these core criteria, additional dimensions were considered that would serve to give a variety of companies to compare.

5. *Variation in contextual aspects.* To get a broad view, cases representing variations in the contextual aspects were used. These were discussed in the theoretical chapter and were used in the case study to explain patterns and differences between the cases. The contextual aspects were:
    - *Company size*
    - *Operating margin*
    - *Technology character*
    - *Length of product life cycle*

The companies which fulfilled core criteria are listed in *Table 6*, including interviewees and industry. To provide further credibility to the study, Axis was used as a test case. This to provide credibility to the study and ensure the quality of the data collection protocol (Yin, 2009).

Table 6 – Companies participating in the multiple case study, PM – Product Manager

Company name	**Industry**	**Interviewee(s)**	**Criteria Fulfilled**
Axis (Camera R&D)	Electronics	-Kent Fransson, PM -Andres Vigren, PM -Petra Bennermark, PM	1,2,3,4,5
Thule	Consumer Goods	Eric Norling – PM Director	1,2,3,4,5

Sony	Electronics	P-O Bergkvist – Former purchaser Sony Sara Wall-Sörensen – Former PM at Sony	1,2,3,4,5
Husqvarna	Construction and Gardening	Anna Annvik – Director PM	1,2,3,4,5
Alfa Laval	Process industry	Anna-Maja Eriksson - PM	1,2,3,4,5

The relative characteristics of the case companies are described in *Figure 26*. As seen there is a significant variation in the relevant aspects.

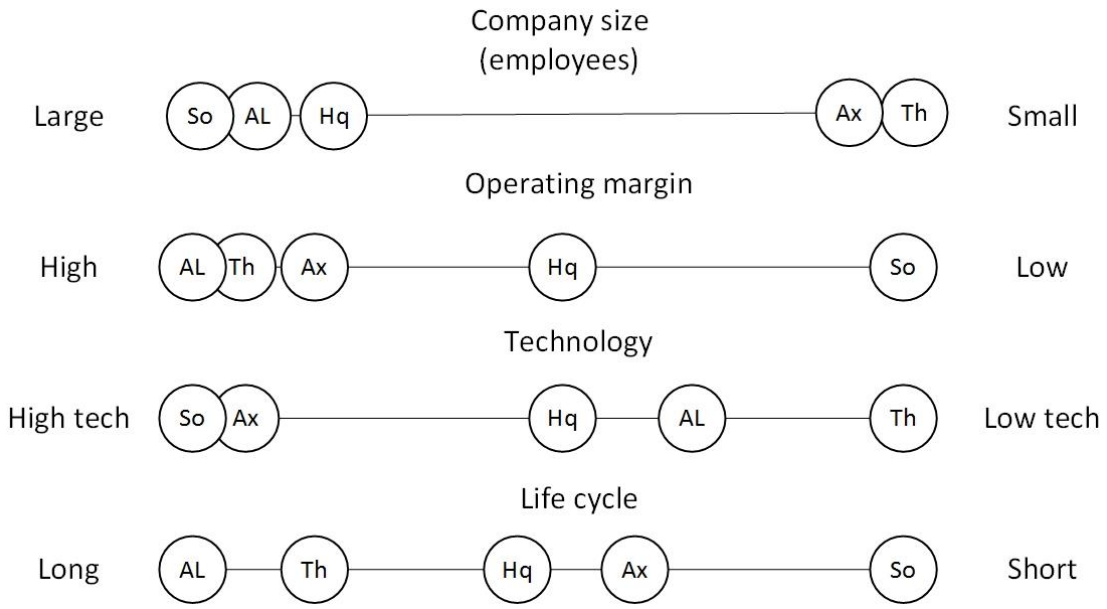

Figure 26 – Case company characteristics. Ax=Axis, AL=Alfa Laval, Hq=Husqvarna, So=Sony, Th=Thule

3.4.2.3 Design data collection protocol

Parallel to case selection, a protocol for data collection should be developed. Stuart et al. (2002) describe the protocol as a way of providing focus for the study. It can help the researcher to stay on target and keep information gathering as efficient as possible. Yin (2009) proposes the protocol should consist of:

- An overview of the case study project including objectives and theoretical framework
- Data collection plan

- Case study questions
- A guide for the case study report

A data collection protocol was developed and can be found in *Appendix I: Case study protocol.* As mentioned it was tested with Axis as one of the cases. This way it was possible to modify and improve the protocol for the ensuing cases.

3.4.2.4 Data collection

A strength of the case study is the flexibility of data collection methods. Ways of collecting data include interviews, historic data, business data and observations. Some of the strengths and weaknesses of these methods are presented in *Table 7.*

Table 7 - Strengths and weaknesses of data collection methods (Yin, 2009; Hancock & Algozzine, 2006).

Method	**Strengths**	**Weaknesses**
Interviews and focus groups	Targeted – Focus on case topic Contextual – Covers case context	Depending on interviewees' memory, biases and knowledge Questions decide answers' quality
Documentation and archival records	Exact and quantitative Can be reviewed continuously Not created for case study Broad coverage	Can be difficult to access Can reflect bias of authors or bias due to retrievability
Observations	Contextual Reality – covers events in real time Insightful into interpersonal behavior and motives	Time consuming Observation can affect behavior Broad coverage need team observers

The data collection in the case study consisted mainly of interviews, with support from public and internal documentation when available. Before each interview, external documentation was gathered to get an initial view of the case company. The interviews were held with people deemed relevant for the unit of analysis. These were often senior people within product management which ensured they had the right knowledge and experience. Due to the limited time for the thesis, it was not possible to conduct more interviews within each case. It would have been preferable but it was prioritized to have more cases with less depth than fewer cases with more depth.

Each interview was 1.5 hours. They were all conducted in person except for the interview at Husqvarna and one at Sony, which were done through Skype. A semi-structured interview protocol was used in line with Yin (2009). It allowed for comparison between cases but to still

dig deeper into interesting topics (Ellram, 1996). During the interviews we had separated tasks. One was leading the interview while the other took notes. Each interview was recorded to allow us to revisit and ensure the correct data was collected.

After each interview we reviewed the notes and summarized the interview into write-ups to make sure the right data was collected. This way, higher quality data was available for analysis later, in line with what Miles et al. (2014) recommend. When possible, we requested internal documentation from the interviewees to ensure construct validity (Yin, 2009). Once the case description had been finished, it was sent out to the interviewees for fact checking. This helped ensure reliability (Yin, 2009).

3.4.2.5 Data analysis

Yin (2009) describes analysis as the most difficult and least developed aspect of case study research. Many novice researchers gather data before they know what to use it for. Yin does not go into detail on case analysis which is why Miles, et al. (2014) was used to complement.

We used the theoretical proposition strategy recommended by Yin (2009). Time limitations made it less suitable to use rival explanation or case description strategies. The mainly qualitative nature of the collected data and the authors' inexperience also limited using the combined qualitative and quantitative strategy. The theoretical propositions guided the data analysis which is another motivation for using the theoretical proposition strategy (Yin, 2009). An alternate strategy would have been to examine rival explanations but this was deemed difficult due to our limited experience within the field.

The propositions consisted of a theoretical model based on the developed framework. This model and its components was used to create the initial coding for the multiple case study. In line with Miles, et al. (2014), coding was further refined and rearranged as the case study progressed which enabled a structured single case and cross-case analysis of the data.

As proposed by Miles, et al. (2014), it underwent the following steps during the analysis phase:

First cycle coding. The write-ups and selected documentation from each case was processed and coded using descriptive coding to structure the data. First cycle coding was done using theoretical propositions based on literature.

Second cycle coding. The coding was further systematized into pattern codes which were applied to each case. The cases were summarized using matrix displays, as seen in *Table 8*. These were inspired by conceptually clustered matrices described by Miles, et al. (2014, p. 173). This way, case data was easy to overview which enabled structured analysis and conclusions to be drawn. Theory and empirics were compared through pattern matching which helped test internal validity of the case findings (Yin, 2009).

Explanation building. Throughout this process, initial theoretical propositions were developed together with new propositions and assertions as new insights were gathered. This is in line with

the explanation building technique suggested by Yin (2009) while formalization was reached by Miles, et al.'s (2014) assertion and proposition development.

Cross-case synthesis. Finally, each case was compared in a cross-case analysis using the matrix displays. Cases were combined into a full meta-matrix to enable a systematic comparison of all cases. Thus, the "stacking comparable cases"-approach, suggested by Miles, et al (2014) was used. That is, first within-case analyses were conducted to draw conclusions from each case. Later, the cross-case analysis helped find broader patterns common between the cases.

Table 8 – Conceptually clustered matrix display used for individual case analysis

Input	Decision	Output	Contextual Aspects
Information requirement	**Criteria**	**Execution**	**Strategy, Market and Company**
Data integrity	**Decision makers**	**Implementation**	**Product & technology**
Responsibilities	**Variations**		

3.4.3 Combine and construct model

After the case study was conducted, the construction and application at Axis began. It was conducted in line with the constructive approach as described earlier by Kasanen, et al (1993), seen in *Figure 27*.

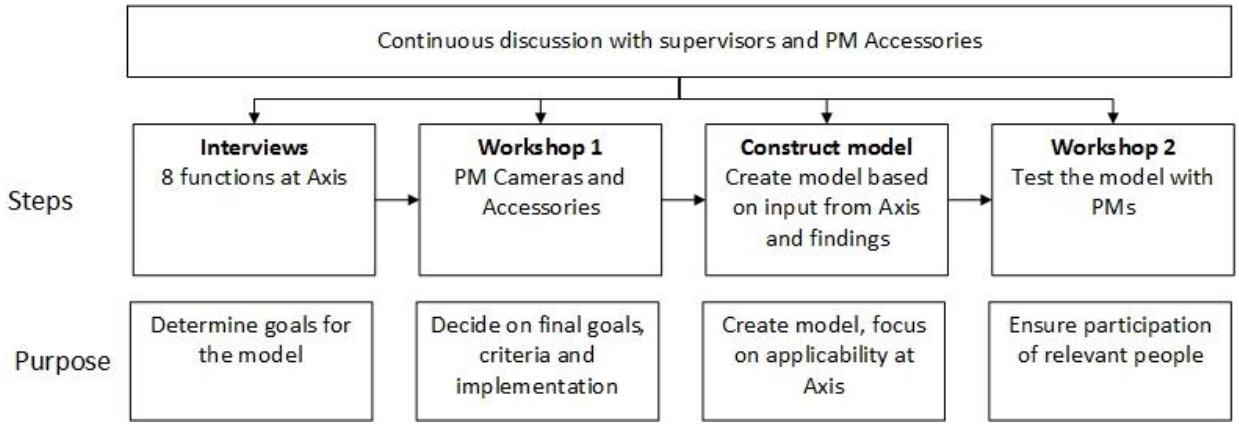

Figure 27 – Description of the steps of constructing a model at Axis

At first, interviews were held with employees at Axis to get an understanding of the problem. The interviews were held one by one for 1 hour which gave a cross-functional view of the problem and context specific factors affecting accessory decisions. The interview guide can be found in *Appendix II: Interview guide, interviews at Axis* and the interviewees in *Appendix III: Interviews conducted at Axis.* The interviews were semi-structured to allow to go in depth when

interesting topics surfaced. These interviews gathered suggestions for how the problems could be solved through more informed decision making.

Workshop 1 was then held with two important stakeholders at Axis, Product Managers for accessories and for the largest product line at Axis. The purpose was in part to validate the findings from the interviews and prioritize them. The other purpose was to understand how to design a practically functioning solution in their specific context.

After this, the model construction continued where the previous input was synthesized into what we thought would be a functioning model. It was an iterative process where we discussed the model together with our supervisor at product management to make sure it was aligned with Axis needs and possible to implement.

3.4.4 Test and validate at Axis

Validation at Axis was done through a workshop with employees suggested to use the model, described as workshop 2 in *Figure 27*. Several of the employees took part in development of the model. The primary objective of the session was to agree on implementation. A description of the workshop is found in *Appendix V: Workshop 2, test and validation at Axis.*

The tools suggested for use in decision making were presented in the form of a Power Point presentation. Motivation of the extra time it takes to use the model had to be made. Most of the model was already known to the participants as informal presentation with feedback had been held. The participants were allowed to grade each suggestion. Discussions regarding possible improvements and implementation were then held based on the feedback.

Some minor changes on the model and responsibilities for implementation were agreed on in the workshop.

3.4.5 Compare theory and examine generalizability

Kasanen et al. (1993) recommends the final construct should be applicable in other instances as well. Therefore, a discussion about the final model and its applicability was conducted towards the end. Generalizability of single propositions were conducted and discussed in the cross case analysis and general model construction.

3.5 Reliability and validity

There have been doubts whether case study can be used to gather reliable research data. The researcher must ask if stated evidence is relevant (validity) and correct (reliability) (Seuring, 2005). Yin (2009) describe how the researchers should follow a rigorous methodological path to secure credible insights. He divides the problem into construct validity, internal validity, external validity, and reliability.

3.5.1 Construct validity

Many critics of case study research are pointing to subjectivity of judgments. Stuart et al. (2002) describe the issue as the researcher's ability to choose measures that reflect the phenomena. This study has used multiple sources of evidence, developed a research protocol and drafted the report by key informants in line with what Yin (2009) suggests.

3.5.2 Internal validity

Internal validity criteria are valid for explanatory studies, when the researcher wants to determine if event x leads to event y. If the researcher has missed a factor z which has a significant effect on y, internal validity has failed (Yin, 2009). The underlying factors need to be determined through interviews (Yin, 2009). Internal validity was ensured through the use of pattern matching and explanation building, as described in chapter *3.4.2.5 Data analysis*.

3.5.3 External validity

External reliability asks whether the findings of the case study are generalizable to other contexts. Yin (2009) suggest this as a major explanation why case studies are not more widely used. He explains that findings from a case study should lead to generalizable results, suitable in similar contexts. This was one of the reasons for choosing a multiple case study.

3.5.4 Reliability

Reliability is about ensuring that evidence is correct. A new researcher should be able to do the same case study with the same results. Documentation of each step of the process must therefore be secured (Yin, 2009). This has been ensured through including our case study protocol, see *Appendix I: Case study protocol*, and keeping a case study database. In addition, information gathered in the case study interviews was fact checked by interviewees.

3.5.5 Validity & reliability as operationalized in the study

To ensure validity and reliability, measures have been taken throughout the study. The measures, together with the corresponding tactics on how they were ensured are seen in *Table 9*.

Table 9 – Validity and reliability tactics of the study

	Tactic	**Description**	**Applied in**
Construct Validity	Triangulation	Multiple sources of evidence for vital data	Data collection
	Establish chain of evidence	Plan data collection based on research questions	Data collection
	Draft report reviewed by key informants	Supervisors at Axis and LTH read report	Composition
Internal Validity	Pattern Matching	Evidence from study is compared to theoretical framework	Data analysis
	Explanation building	Create understanding by analyzing links between factors found	Data analysis
External Validity	Replication logic	Cross case analysis to motivate recommendations	Research design
Reliability	Case study protocol	Planning of case study prior to execution	Data collection
	Summary sent to interviewee	Interviewee reads and approves case description	Data collection
	Case study database	All interview notes and open sources are saved	Data collection

4 Empirical Study

The empirical study describes each company, then develops the unit of analysis specificities for the cases. The information found is used in the single case and cross case analyses chapters.

4.1 Case 1 – Axis Camera Division

Axis camera division is used as a case to gain further insight into the company and get new input into the problem at hand. This case will only look at camera projects, not accessories.

4.1.1 About Axis Communications

Axis is a Lund based company with high levels of growth and profit in the last few decades. It was recently sold to Canon but is planned to continue being a separate entity. Axis has three core values – Act as One, Think Big and Always Open. These describe the culture of the company which is characterized by openness and cooperation (Axis Communications, 2016).

4.1.2 Industry and Products

Axis develops and sells network cameras and related products. They have a high focus on R&D which has served the company well, enabling high growth and profitability.

4.1.3 Product Management at Axis

The information in this chapters based on three individual interviews with Product Managers at Axis Communications:

- Kent Fransson – Global Product Manager, Axis PTZ cameras (Fransson, 2016)
- Andres Vigren – Global Product Manager, Axis fixed box cameras (Vigren, 2016)
- Petra Bennermark – Global Product Manager, Axis fixed dome cameras (Bennermark, 2016)

They each have 8-15 years of experience in the Product Manager role at Axis.

Product management is responsible for Axis products from inception to end of life. Each Product Manager is responsible for one of eight product groups, four of which are cameras, the others are related to encoders or accessories.

4.1.4 Product Management Decision Point

The company's product development process, seen in *Figure 28*, resembles a Stage-Gate process. The interest point, matching the unit of analysis, is the start gate between startup and planning. At this meeting, the decision is made whether the project should be allowed to continue or not. However, from interviews it seemed that this decision was in reality passed earlier in the process as almost all projects pass this start gate. Therefore, the unit of analysis was found to be the roadmap meeting, held once every 6 months.

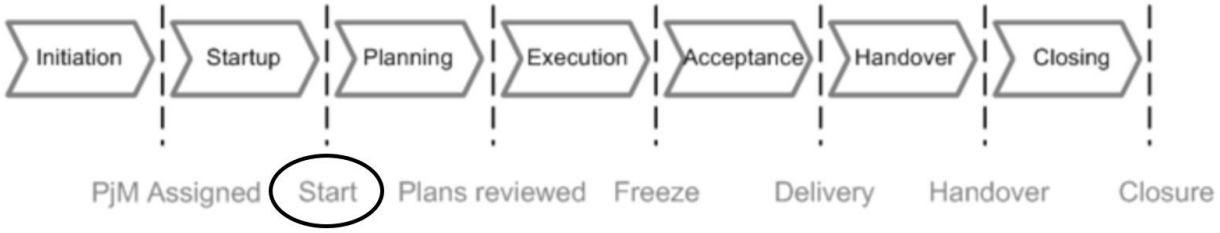

Figure 28 - Axis Product Development Process, adopted from Axis intra-net (Axis Communications, 2014)

The roadmap is updated two times per year and the process can be seen in *Figure 29*. It contains projects and products to be released within the next 36 months. The products selected for the roadmap are then initiated through the start meeting. The purpose of the roadmap is to operationalize the business plan so that it is reflected in the product portfolio. The business plan is business area specific, based on company strategy.

The criteria used in the roadmap and start meeting are basically the same which, according to the interviewees, explain why so few products are killed there. As the project has passed the criteria once already, the start gate is a confirmation point.

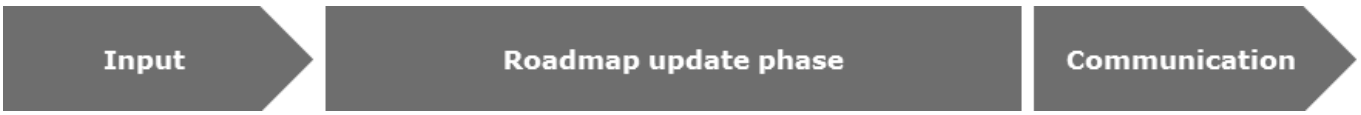

Figure 29- Roadmap process at Axis (Axis Communications, 2016)

4.1.4.1 Input

Input to the roadmap and start meeting is compiled by the Product Manager. They collect information and receive help from departments. There is a higher focus on the quantitative data for the start meeting. Normally that information is more exact and researched as well.

Market data is used to find customer needs. It is compiled by regions from opinions and observations of resellers and salesmen.

Competitor analysis is made by a department at Axis which works solely with analyzing competitors.

User proposition describes what type of customer need the project satisfies. Much focus during roadmap meetings is directed towards this aspect. There is a separate technology department working on new technologies which can be used in the user proposition.

Business case is the main focus of the start meeting. The case consists of investment, revenue and cost calculations based on previous experience from similar projects.

The business case is calculated by the Product Manager and contains estimated sales figures, project investments and the expected COGS, which includes raw material and assembly of the

product. Axis includes a flat rate percentage to cover customs, freight and warranty which is used to some extent but not in all business cases. The business case boils down to an estimated payback time.

There is no clear follow-up of decisions or input information. None of the Product Managers follow-up on estimations and their accuracy. It is motivated by the development project's small size and that most of them are profitable eventually.

The input is gathered into a shortened presentation at the roadmap meeting while the full version is presented at the start meeting for each project.

4.1.4.2 Decision

The Product Manager and Project Manager present project input, thus starting a discussion about the project. During the roadmap meeting there are representatives from many different areas of Axis:

- Operations
- Test
- Core technology – responsible for Axis product platforms
- R&D – both engineering manager and director of R&D
- Product management – Product Manager and the director of product management is present
- Project Manager
- CTO

Criteria used to evaluate the projects consist of formal and informal criteria.

Formal criteria used are payback time and project length. Payback time should be less than 6 months for a camera project. Longer payback can be accepted with further motivation. Development projects can be questioned if they are expected to be very long since the risk increases with longer projects.

Informal criteria play an important part in decision making. Strategic balance is measured in terms of different project types. They are classified as protect, expand or innovate. Protect-projects replace "old" products needing an update. Expand-projects improve current products to capture new market share. Innovate-projects are often based on new technologies for Axis. The roadmap requires balance between project types in line with company goals. Lastly, the user proposition is weighed in to give a full picture.

The roadmap decision making consists of two meetings. The initial roadmap is presented during the first meeting and receives feedback. After this, the Product Manager adjusts the roadmap based on feedback and presents the final version at the second meeting. The decision makers decide if the projects should pass or not. Most often this decision is unanimous. If there are conflicting opinions, the CTO has the final say.

4.1.4.3 Output

The main purpose and output of the roadmap meeting is a three-year plan of upcoming products, including resource need. The Product Manager is responsible for implementation together with the engineering manager.

The roadmap is updated each six months. The Product Manager must then be able to explain changes relative to the previous plan. If a project has been killed it must be motivated as the roadmap is a plan which should be implemented.

At the start meeting the possible outputs are:

- *Go* – The project is ready for development. Seen as a handshake between departments to start the project and commit resources.
- *Wait* – Something is missing. The Project Manager must add more information or make the project clearer in order for it to go through to development. It will be presented again at the next start meeting.
- *Kill* – The project is killed and no more resources are committed.

4.1.4.4 Satisfaction

The Project Managers are happy with the current process. They like having a roadmap deciding the upcoming work and resource use and a start meeting to confirm the decision. The interviewees could not find any major weaknesses but saw many positives in the process:

- *Freedom* – Axis is seen as a company with few processes which enables innovation and personal responsibility.
- *Time to market* – With fewer gates and hurdles a project can go to the market faster than a more extensive process would allow.
- *Transparency* – A clear roadmap makes it is clear to everyone what has been decided. Communication to customers and functions within the company gets better and enables feedback from them.
- *Cross functionality* – As the process involves several functions gathering information, it increases the level of integration and communication.
- *Low complexity* – It is easy for everyone involved to understand.

A future challenge mentioned by the interviewees is competing with new low cost entrants to the market. The general answer is to be more creative and innovative.

4.1.5 Contextual Aspects

Axis is a company with several years of 15-20% growth and profit margins around 10%. The organization has grown quickly which can explain the lack of standardized ways of working. Axis has a high focus on innovation and aims to be the technology leader within their industry. Some important aspects for the future are investments in new technology and innovation while increasing the presence in high growth markets and increasing organizational efficiency (Axis

Communications, 2016). Technology leadership and innovation has enabled a premium price on products. This can be an explanation for the freedom in the development process. The culture at Axis plays a part as it is characterized by openness and cross functional integration. The development process and decisions are also meant to be driven by these values.

The product life cycle in the industry is relatively short, around three years. Combined with the technology leadership strategy this increases time to market importance.

4.1.6 Summary

Axis has a focus on innovation rather than structure. *Table 10* shows how formal criteria is limited to payback and project length. Both of these have no strict limit but are rather guidelines. The Product Managers have a lot of power over the process, this because of Axis technology leadership strategy which requires rapid decision making and autonomy.

Table 10 – Summary of Axis Camera Division

<table>
<tr><th>Input</th><th>Decision</th><th>Output</th><th>Contextual Aspects</th></tr>
<tr><td>Information requirement
-Market data
-Competitor analysis
-User proposition
-Business case (includes flat rate for freight & customs costs)</td><td>Formal criteria
-Pay back (~6 months)
-Project length
Informal criteria
-Strategic balance
-User proposition</td><td>Execution
-Go/Wait/Kill</td><td>Strategy, Market and Company
-Technology leader
-Time to market critical
-High growth & profitability
-Company culture</td></tr>
<tr><td>Data integrity
-No feedback loop</td><td>Decision makers
- Heads of: Operations, Test, Core Technology, R&D, Product Management
- CTO</td><td rowspan="2">Implementation
-Resources allocated</td><td rowspan="2">Product & technology
-High Tech
-Relatively short life cycles
-High focus on R&D</td></tr>
<tr><td>Responsibilities
-Product Manager gathers data
-Other functions gather information</td><td>Variations
-Same for all projects</td></tr>
</table>

4.2 Case 2 – Sony Mobile

Sony Mobile does currently not have much activity in Lund even though it was the place of the head quarter for a long time. This case focuses on the previous operations, having interviewed with former employees to gain insights.

4.2.1 About Sony Mobile

Sony Ericsson started as a joint-venture to manufacture and sell mobile communications technology. In February 2012, Sony bought out Ericsson and integrated the company as the subsidiary Sony Mobile (Sony, 2013).

Sony Mobile has had financial difficulties for a long time and is still struggling to show a positive result. Global headquarters for Sony Mobile was earlier placed in Lund. After integration with Sony, the headquarters moved to Tokyo, leading to down-sizing in Lund.

Sony's vision is to inspire and fulfill the curiosity of its customers through innovation and technology (Sony, 2016).

4.2.2 Industry and Products

Sony Mobile develops mobile phones and mobile tablets under the name Xperia. Accessories to Sony's main products are referred to as Companion Products and had much of its development in Lund before it was moved to Tokyo. (Sony Mobile, 2016a).

Companion Products at Sony Mobile consisted of four main product groups:

- *Smartwear* – technically advanced smart watches and smart bands
- *Extensions* – enhanced experience products for mobile phones
- *Wireless* – wireless speakers and head phones
- *Fundamentals* – cables, screen protectors and other basic accessories

4.2.3 Product Management at Sony

The information in this case was based, unless otherwise stated, on interviews with former Sony employees:

- Sara Wall Sörensen – Head of Global Product Management, Companion Products (Sörensen, 2016)
- Per-Olof Bergkvist – Head of Manufacturing & Sourcing, Companion Products (Bergkvist, 2016)

Both have over 14 years of experience at Sony/Sony Ericsson within different roles before moving on to new roles at other companies. They worked at Sony until 6 months ago which was considered recent enough to obtain quality information. Since their most recent positions have been within Companion Products, that is where the focus will be for this case.

4.2.4 Product Management Decision Point

Sony Mobile developed its four product categories with combinations of in-house and outsourced development. Smartwear used mostly in-house development due to the technical complexity of the product. Fundamentals were often contracted out to partners for both development and manufacturing. Extensions and Wireless used combinations of these two. All development projects went through the same decision making process however.

The decision making process for Companion Products had a toll gate called *toll gate define*, the last one before projects received R&D resources. Before reaching this gate, projects were approved at a monthly portfolio meeting where the portfolio as a whole was examined and product proposals were evaluated. Approved proposals underwent further information gathering before reaching *toll gate define*. This tollgate is the one matching our unit of analysis, seen in *Figure 30*.

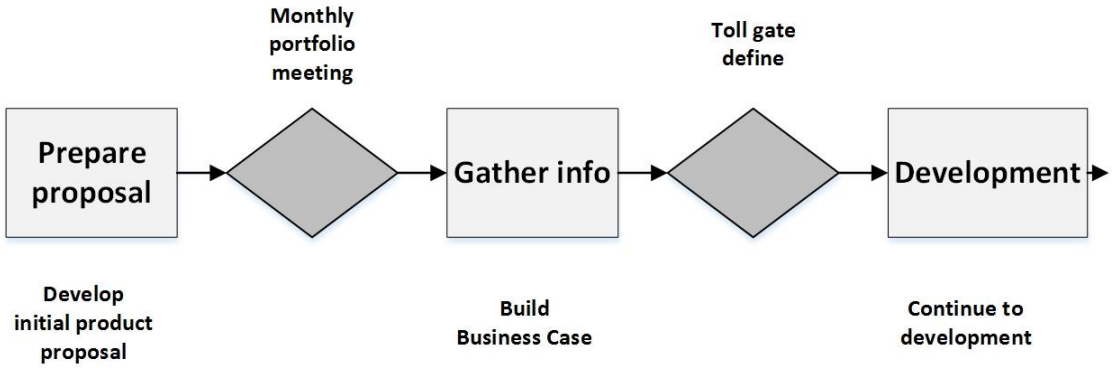

Figure 30 – Process description at Sony mobile

4.2.4.1 Input

The input to this tollgate consisted of:

User proposition and positioning described the user need and how it would be fulfilled by this product. It also described positioning relative to competition and current product portfolio. Examples of information provided to position products were price, sales channels, promotion and product characteristics.

Business case was a detailed calculation of product financials. On a product level it contained estimated price and direct costs/COGS. On project level it contained costs for investments and development resources. An estimated sales figure was calculated based on market data. This data was used to calculate gross margin of the product and return on investment (ROI). The business case used a flat rate for overhead costs to estimate the life cycle cost of the product. These included costs for freight, customs, logistics, warranty and royalties.

The business case had two versions. A base case with the most realistic assumptions and a more uncertain stretch case which required new sales channels or additional marketing.

Technical specification described technical requirements like battery life, weight or size, and technology performance requirements like screen resolution. These had to match the user proposition.

Development & manufacturing partners contained a presentation of manufacturing and development partners required to realize the product.

Product management and product planning were responsible for providing user proposition, business case and technical specification. The project, mainly manufacturing & sourcing, provided estimated COGS and description of partners.

The company used independent reports to complement in-house estimates of market size and sales. After the product launch, figures and learning points were discussed in a separate tollgate. The feedback was used to improve estimates and the process for future projects.

4.2.4.2 Decision

At the decision meeting a number of functions were involved. The person with profit-and-loss (P&L) responsibility for the project always had the final say in decision making. The decision makers present at the meeting were:

- *Decision owner* – P&L responsible. Often a business unit manager
- *Head of Product Management* – Present but not a decision maker
- *Head of Product Planning*
- *Head of Development*
- *Head of Sourcing*
- *Head of Supply*
- *Head of Customer Service*
- *Head of Business Control*

The decisions were made in the same way regardless if the project required internal or external development. An important discussion at the meeting was how realistic technology and costs were. If adjustments had to be made, the value proposition could change. Thus leading to further adjustment of other aspects.

The most important criteria which decided the project's future was product margins and positioning. The business case provided product margins, taking the entire product life time into consideration for a holistic picture.

The positioning aspect of the decision was a vital part of company strategy. Products need to complement each other to form a complete portfolio. The short product life cycles of the industry required a high replacement rate to keep up with customer demand. Product Managers had the responsibility to provide this positioning information to the meeting.

Information regarding margins and positioning was discussed and the final decision was made. The aspects did not have a set weighting but varied between projects. It varied based on project

specific aspects and the decision makers' previous experience from similar situations. There were target margin requirements for each category but they could be overruled by strategic aspects.

4.2.4.3 Output

There were two possible decisions in the meeting:

Pass – the project went to development, an order and product specification went to R&D. The project leader, appointed before, received resources to drive the project forward. To follow-up on the progress of the project, 4-5 tollgate meetings were held before the project was over. Criteria in these meetings were the same but with updated information.

No Pass – the project was not good enough at the moment. In some instances, the project and idea was killed off entirely and the Project Manager got another assignment. However, most common was that it came back in a different shape and later on.

4.2.4.4 Satisfaction

Positive aspects brought up in the interviews about the process were:

- Very clear and structured
- A learning process which developed as flaws were found
- A good way to involve executives into product development decisions
- Good at removing bad projects early on as they were challenged

There were also improvement points brought up where the process was not optimal. For example, many Companion Products had overestimated sales if new sales channels needed to be introduced. There were also doubts regarding the necessity of full cost analysis as it was very time consuming with limited accuracy. One important improvement area was that the tollgate structure, while clear and structured, was not always followed. Some projects were prioritized differently and would receive a less rigorous treatment than others. There were often problems with these products which is why it was later changed.

4.2.5 Contextual Aspects

The strategy of Sony was previously focused on innovation. Recently however, profitability has received higher priority through a restructuring program for 2014-2018 (Sony, 2015). Sony Mobile's strategy has been to focus on volatility management through securing profits and limiting capital investments (Sony, 2015). It has shown results and the division has reduced its losses from -14% (2014) to -5% (2015) while experiencing sales losses of 15% (Sony, 2016). The market is one of intense competition in terms of cost and commoditization which has been hard on Sony Mobile (Sony, 2015).

R&D spend within Sony Mobile is classified but Sony as a whole spent 6% of total revenue on R&D 2014 (Bloomberg, 2014). Smart wear products were considered strategically important for

Sony as a whole and therefore received high priority and focus from the parent company in Japan.

In recent years the mobile phone market has experienced shorter life cycles for its products. A phone and its accessories can be sold for around 9 months before a new model needs to be released to the market. Development of a new product took around a year and related Companion Products needed to be synchronized with that time frame.

4.2.6 Summary

Sony use a strict process with high cost focus. The company is ambitious in their information gathering and employ senior decision makers, as seen in *Table 11*. Industry aspects like intense competition and short life cycles puts high pressure on the company's processes. Sony handles this pressure by using a strict business case and follow-up after product release.

Table 11 – Summary of Sony Mobile

<table>
<tr><th>Input</th><th>Decision</th><th>Output</th><th>Contextual Aspects</th></tr>
<tr><td>Information requirement
-User proposition & positioning
-Business case (including logistics & lifecycle costs)
-Technical specification
-Partner specification</td><td>Formal criteria
-Product margin
-Product positioning
-Technical assumptions</td><td rowspan="2">Execution
-Pass/No Pass</td><td rowspan="3">Strategy, Market and Company
-Profitability focus
-Intense competition</td></tr>
<tr><td>Data integrity
-Feedback loop 6-12 months after launch
-Independent market reports</td><td>Decision makers
-Director business unit
-Heads of Product Management, Product Planning, R&D, Sourcing, Supply, Customer Service, Business Control</td></tr>
<tr><td>Responsibilities
-Product Manager gathers data
-Other functions supply information</td><td>Variations
-Small projects used simplified version</td><td>Implementation
-Resources allocated or withdrawn
-Steer group takes over</td><td>Product & technology
-Short life cycle
-Strategic importance of Companion Products
-High focus on R&D</td></tr>
</table>

4.3 Case 3 – Alfa Laval

The case at Alfa Laval is focusing on R&D in Lund. The interview is with an employee within heat transfer, resulting in a higher focus within that area.

4.3.1 About Alfa Laval

Alfa Laval is a Swedish company founded in 1883. It is listed on the Stockholm stock exchange and its largest owner is Tetra Laval with 26% of votes (Alfa Laval, 2015).

4.3.2 Industry and Products

Alfa Laval is divided into the three segments of heat transfer, fluid handling and separation. It is one of the largest companies in each of the segments with 30, 30 and 10 percent world market shares respectively.

4.3.3 Product Development at Alfa Laval

Information in this chapter is based on open sources when cited and otherwise from an interview with:

- Anna-Maja Eriksson –Product Manager for small and medium GPHE (Gasketed Plate Heat Exchangers).

Anna-Maja has worked at several positions during her 14 years at Alfa Laval. She has been at her current position for the last 9 months having previously worked as a Project Manager for 9 years.

4.3.4 Product Development Decision Point

Alfa Laval has two kinds of development projects. First, New Product Development (NPD), development of an entirely new product. Second, Existing Product Development (EPD), expanding or further developing an existing product. NPD projects are normally longer and more complex but the decisions process is the same for both types.

The process' most important gate before product development is a business plan, updated every six months. This is done at a product board meeting, gate 2 in Figure 31. In this forum it is decided whether a development project receives resources. As this gate only occurs every six months, some projects start the next stage before being approved.

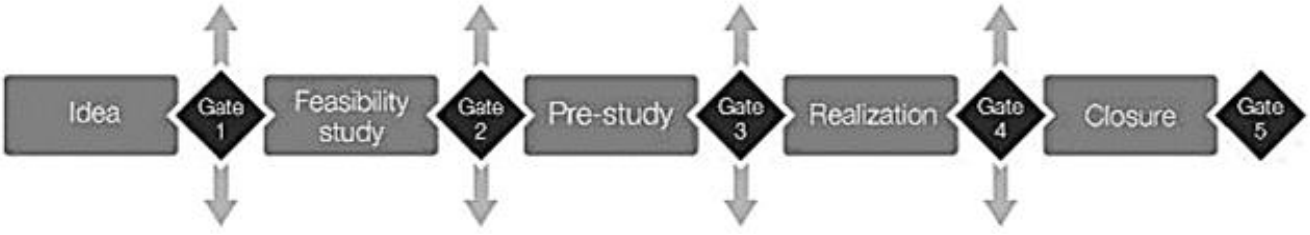

Figure 31 – Alfa Laval's development process

4.3.4.1 Input

Product management has the responsibility for input to the product board meeting. Product Managers collect information and the business unit's product management director present the material.

Business case in form of the Cost-Benefit-Analysis (CBA) is the foundation of decision making. The format is formalized and the same for every project. Input data on the cost side of this model includes COGS, investment, project cost, contingencies and cannibalization on other products. The revenue side consists of predicted sales volume, price of the product, after sales revenue and potential up sales of other products. The data is collected using similar products, input from functions and previous experiences.

Project specification includes all products and accessories in the project.

User proposition explains what value the product creates for customers. It is formulated by the Product Manager and is the product vision. If there are questions on a technical level, information is collected from relevant functions.

Technology forum suggest technological advances for the future. They do not have the power to bring suggestions into real development projects. Product Managers use these as a foundations for proposed projects.

The data is presented using an excel template for the CBA which is the same for all projects. In addition to the CBA, a presentation is made which takes strategic factors into account in the form of strategic fit and strategic technology factors.

To improve assumptions, the process itself and data integrity, projects are evaluated at a meeting after product launch. The purpose of the evaluation is to identify learning opportunities for future projects.

4.3.4.2 Decision

The decision makers involved in product board meetings are of high seniority within the company. There are normally 4-5 people from the company's directorate and the business unit manager. The director of product management presents the proposed projects.

In the decision making the company use a number of criteria:

- *Time to million* – time for the project to make 1 M EUR
- *Time to two-times-investment* – how long it takes to make two times the investment. This metric is used mostly on small projects
- *Net cash flow* – essentially an analysis of the project's NPV
- *Strategic aspects* – an informal criteria evaluated by the decision makers

The outcome of financial criteria is simulated in terms of uncertainty. Sales volume is altered to look at the risk involved in the project's assumptions. Most attention among the decision makers

is often put on financial criteria. The seniority of the decision makers ensures that strategic aspects are considered for a more balanced project evaluation.

4.3.4.3 Output

The output from product board meetings is a product development plan for the upcoming 3-5 years. Possible outcomes of the meeting for a single project are:

- *Go* – The project gets a spot in the plan and resources to start the project, including a Project Manager to drive the project forward.
- *Kill* – The project is killed and receives no further resources.

Most projects go through the gate with a Go-decision as the Product Managers have a good understanding of what is expected from a project.

When a project receives resources and starts it is evaluated by a project board. It is responsible for keeping projects on time and making decisions regarding sales start and project end. The Product Manager is the project owner and the board is the same for all of a Product Manager's projects. It consists of representatives from the functions:

- Operations
- R&D
- Sourcing
- Marketing and sales

4.3.4.4 Satisfaction

An important purpose of the process is to bring up the product decisions on a directorate level as R&D is considered of high strategic importance. The six month check points are keeping up the tempo of the organization as all managers will have to present progress for their part of the organization.

The interviewee believes the process is structured and works well. Everyone knows what should be included in new product proposals. A potentially negative aspect of the structured process and focus on financial aspects is the difficulty to take on risky projects with potentially high rewards. The current process favors safe projects which might affect innovative, new technologies. An additional problem is that the weighting of criteria is not entirely clear to the Product Managers as decisions are made on a higher level.

4.3.5 Contextual Aspects

Alfa Laval has been a profitable business for a long time, having had an operating margin between 15-20% during the last five years while keeping up an average growth of 10%. The long term goal of the organization is to grow by 8% which is to be accomplished by a combination of organic growth and acquisitions. (Alfa Laval, 2015)

The company strategy is to keep focusing on its three key technologies. Some attributes identified as key drivers of customer value are energy efficiency and quality. R&D and acquisitions are mentioned as the important tools to increase that value, adding new product lines and complementing existing lines. (Alfa Laval, 2015)

To reach profitability goals Alfa Laval have identified three strategic focus areas (Alfa Laval, 2015).

- Decisions regarding make or buy are reviewed continuously to maintain an optimal production set up.
- Central stocks of inventory are kept to lower tied-up capital.
- A limit to the scope of customer offering, no solutions outside of a process line are delivered to ensure profitability and limit risk.

The company has a high level of investment in R&D compared to the competition in the industry, approximately 2,5% of revenue. The company sees this as a way of ensuring a market leading position. It aims to have the newest, most efficient products in the industry. The R&D organization is divided along the industry segments as there is a great difference between the technologies (Alfa Laval, 2016a).

Alfa Laval sells industrial products with a long life cycle. Most contracts for large systems include a pledge to sell spare parts for up to 60 years. The company therefore undertakes long term costs every time they introduce a new product with new spare parts.

Most products sold by the company are available for more than 10 years before end-of-life. An average development project span over one year. If the project is a new iteration of an existing product it usually goes faster.

4.3.6 Summary

Alfa Laval has a very structured process in general. It has inclusion of senior personnel in the decision making as seen in Table 12. The company uses an input template which standardizes the information requirement. In addition, it employs strict go/kill decisions to further structure the process.

Table 12 – Summary of Alfa Laval

<table>
<tr><th>Input</th><th>Decision</th><th>Output</th><th>Contextual Aspects</th></tr>
<tr><td>Information requirement
-Business case (CBA)
-Project specification
-User proposition
-Technology forum</td><td>Formal criteria
-Financial performance
-Project risk
-Strategic aspects</td><td>Execution
-Go/Kill</td><td>Strategy, Market and Company
-Profitability & R&D focus
-Mature market
-High growth & high profitability</td></tr>
<tr><td>Data integrity
-Feedback loop 6-12 months after launch
-Sensitivity analysis</td><td>Decision makers
-Director business unit
-Members of the directorate</td><td>Implementation
-Resources allocated or withdrawn
-Steer group takes over</td><td>Product
-Long life cycles
-Mature technology</td></tr>
<tr><td>Responsibilities
-Product Manager gathers data
-Other functions supply information</td><td>Variations
-All use same version</td><td></td><td></td></tr>
</table>

4.4 Case 4 – Husqvarna Group

The case at Husqvarna Group is focusing on the biggest company within the group, Husqvarna. The interviewees position within handheld electric products mean that is where much focus is put.

4.4.1 About Husqvarna Group

Husqvarna Group is a Swedish company founded in 1689. The company's largest owners are both investment firms, Investor with 32,7% of votes and Lundbergs AB with 24,9%.

4.4.2 Industry and Products

Husqvarna group is a market leader in Europe within gardening and watering products. It is a world leader within diamond tools and cutting equipment for the construction and stone industries. (Husqvarna Group, 2016a). The group consist of several brands, divided into Husqvarna, Gardena, Construction and Consumer brands (Husqvarna Group, 2016b).

4.4.3 Product Development at Husqvarna Group

Information in this chapter is based on open sources when cited and otherwise information from an interview with:

- Anna Annvik – Director Product Management, Handheld Electric at Husqvarna (Annvik, 2016)

Anna has worked as a director of global product management (DPM) within Husqvarna group for nine years with previous consulting experience at Accenture. She is responsible for handheld electric which contains all handheld electric gardening. Product Managers within this product line report to her.

4.4.4 Product Development Decision Point

The Husqvarna division use a process where two gates are of interest for decision making ahead of NPD, described in *Figure 32*. Projects with a budget over 2 M SEK are subject to the process. Smaller projects can be brought directly to R&D by DPMs.

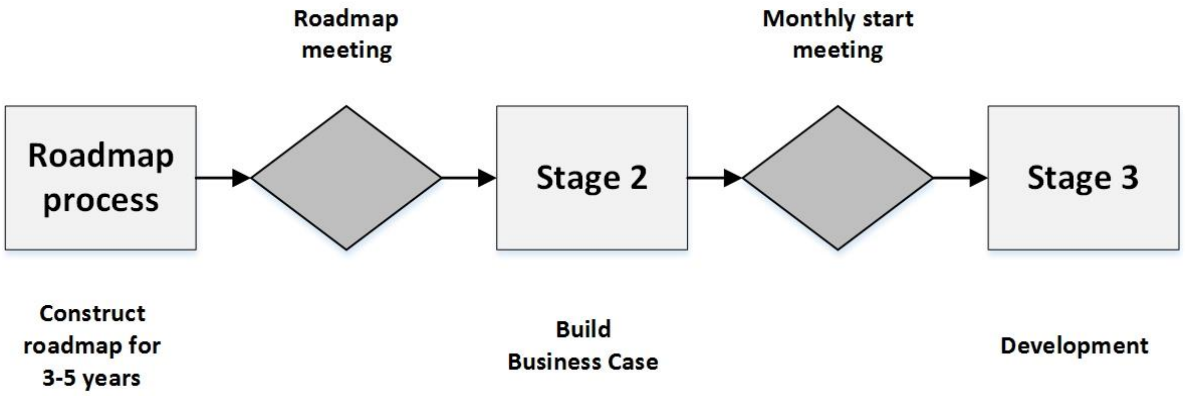

Figure 32 – Husqvarna decision points

At the roadmap process, held two times per year, each DPM presents their roadmap for the coming 3-5 years. The second gate consists of monthly meetings within the division. Projects closest in time are presented more in detail for a committee that decides if the project will be funded or not. These meetings are focusing on financial aspects and how to prioritize among projects. Since both of these decisions combined decide if the project should receive development resources, both will be studied in the case.

4.4.4.1 Input

A diverse set of sources are used as input to the roadmap, focusing on qualitative data. At monthly gate meetings, the input data is similar but with more quantitative data. Product Managers are collecting the data with help from other functions.

Internal market data provides insights on customer behavior and what new needs should be satisfied. It includes competitor analysis and what types of products they bring to the market. The data is collected continuously through Product Managers' contacts with resellers and end customers.

External market data, bought from external sources, complements internal data and customer contacts for a better picture. It includes segments, competition and trends.

Internal predictions are made by Product Managers to predict resellers' and end customers' needs will be long-term. It is based on the experience and competence of Product Managers.

Strategic push can come from an executive level regarding specific technologies or segments deemed strategically important to the company. The Product Managers must try to add products that are in line with the push.

Strategic aspects are assessed by the Product Manager. These matrices, described in Figure 33, are describing areas used in the decision making.

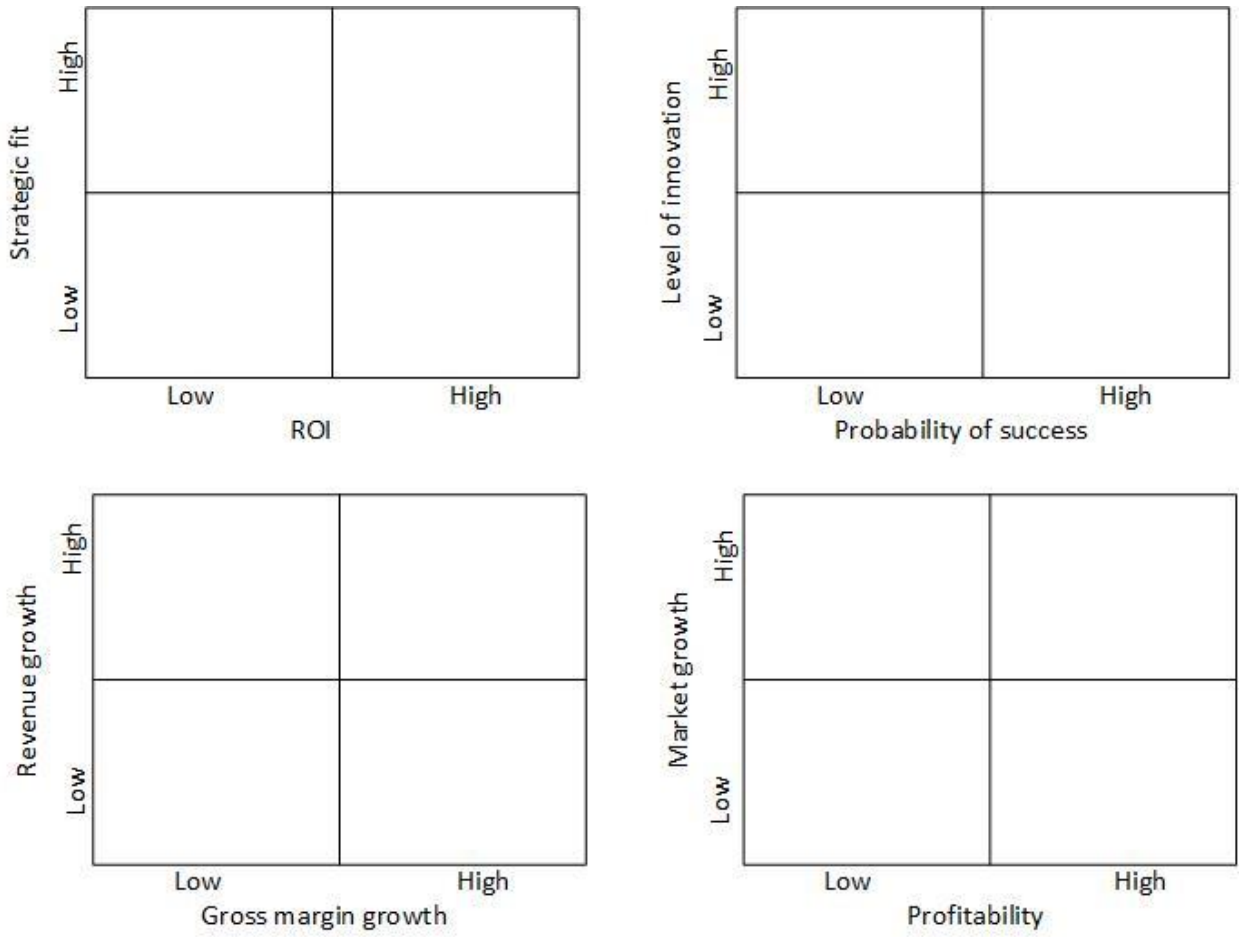

Figure 33 – Strategic matrices used as decision input

The DPM generally has a basket of projects which are candidates for development. The roadmap is constructed from current projects and 5-10 new projects deemed to deserve priority and fit within the R&D capacity available.

The gate meeting has a strict power point template for information collection. The purpose of this formality is to ensure comparability of projects and a fair judgment.

Husqvarna have a follow-up 6-12 months after product launch. The purpose is to improve data integrity and ensure continuous process improvement.

4.4.4.2 Decision

As the handheld electrical products is an immature market with growth potential, there is more emphasis on market growth potential in the roadmap decision making. There is no business case made ahead of the roadmap meeting. Instead, the focus is put on high level business potential. Some factors given focus based on the Product Manager's strategic assessments are:

- *Strategic potential* – the project's overall strategic fit and return on investment
- *Innovation potential* – the project's level of innovation and probability of success

- *Product potential* – the product's future revenue and profitability growth
- *Market potential* – the market's expected growth and profitability

These factors are described at a general level at the roadmap meeting and then in more detail in the business case. Each area is visualized in matrices which describe the project potential for each aspect to enable project overview, see *Figure 33*.

The DPMs are responsible for collecting information to the roadmap meetings. They are presenting their proposed new products and a decision is made. Participants in the meetings are:

- DPMs at various business areas
- Controller to keep track of budget
- Head of DPMs who has final say in decisions
- Representatives from
    - Brand & marketing
    - Sales
    - Sourcing
    - Manufacturing

Decision making is made in one meeting where the initial roadmap can be modified. The goal is to have a final roadmap when the meeting is done.

As the products in the roadmap are going into R&D they are subject to the monthly meeting which screens all development projects. The people responsible for that gate are in the directorate of the company division and thus on a higher hierarchical level than decision makers at the roadmap meeting. At these meetings, the head of DPMs are responsible for presenting the business case for their development projects.

At monthly gate meetings, where priorities are set among the division's roadmaps, focus is put on the formal business case. The criteria with top priority in these meetings are:

- Pay-back time
- Total project cost

These criteria are focused on the entire portfolio and projects are chosen to reach a good total value for the company. Qualitative factors described above are given different weight depending on the characteristics of the product line. For young product lines such as handheld electric, innovation, product and market potential receives a greater focus than in other more mature product lines.

4.4.4.3 Output

The output from the roadmap meeting is a roadmap including the products to be developed in the upcoming years. It includes loose specifications on the product itself, the target market and time plan. Projects usually go through the roadmap process without large changes as the DPMs have a feel for preferred projects. Sometimes a project gets a no at that meeting. In those cases the

project is put on hold. The same project can be brought up in later roadmaps if additional information is found or the market situation has changed.

When a roadmap has been set, projects receive a number and manager. Preparations for the project are made, including a specification and business case for the monthly meeting.

The most common outcome of the monthly meeting is a go decision, where the project continues as planned. If that is not the case, usually because of a lack of resources, some projects will have to be delayed. It is rare that projects are killed off entirely at this gate.

4.4.4.4 Satisfaction

A positive aspect of the current process is the clarity of what information is required. It is also clearly defined who the decision makers are. The interviewee believes the main purpose of the process is to give the division's directorate better insight and operational power over future products.

The interviewee mentions some problems. She believes it can be difficult for the decision makers at the monthly meetings to make decisions as they do not have insight into product roadmaps. The high number of projects going into that meeting has the effect that financial factors gets the most weight, which is not always optimal.

4.4.5 Contextual Aspects

Husqvarna Group has experienced an average of 2% growth in the last ten years. Operating margins has been around 5% in the last years and the biggest focus of the company's 2020 strategy is to increase these. It is done by focusing the company's product mix to the most attractive segments. At the same time they try to keep the cost of goods sold down. The strategy mentions how important it is for the company to be a product and technology leader. (Husqvarna Group, 2016c)

Generally, there is a high variety products offered by Husqvarna Group as it operates in various industries with several brands. A common theme in most of the company's industries is the high seasonality, which provides challenges to the company (Husqvarna Group, 2016a).

Husqvarna is structured into the four different segments Husqvarna, Gardena, Construction and Consumer brands. Each segment has its own organization and product development. There is a group CTO with the task to organize a more efficient global R&D capacity spanning all brands (Husqvarna Group, 2016c; Husqvarna Group, 2016d). Total spend on R&D within the company is currently around 3% of turnover (Husqvarna Group, 2015).

Husqvarna, and the handheld electrical devices in particular, has a life cycle of around seven years. It is a relatively new segment of products which started selling five years ago. They are currently starting work on the second generation. The development projects usually span over two years.

4.4.6 Summary

Husqvarna is operating in several industries and markets with different characteristics. The company use a relatively formal process. To handle the differences between decisions they utilize strategic criteria with flexible weighting.

Table 13 describes how the company works with these decisions. Ambitious data gathering and senior decision makers to ensure informed decisions are made.

Table 13 – Summary of Husqvarna

Input	Decision	Output	Contextual Aspects
Information requirement -Internal & External market data -Internal predictions -Strategic push -Strategic aspects	**Criteria** -Strategic / Innovation / Product / Market potential -Payback time -Total project cost	**Execution** Roadmap meeting -Go/kill/hold Monthly meeting -Go/hold	**Strategy, Market and Company** -Profitability & R&D focus -Seasonal market
Data integrity -Feedback loop 6-12 months after release -External data to complement	**Decision makers** Roadmap meeting -Head of DPM -DPM of all business areas -Controller -Representatives from Marketing, Sales, Sourcing & Manufacturing Monthly meeting -Directorate of company division	**Implementation** -Resources allocated or project is paused	**Product** -Medium life cycle -Electric a young segment
Responsibilities -Product Manager gathers data -Other functions supply information	**Variations** -Projects over 2M SEK go through process		

4.5 Case 5 – Thule Group

The case at Thule Group is not focused on a particular part of the company. The smaller size of the company and the seniority of the interviewee enable a holistic view of the company.

4.5.1 About Thule Group

Thule Group is a Swedish company founded in 1942. The company turnover is 5,3 billion SEK and it is traded on the Stockholm stock exchange after going through an IPO in 2014. The company currently has no owner with more than 10% of the votes.

4.5.2 Industry and Products

Thule Group consists of several brands where Thule stands for 65% of total sales. The company focuses on premium products for an active lifestyle. (Thule Group, 2015)

The company consists of two business areas, divided into business units (Thule Group, 2016a):

- Outdoor & Bags includes:
    - Sports and Cargo Carriers (60% of sales) – The largest business unit, includes car roof mounts and other carriers
    - Bags for Electric Devices (15% of sales) – Bags for cameras, tablets and other electric devices
    - Other Outdoor and Bags (16% of sales) – Some examples of products are hiking bags and strollers
- Specialty (9% of sales) – Includes work gear, mainly tool boxes and work wear

The largest markets for the company are Europe and America, standing for 54% and 38% respectively (Thule Group, 2015).

4.5.3 Product Development at Thule Group

The information gathered for this case was obtained, unless otherwise cited, from an interview with:

- Eric Norling – Director Product Management Outdoor & Bags Europe and Rest of World (Norling, 2016).

Eric has been working at Thule Group for four years and has previous experience from Procter & Gamble and PepsiCo. He started as a Product Manager for the business unit Sports & Cargo and is now responsible for the overall business area, having Product Managers for the other business units reporting to him.

Thule Group relies heavily on their products for success and the company puts an undisclosed but considerable amount of resources into R&D. It has become especially apparent since 2014 as focus and brand recognition is a bigger part of company strategy.

4.5.4 Product Development Decision Point

Thule Group employs a Stage-Gate process called Thule Process System for their product development, seen in *Figure 34*.

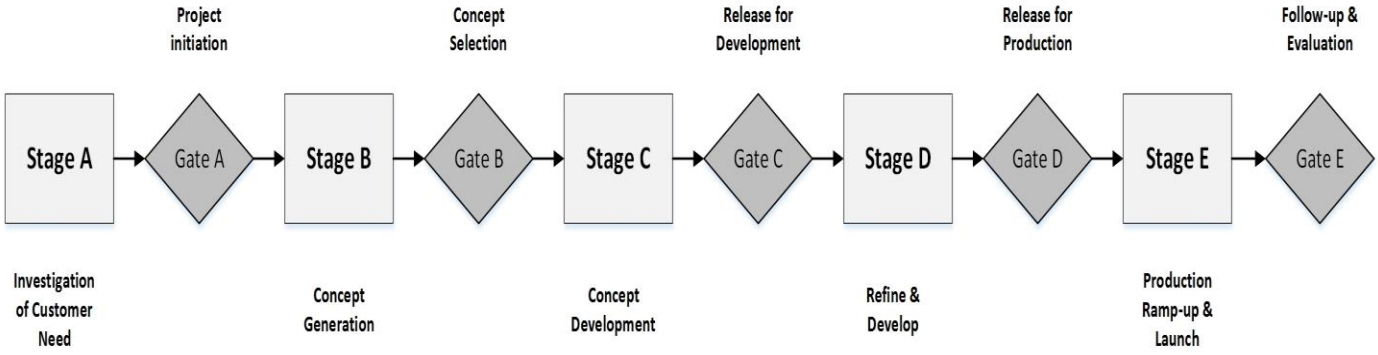

Figure 34 – Thule Process System, product development process at Thule Group.

Thule continuously tests and develops products throughout the process as product quality is critical for the brand. There is no clear distinction when a product goes into development as internal resources are involved throughout the process. The project is evaluated using the same criteria at each gate but estimation quality is expected to be higher later on in the project.

At gate C the decision is made if external investments should be made in tooling and external development. That it is best match to the unit of analysis. However, according to the interviewee, gate B is the point where more projects are questioned and killed. As the gates are so similar they are both studied in the case.

4.5.4.1 Input

The input to the gates consists of several parts:

Market & user input consists of impressions from customer interactions and industry specific exhibitions, where Product Managers participate. It is used to assess market trends and customer needs to motivate the business case. The market input is not available from third parties which is a difference compared to other consumer goods industries.

Business case consists of estimated sales volumes, product sales price and COGS which is used to calculate gross margins for the product. In COGS, a detailed calculation is made including direct material, labor and material overhead to account for scrap, freight and handling costs. The business case also considers the overall project cost in terms of tooling and development resources needed. Finally, the market potential is evaluated in terms of expected growth. Sales and cost estimates are used to perform an NPV-analysis of the project to determine financial attractiveness.

Project schedule consists of the estimated time line for the project which includes different tooling, certification and development resources needed.

Project risk tries to capture risks which affect the attractiveness of the project. These can be related to a delayed product launch or uncertain estimations. A number of scenarios where price and volume change illustrate the estimations' impact on profitability.

Technical specification captures the customer need and converts it to a technical specification. It includes size, weight and load requirements of the product. It also considers blue prints, prototypes and supporting material for products in the project.

The Project Manager is responsible for gathering input and gets help from functions in finding data. Decision makers questioning data at all gates help ensure data integrity. Gate E is a follow-up and evaluation meeting which takes place a year after product launch. The initial input at gate B is compared to the actual results showing estimation accuracy and helps create feedback for future projects.

4.5.4.2 Decision

Thule Group uses a number of criteria for evaluation before and during decision meetings.

Technical solution & product quality evaluates the product on quality of its technical aspects and how well it solves customer needs. Technical aspects receive special attention to maintain product quality, both at gates B and C. Feasibility of the technical solution is judged through estimated costs using the current design for example. Environmental performance is evaluated in that the engineers must show they have considered eco-design and environmental footprint.

Financial attractiveness is determined through the business case and reliability of the estimations. Top line revenue growth and gross margins are in focus. Projects with lower than target gross margins can be accepted under special circumstances. These can be strategic aspects such as covering up for lost sales or completing the product portfolio.

Project schedule & cost examines how realistic the schedule is and how critical the milestones are for project success. The project cost considers investments in tooling, development as well as resources available.

The criteria weight is not set but financial attractiveness and project schedule & cost have high priority, especially at gate C. At gate B, the technical solution is prioritized as it decides the product concept. Strategic aspects of the project are not evaluated by criteria but is judged by the decision makers.

Decision meetings are scheduled at set times every second week. Projects that have reached a gate book a presentation slot. Material is sent out two days before to make the decision meeting efficient and enable decision makers to send questions ahead of the meeting. Decision makers are the business area management team:

- Business area president – CEO of Thule Group
- SVP Finance – CFO of Thule Group
- Director Product Management

- VP Sales
- VP Marketing
- VP Product Development
- VP Supply Chain
- Director Operations
- Director Sustainability

Each participant cast a vote to pass or not to pass the project with the CEO having the final say. Projects reaching these gate meetings are often approved as they have been questioned ahead of the meeting. If severe problems are found they are held back before the meeting. Less critical questions related to the pre-read are dealt with during the meeting.

4.5.4.3 Output

The output from the gate can be of two types:

Go - the project is allowed to proceed to the next stage and the required resources are approved.

Go with restriction - additional information is needed which means the project has to revisit the gate or work to eliminate uncertainties before proceeding with the project. This decision can mean criteria have been fulfilled and the project is approved but the budget situation requires a project pause. If timing is not critical, the product can be postponed at a low cost.

Projects are rarely killed at the gate meeting but instead in between. Most common is that information has surfaced that severely affects the business case or other input variables. This relies upon senior directors being informed of projects' status continually.

4.5.4.4 Satisfaction

Overall, the interviewee is satisfied with the decision making process. Its success lies in sufficient structure to support decision making while not limiting efficiency through excessive formality. Scheduled gate meetings and senior decision makers ensure information spread throughout the company through executives, which is positive.

4.5.5 Contextual Aspects

Thule Group has had a strong development recently after some turbulent years. In its recent report it had a growth of 17% and an operating margin of 16%.

Thule Group has R&D and production internally, facilitated over nine different production plants. The company sees itself as a premium brand and uses product development to strengthen that position. Product development is always attractive as long as it is within the company's competence and strategic direction to provide *"branded consumer goods that enable active lives"* (Thule Group, 2016b).

The product life cycle varies a lot between business areas. Normally it is 4-5 years while some rare cases can be as high as 15. Development projects are typically 18-24 months but can be shortened to 12 months for smaller projects.

Products generally have a high level of mechanical development. According to the interviewee the decision making process is tailored for these projects and would not suit high tech development projects as well.

Thule Group considers itself pragmatic in its view on business processes. They prioritize fast decision making over rigorous planning. They rather be 70% sure with quick decision making than 100% sure with the risk of losing the window of opportunity.

The company has had a relatively high level of product variety. To focus its activities and get a clearer brand, the divisions of snow chains and towing & trailer have been divested (Thule Group, 2015; Thule Group, 2016a). These transactions have been to focus the company's strategic direction.

4.5.6 Summary

Thule Group has the ambition to be pragmatic. In the information gathering they use internal sources to save time. It is said that it is better to be nearly correct fast than completely right later on. *Table 14* describe a high involvement of senior management. The company has a high focus on R&D which is considered to drive company performance.

Table 14 – Summary of Thule Group

<table>
<tr><th>Input</th><th>Decision</th><th>Output</th><th>Contextual Aspects</th></tr>
<tr><td>Information requirement
-Market & user input
-Business case (includes freight, scrap & handling costs)
-Project schedule
-Project risk
-Technical specification</td><td>Criteria
-Technical solution & product quality
-Financial attractiveness
-Project schedule & cost</td><td>Execution
-Go/go with restriction
-Kill decisions executed between gates</td><td>Strategy, Market and Company
-Product quality focus
-Mature market
-Pragmatic view on business processes
-High growth & profitability</td></tr>
<tr><td>Data integrity
-Feedback loop 12 months after product launch
-Sanity checks from function heads</td><td>Decision makers
-CEO
-Directors of: Product Management, Business area, Sales, Marketing, Finance, Sustainability, Operations & Supply Chain</td><td>Implementation
-Resources allocated or project awaits budget</td><td>Product
-Medium/long life cycle (4/15 years)
-High product variety
-High focus on R&D</td></tr>
<tr><td>Responsibilities
-Project Manager gathers data
-Other functions supply information</td><td>Variations
-Project cost > 100 000 SEK go through process</td><td></td><td></td></tr>
</table>

5 Analysis & Findings

The cases presented in the previous chapter will here be analyzed based on the theoretical propositions through pattern matching. In addition, new propositions based on the empirical study will be made. In the analysis each case is compared to theory and a rating is made whether the case supports (+), contradicts (-) or is neutral (0) to the theoretical propositions.

5.1 Axis Camera Division

Axis uses a relatively unstructured approach when selecting development projects. The company's outspoken prioritization of creativity and freedom of thinking makes a clear mark on the process. The company's financial success has enabled it to invest heavily in R&D which so far has paid off in high growth and profit margins.

5.1.1 Comparison to theory

Axis' unstructured approach lead to a low theoretical alignment in aspects of formality. In other areas they are more in line with theory.

5.1.1.1 Input

As seen in *Table 15* Axis' camera division supports propositions regarding information requirement and responsibilities. In the area of data integrity however, there is a lower level of alignment to theory. This can be explained partly by the fact that follow-up of information is low at the company.

Table 15 – Comparison to input theory at Axis Camera Division

Area	Proposition	Rating
Information requirement	1 – Criteria sophistication drive information need	0
	2 – Cross functional information gathering	+
	3 – Cross functional teams and integration	+
Data integrity	4 – Misaligned incentives lead to poor data integrity	0
	5 – Data integrity is critical for good decision making	0
	6 – Risk of ending wrong project is greatest at start	+
	7 – Key factors hard to financially quantify	0
Responsibilities	8 – Functions are responsible to deliver information	+
	9 – Organizational integration support information sharing	+
	10 – Management support drive information sharing	+
	11 – Project Managers should collect information	+
	12 – Marketing, design, manufacturing provide info	+

Information requirement

Axis gathers a wide range of information to the decision making, examples being competitor analysis and customer needs. Most is not collected to serve the formal criteria of payback time and project length, but rather to help the Product Manager choose new projects. The information comes from different functions. Interviewees argue that the entire decision process is a tool for connecting personnel across functions, improving the level of integration.

Data integrity

The importance of data integrity at Axis is not apparent as estimations are not followed up after the project goes live. Product Managers have great power in deciding which projects to put forward. They are constructing the business case and there could be instances where goals or incentives are at risk of misalignment. No evidence has been found but it can follow due to the lack of data integrity. In regard to the informal criteria there is more effort put into information collection as people are working solely on analyzing competition and customer needs.

As formal financial criteria are not alone in the decision making, quantifying key figures can't be viewed as a great issue to the process. There is room to make decisions on project specific or strategic factors if needed. It can be argued that there is a risk of ending quality projects prematurely as Product Managers are responsible for bringing projects to the meeting. That is the single greatest screening of projects and also where the least amount of information is available.

Responsibilities

Even though the Product Manager performs the data collection, the engineering manager is responsible for information on R&D costs. There are people working full time with information collection on competition and technical development. This supports the proposition that functions should be responsible for delivering reliable information. The main purpose of the decision process as described by interviewees is to increase functional integration and communication. Management support is apparent which is seen in that the CTO is involved in these decisions. The Product Managers are responsible for the information gathering at early stages but it is the Project Manager's responsibility when assigned. This supports the proposition that the Project Manager should gather the information. Marketing, design and manufacturing are all vital information providers through the entire decision making process. These functions also have people represented in the decision meeting as the Product Manager can be seen as a representative for marketing and sales.

5.1.1.2 Decision

The decision aspect at Axis gives a low rate of support to theory in the two areas of criteria and variations, as seen in Table 16. There is a low use of formal criteria which explains the lack of alignment. However, in the area of decision makers the case supports theory to a high degree.

Table 16 – Comparison to decision theory at Axis Camera Division

Area	Proposition	Rating
Criteria	13 – Formal criteria important for structure	0
	14 – Formal criteria drive company performance	-
	15 – Strategic goals should drive criteria	+
	16 – Financial criteria is good as a complement	+
	17 – Strategic criteria should sort out candidates	0
	17a – Use of scoring/ranking/checklists	0
	17b – Use of visualization tools	0
	17c – Use of business strategy models	0
	18 – Criteria should be understood by organization	0
	19 – Roadmaps can connect to company strategy	+
Decision makers	20 – Use of formal decision makers	+
	21 – Decision makers at strategic level	+
Variations	22 – Project importance should decide thoroughness	0

Criteria

The case at Axis does not support that formal criteria is a requirement for comparing projects. Axis does so in a more informal setting, relying on the collective gut feeling of its Product Managers and people at the roadmap meeting. This disproves the proposition that formal criteria is necessary to drive company performance as Axis has been very successful despite, or perhaps thanks to, its lack of formal criteria. Furthermore, the overall strategic goals of Axis and the goals of each respective portfolio is reflected in the way Axis chooses its projects. Although this is reflected in the informal criteria rather than the formal, financially based criteria. The formal criteria function as a complement to the informal, strategic criteria. Important projects can be prioritized despite their lack of financial performance if they are seen as important for maintaining Axis technology leadership role. However, these informal, strategic criteria are not the main drivers of sorting out projects initially which is why that proposition is not fully supported.

Axis uses almost no suggested methods such as scoring, visualization or business strategy models in selection of comparison of development projects. Selection is done by Product Managers in the presentation at the roadmap meeting. This can then be questioned and projects be changed. It is not done in a structured way with standardized methods but is rather through an open discussion at the roadmap meeting. Since the criteria are informal it does not support the

proposition that the criteria must be understood by the organization. It is up to each of the Product Managers to interpret what is important to present in the roadmap meeting to gain acceptance for their projects. Product roadmap use is implemented at Axis to a large extent. The purpose is to include company strategy into the selection of development projects.

Decision makers

Axis uses a formalized decision process where it is clear who should be represented at the decision meeting. It provides a sense of transparency to the organization which is important according to interviewees. The decision makers are at a high hierarchical level at the company, with the CTO highest ranked. It gives the decisions a higher strategic connection even though the formal criteria are not necessarily of strategic nature.

Variations

Axis does not have a formalized way of prioritizing the most important projects to give them a more thorough decision process. The process and criteria differ among the Product Managers and projects. Therefore, it might be a tendency towards more important projects receiving more resources before the decision is made. This hasn't been confirmed through the empirical study however.

5.1.1.3 Output

Table 17 shows that Axis gives a relatively low level of support to the output aspect of theory. The company supports one proposition while contradicting another. This is mainly due to the lack of formality and employing a binary go/kill decision.

Table 17 – Comparison to output theory at Axis Camera Division

Area	Proposition	Rating
Execution	23 – A clear, formal output based on decision is vital	0
	24 – The decision should be a clear go/kill	-
Implementation	25 – Resource allocation should reflect decision	+
	26 – Goals for next gate should be set if go-decision	0

Execution

The formal output from the roadmap is a collective decision to let the project start. The fact that few projects are killed but rather postponed proves that Axis does not follow a binary go/kill decision.

Implementation

In the few instances where there is a clear kill decision the project is stripped of its resources. As a decision is made to start product development, the project is receiving the resources requested.

Other than the project plan, the time frame for the project, there are no formal criteria set up for the upcoming gates of the project.

5.1.2 Complements to theory

The Axis case gives interesting complements to theory regarding the use of less formal criteria and the roadmap as a tool for cross functional communication.

5.1.2.1 Decision

Axis does not put much focus on formal criteria. The interviews argued that the company wants to free up the employees and thereby enable more innovation. Product Managers are very free in their role and can argue for new projects where they see potential. It seems to be a conscious choice by management to have this loose process.

- Use of less formalized criteria enables a more innovative organization.

5.1.2.2 Output

The use of a roadmap is an important part of product development and product planning at Axis. However, it is an important tool not only for decision support. The Product Managers are pushing for the idea of using it to communicate decisions and plans to the company to provide transparency and company alignment. Some important functions using this tool are sales and others with customer contact.

- A roadmap can provide valuable cross functional communication after a development decision has been made

5.1.3 Contextual Explanation

Axis has long been a very successful and profitable company. Innovation and technology leadership have been important factors enabling success in an industry with short product life cycles. It is not surprising that the heavy focus on innovation is holding back the company from introducing more formal criteria. It is not clear that a more formal process with the same criteria would necessarily help the company. It can be argued that their current approach is successful when looking at the company and its performance as a whole.

Many theoretical propositions which Axis does not fulfill are due to the lack of formality. It can be argued that the innovation weight in company strategy cause this prioritization. The company is therefore in line with some of the propositions regarding strategic alignment indirectly. The lack of criteria and connection to company strategy is arguably fulfilled by the hierarchical level of decision makers, indirectly taking strategic aspects into account.

While Axis matches fewer of the propositions regarding formality, they match more concerning cross functional integration and cooperation. The company culture, which is characterized by openness and cooperation, can be seen as an enabler. The theoretical framework states this is an important part of the decision making and it is clear that Axis fulfills these propositions.

5.2 Sony

Sony is the case that is most aligned with theory regarding formality of the decision point. Several deliverables are required and the product projects are scrutinized in detail.

5.2.1 Comparison to theory

Sony has a high level of formality in its processes. It provides much of the alignment with the theoretical framework. The company is less in line with theory in aspects of information sharing and cross functionality.

5.2.1.1 Input

Table 18 shows a relatively high level of support for theoretical propositions from the Sony case. The exceptions are primarily related to cross functional information sharing and integration.

Table 18 – Comparison of input theory at Sony

Area	Proposition	Rating
Information requirement	1 – Criteria sophistication drive information need	+
	2 – Cross functional information gathering	+
	3 – Cross functional teams and integration	0
Data integrity	4 – Misaligned incentives lead to poor data integrity	+
	5 – Data integrity is critical for good decision making	+
	6 – Risk of ending wrong project is greatest at start	0
	7 – Key factors hard to financially quantify	+
Responsibilities	8 – Functions are responsible to deliver information	0
	9 – Organizational integration support information sharing	0
	10 – Management support drive information sharing	0
	11 – Project Managers should collect information	+
	12 – Marketing, design, manufacturing provide info	+

Information requirement

Information requirements are to large extents set by the criteria used at the gate meeting. The thoroughness of criteria in the detailed business case decides the information required. Short development life cycles meant a project could be killed only based on demand or cost estimations, which could change rapidly. This required sufficient quality from the information gathering from functions. Mainly, product and Project Managers were responsible for gathering information by contacting departments and functions.

Data integrity

Alignment of incentives was an issue at times. There could be directives from corporate headquarters that a certain project should be allowed to pass through the toll gate even if information gathered by product management suggested otherwise. Other than these issues, Sony was successful and adamant about ensuring data integrity. It is shown in that each project was followed up after release to evaluate initial estimations. This was further enforced by the fact that a financial controller was present at the tollgate meeting to verify and question data validity.

No sufficient evidence was found to support that Sony was at risk of ending projects based on insufficient information at early gates. It was however clear that, although the business case and project financials were the most important, strategic factors could overrule financial data. Sony had projects that were accepted despite lack of solid financial data due to a strategic technology push. It also had projects which were killed when other factors were considered to affect credibility of the calculations.

Responsibilities

Information gathering and sharing was found to be largely attributed to the project and Product Managers. No sufficient evidence was found of information sharing happening due to cross-functional integration or by enablement of top management. Involved functions would however provide information upon request from the project or Product Manager which supports these propositions.

5.2.1.2 Decision

The Sony case supports theoretical propositions concerning the decision to a varying extent, as seen in *Table 19*. The company supports most of the propositions concerning formality. The two contradicting aspects are also connected to formality, not allowing for any variations.

Table 19 – Comparison to decision theory at Sony

Area	**Proposition**	**Rating**
Criteria	13 – Formal criteria important for structure	+
	14 – Formal criteria drive company performance	-
	15 – Strategic goals should drive criteria	+
	16 – Financial criteria is good as a complement	0
	17 – Strategic criteria should sort out candidates	+
	17a – Use of scoring/ranking/checklists	0
	17b – Use of visualization tools	+
	17c – Use of business strategy models	0
	18 – Criteria could be understood by organization	0

	19 – Roadmaps can connect to company strategy	+
Decision makers	20 – Use of formal decision makers	+
	21 – Decision makers at strategic level	+
Variations	22 – Project importance should decide thoroughness	-

Criteria

Sony Mobile relied on formal criteria to structure the decision making and compare projects. At the same time, they struggled to deliver financially during a long period of time. It shows that formal criteria do not necessarily drive company performance. There is certainly a more complex relationship that drives company performance but the Sony case showed an exception to this proposition.

They let strategic goals drive criteria by allowing riskier projects, with more uncertain business cases, to proceed if they were of strategic importance to the portfolio. It was clear that most of the time however, financial criteria were relied upon heavily. Strategic criteria were used to sort out candidates during the portfolio meetings which occurred before the start meeting of any project.

No evidence was found for use of scoring or business strategy models. Visualization tools were only used to minor extent during the portfolio meeting. That is why the proposition regarding visualization tools was not fully supported. Criteria was not always understood by stakeholders as they could differ depending on involvement and pushes from top management. Roadmaps were used to connect the portfolio with company strategy. This was done in the portfolio meetings before the first tollgate of the project.

Decision Makers

Formal decision makers were used at the gate meetings. These were senior managers of the functions involved. This ensured involvement of decision makers at a strategic level.

Variations

Sony had a differentiated way of working with different projects which decided the thoroughness of the decision making. According to an interviewee this led to more problems than it simplified the process. Less important projects that were allowed to pass through faster often led to the most problems later on. This led to a change where all projects needed a thorough business case to be approved.

5.2.1.3 Output

There is a high level of variety in support of output propositions, as seen in *Table 20*. There is a formal output which drives resource allocation. However, the decision is not a binary go/kill and no goals are set for the next gate.

Table 20 – Comparisons to output theory at Sony

Area	Proposition	Rating
Execution	23 – A clear, formal output based on decision is vital	+
	24 – The decision should be a clear go/kill	-
Implementation	25 – Resource allocation should reflect decision	+
	26 – Goals for next gate should be set if go-decision	0

Execution

Sony had a clear and formal output based on the decision. Projects would receive their proposed resources after being approved by the decision makers at the tollgate. The decision was not a clear go/kill decision. Projects could be questioned, put on hold and then revisit the tollgate if they would not pass it the first time. This meant a grey zone where the binary go/kill decision suggested by theory was not present.

Implementation

Resource allocation was reflected after a decision as the project received the necessary amount after it passed. Similarly, when projects were a no pass they were stripped of funding even if they had reached later toll gates. Since criteria and goals were essentially the same throughout the tollgate process, not new goals were set after a go-decision had been taken.

5.2.2 Complements to theory

The Sony case showed interesting additions to theory in terms of decision input and follow-up of data. Additionally, the case suggests loosening criteria for some projects can cause problems later on.

5.2.2.1 Input

Sony use two different business cases as input to the decision. A base case and a stretch case which gives one realistic and one optimistic version to consider. Due to the rapidly changing business environment, this was a tool for them to try to capture uncertainty. The decision makers would then review both versions and decide upon which to rely on.

- Differentiated input scenarios is a way of capturing uncertainty

To ensure continuous improvement of the process and input information Sony use a feedback loop. To improve a process, the mistakes need to come to light. By looking at a project in retrospect both data integrity and the overall process can improve.

- Use of a feedback loop after product launch can improve data integrity and enable continuous process improvement.

5.2.2.2 Decision

Theory suggests that rigidness of criteria can be adjusted depending on the financial importance and risk of the project. At Sony Mobile, this was found to be difficult to apply in practice as projects with looser criteria would be problematic later, when the product was released. These problems were traced back to the business case which is why data integrity needs to be ensured for all projects.

- Loose criteria for low risk projects can lead to issues later on. Therefore, data integrity must be ensured also for these projects

5.2.3 Contextual Explanation

Sony operate in an extremely competitive industry which has been increasingly commoditized, with smaller margins as a consequence. It has a great impact on how they work with product development. The company calculates the cost structure of a new product for the entire life cycle to control costs. The process and decision input is heavily formalized and all assumptions are evaluated as a project is closed. Strictness and thoroughness of the data collection is drawing a lot of resources. The company has deemed it to be important anyway, as a development project decide what costs a product drives through its entire life time. Company size could be a factor in strictness of data collection. As poor data has a bigger impact in a larger company it can be argued to be a better investment there.

The proposition of process formality and its relation to company performance should not be considered a direct correlation. It is probable that the industry characteristics and competition are stronger drivers of performance than decision process formality.

The short life cycles of the industry mean there is a lot of pressure on the R&D aspect of the company which can further explain the formality of the process. They were forced to keep a steady product introduction rate, while maintaining a competitive product portfolio. This put pressure on the decision making process to deliver. Having an external owner who wants to control the process further explains the uniformity of development projects and their formal set up.

5.3 Alfa Laval

Alfa Laval has a relatively formal process for product development decisions. The company strategy mentions both cost control and resource focus which requires restrictions. At the same time R&D is given a high focus, shown by the involvement from senior managers. Formal processes at the company can be seen as a way for the directorate to have control of R&D.

5.3.1 Comparison to theory

The support for theoretical proposition is high at Alfa Laval. Formality and theoretical alignment is most apparent in information gathering up until the decision making. The support for decision and output dimensions is not as strong.

5.3.1.1 Input

The Alfa Laval case gives a high level of support for input propositions, as seen in *Table 21*. The less supported propositions are primarily related to spontaneous information sharing and functional integration. An explanation is that the responsibility for information gathering is concentrated to the Product Manager.

Table 21 – Comparison to input theory at Alfa Laval

Area	**Proposition**	**Rating**
Information requirement	1 – Criteria sophistication drive information need	+
	2 – Cross functional information gathering	+
	3 – Cross functional teams and integration	0
Data integrity	4 – Misaligned incentives lead to poor data integrity	0
	5 – Data integrity is critical for good decision making	+
	6 – Risk of ending wrong project is greatest at start	+
	7 – Key factors hard to financially quantify	+
Responsibilities	8 – Functions are responsible to deliver information	0
	9 – Organizational integration support information sharing	0
	10 – Management support drive information sharing	+
	11 – Project Managers should collect information	+
	12 – Marketing, design, manufacturing provide info	+

Information Requirement

Alfa Laval has a high sophistication level regarding criteria. This is partly because the decision meetings are held every 6 months with very senior decision makers. The sophistication is shown in the detailed input data calculated in the form of the thorough cost-benefit-analysis (CBA). Several functions are involved in collecting this data and the related documents. It is especially apparent when projects have been initiated from the technology forum, requiring information from more sources. However, cross functional teams were not found to be the enablers of this information gathering. Rather, Product Managers gathered the information when needed.

Data integrity

There were no signs of misaligned incentives leading to manipulated data. Instead, data integrity was a critical part of Alfa Laval's decision process. It is seen in follow-up meetings after product release and use of sophisticated sensitivity analyses within each CBA. The importance of financial criteria favors safer projects which affect innovative and risky projects. These were

often based on more uncertain information at the early project stages. This can be a problem since the early project financials might not reflect the full potential of a project.

Responsibilities

At Alfa Laval it is not the responsibility of each function to deliver information. Instead it was up to the Product Managers early on and Project Managers at later stages. Other functions would then provide information upon request. Management support for the decision process was clear in that the directorate was directly involved in decisions. It is likely to affect the information sharing in a positive way.

5.3.1.2 Decision

Alfa Laval has a high focus on their formal business case in its decision making. Strategic aspects of the decision are primarily inserted through involvement of senior decision makers. As seen in *Table 22*, many of the propositions with no support can be explained by the financial focus.

Table 22 – Comparison to decision theory at Alfa Laval

Area	**Proposition**	**Rating**
Criteria	13 – Formal criteria important for structure	+
	14 – Formal criteria drive company performance	+
	15 – Strategic goals should drive criteria	0
	16 – Financial criteria is good as a complement	+
	17 – Strategic criteria should sort out candidates	0
	17a – Use of scoring/ranking/checklists	0
	17b – Use of visualization tools	0
	17c – Use of business strategy models	0
	18 – Criteria should be understood by organization	0
	19 – Roadmaps can connect to company strategy	+
Decision makers	20 – Use of formal decision makers	+
	21 – Decision makers at strategic level	+
Variations	22 – Project importance should decide thoroughness	0

Criteria

The importance of formal criteria was supported by the Alfa Laval case, demanding strict criteria for a project to be approved. The strong company performance has been apparent for Alfa Laval throughout the years, even though they are competing in a mature market. We believe this can be

somewhat related to the use of strict criteria. It ensures that every project started will yield positive financial results. The strategic goals are not reflected in the use of criteria but through the strategic level of the decision makers.

Alfa Laval relies heavily on financial criteria which could affect riskier, more innovative projects negatively. There is no evidence that strategic criteria were used first to sort out candidates. Neither were any of the qualitative methods of scoring, visualization tools or business strategy models used.

The criteria are not fully comprehended by the people involved. One example is that the interviewee was unsure on how decisions were made, especially what weight criteria had in decisions. The decision meeting can be seen as a roadmap as it gathers current and future projects to be evaluated as a whole. Together with the strategic decision makers it enables a connection between portfolios and the overall company strategy.

Decision makers

Formal decision makers were appointed and were at a strategic level, as most of them were from the company directorate.

Variations

No sufficient evidence supports that Alfa Laval had different levels of sophistication for the decision making depending on project importance. Since only a handful development projects are conducted each year, they can be thorough in each decision.

5.3.1.3 Output

There is high support for output propositions, as seen in *Table 23*. There is a formal output which drives resource allocation and Alfa Laval is the only case that supports a binary go/kill decision.

Table 23 – Comparison to output theory at Alfa Laval

Area	**Proposition**	**Rating**
Execution	23 – A clear, formal output based on decision is vital	+
	24 – The decision should be a clear go/kill	+
Implementation	25 – Resource allocation should reflect decision	+
	26 – Goals for next gate should be set if go-decision	0

Execution

The output from the decision was clear in that formalized ways of proceeding afterwards were implemented. Alfa Laval also support a binary go/kill decision which shows they are formal and strict in their output.

Implementation

Resource allocation largely followed the decisions made to approve or kill a project. There were no new goals set in relation to the criteria however. The same criteria were used at the subsequent gates.

5.3.2 Complements to theory

There are several complements to theory proposed, based on the Alfa Laval case. There is no major change from theory but rather variations of existing theoretical concepts.

5.3.2.1 Input

Alfa Laval demands that all products ina development project are listed in the project proposal. It is mentioned that additional products or modifications are rather put in new projects in the future. It is interpreted that the company wants to keep projects from swelling and taking more time and resources than necessary.

- All planned products in a project should be part of the input to the decision meeting.

To assess the risks involved in business case assumptions, Alfa Laval include a scenario analysis. They use the base scenario which is the projection and adds two cases where the sales differ 10-20% up and down. The scenarios give decision makers an idea of how sensitive the project is to market changes and poor projections.

- Scenario analysis can be used as a way of assessing the risks involved with sales projections.

Alfa Laval use an evaluation meeting at the end of each project. This way they can find possible weak points of the project and improve going forward. Improvements can be found in both data integrity and the working process.

- Use of a feedback loop after product launch can improve data integrity and enable continuous process improvement.

5.3.2.2 Decision

Alfa Laval employ financial criteria similar to pay back time but counting to gross profit reaching one million EUR or twice the investment. This can be seen as a simple way of ensuring that the introduction of the new product is able to cover the hidden costs outside of the direct cost and investments.

- Time-to-million and time-to-two-times-investment can ensure that a project covers all hidden costs it drives.

5.3.3 Contextual Explanation

Alfa Laval has a long experience of being one of the industry leaders in a relatively mature and competitive market. R&D is a priority but is controlled rather tightly to ensure efficiency.

Critique is expressed that the result of the financial control and risk avoidance to keep up margins might actually result in lower innovation. However, in a mature industry it might be motivated to stay within the core business when the company already has large market shares.

Product focus and control of market are key aspects of company strategy which include a limit to the level of customization the company provides to its customers. The product life cycle is long. Since the company often undertakes the liability of providing spare parts for a long time after a sale, it is important not to widen the number of sales units. This liability might also be a strong reason behind the restrictive approach towards uncertain and innovative projects.

5.4 Husqvarna

Husqvarna and its diverse product portfolio is divided into several companies and markets. The company has tried to centralize and reduce cost in recent years which has put focus on formality. As a way of being flexible to market characteristics the company puts high emphasis on strategic aspects and flexible criteria weight.

5.4.1 Comparison to theory

Husqvarna has a high variety in degree of theoretical alignment. The company is following propositions closely at the decision point. However, in input and output there is a significantly lower level of alignment.

5.4.1.1 Input

In the input phase there is a low level of theoretical support from the Husqvarna case, as seen in *Table 24*. The input to the decision has a relatively high focus on qualitative strategic aspects. These are collected by the Product Manager with little input from other functions.

Table 24 – Complements to input theory at Husqvarna

Area	Proposition	Rating
Information requirement	1 – Criteria sophistication drive information need	0
	2 – Cross functional information gathering	+
	3 – Cross functional teams and integration	0
Data integrity	4 – Misaligned incentives lead to poor data integrity	0
	5 – Data integrity is critical for good decision making	+
	6 – Risk of ending wrong project is greatest at start	0
	7 – Key factors hard to financially quantify	+
Responsibilities	8 – Functions are responsible to deliver information	0
	9 – Organizational integration support information sharing	0
	10 – Management support drive information sharing	0

	11 – Project Managers should collect information	0
	12 – Marketing, design, manufacturing provide info	+

Information requirement

Husqvarna has introduced sophistication to its criteria other than the business case and financial measures. They use matrices to visualize strategic aspects ahead of roadmap and start meetings. However, those tools do not drive a significant amount of new data collection. It is mostly a way of putting the Product Manager's existing knowledge to print. Cross functionality and integration are important for data collection as help is needed for some data collection, primarily for the business case input. The data is not reliant on the cross functional teams but rather on the Product Manager being able to contact the right people with the right information.

Data integrity

There is no empirical evidence that a misalignment of incentives lead to poor data integrity. There is however a high level of power over information at the hands of the Product Manager. It seems there is potential for conflicting interests but no incentives have been found which would drive the conflict. Husqvarna employs a feedback loop through their follow-up meetings which ensures data integrity and shows that they value this aspect.

Risk factors of ending the wrong projects can be found in the beginning. An important filter of projects is the Product Manager's decisions regarding which project to bring to the roadmap meeting. However, this is a potential issue rather than something verified by empirical evidence. Visualization of strategic factors could clarify the Product Manager's thinking on relevant factors which could otherwise go unnoticed. This measure acknowledges that financial criteria cannot catch all significant aspects.

Responsibilities

The collection of information is centralized to the Product Manager until the project gets a go in the start meeting. Therefore, it is dependent on that person reaching out to the organization for information collection. This instead of spontaneous information sharing through management support or a functional responsibility to deliver the information. However, when the information is needed it will be gathered from relevant functions such as manufacturing, design and marketing.

5.4.1.2 Decision

The decision aspects at Husqvarna give a high level of support to theory, as seen in *Table 25*. The aspect where the case contradicts theory relates to the hierarchical level of decision makers since they are inconsistent in that regard.

Table 25 – Comparison to decision theory at Husqvarna

Area	Proposition	Rating
Criteria	13 – Formal criteria important for structure	+
	14 – Formal criteria drive company performance	+
	15 – Strategic goals should drive criteria	+
	16 – Financial criteria is good as a complement	+
	17 – Strategic criteria should sort out candidates	+
	17a – Use of scoring/ranking/checklists	0
	17b – Use of visualization tools	+
	17c – Use of business strategy models	0
	18 – Criteria should be understood by organization	0
	19 – Roadmaps can connect to company strategy	+
Decision makers	20 – Use of formal decision makers	+
	21 – Decision makers at strategic level	-
Variations	22 – Project importance should decide thoroughness	0

Criteria

The formality of the process at Husqvarna is used to achieve a similar structure for all projects. It is important to the company to control the alignment of products. It seems criteria are based on strategic goals, especially if looking at the matrices focusing on strategic aspects. In addition, it is possible to include strategic priorities for different product lines. Handheld electronic products receive higher weight on growth and innovation than traditional lawn mowers do for example. Since there is a focus on the strategic aspects in the roadmap meeting and financial aspects in the monthly meeting, one can say that strategic aspects are the primary criteria. A contradiction to this is that decision makers are at a higher hierarchical level at the monthly meeting with financial focus. However, the order of the meetings is deemed to be a primary factor since the strategic factors are prioritized first. The matrices used for the strategic purpose are judged to be visualization tools of strategic criteria rather than business strategy models, as defined in theory.

Decision makers

The fact that Husqvarna employs clear and formal decision makers in their process is one of the positive aspects brought up in the interview. However, contrary to theory the company use senior, strategic decision makers at the monthly start meeting where financial factors are in focus. When strategic aspects are discussed at the roadmap meeting, decision makers there are at a lower hierarchical level.

Variations

The company use the same process for all projects. The factor that change between projects is the weight of criteria, instead of the thoroughness of the process itself.

5.4.1.3 Output

There is variations in support for the output propositions, as seen in *Table 26*. There is a formal output which drives resource allocation. However, the decision is not a binary go/kill and no goals are set for the next gate.

Table 26 – Comparison to output theory at Husqvarna

Area	Proposition	Rating
Execution	23 – A clear, formal output based on decision is vital	+
	24 – The decision should be a clear go/kill	-
Implementation	25 – Resource allocation should reflect decision	+
	26 – Goals for next gate should be set if go-decision	0

Execution

The output from a roadmap meeting is clear for all projects receiving a go decision. They get a place in the roadmap which means a dedicated Project Manager and a start date for development. At the start meeting the project gets necessary resources if it receives a go decision. The decisions are not only go or kill, there is a grey scale as projects not passing the gate can be reintroduced later on.

Implementation

The resources are deemed to be allocated according to the decision meeting, even though projects which were killed sometimes are reworked to get a second chance. When projects are passed at a gate there are no project specific criteria decided for the next gate as they are constant for all gates.

5.4.2 Complements to theory

Husqvarna offers two complements to theory. The company generally has a relatively high alignment to theory which explains the low number.

5.4.2.1 Input

Husqvarna uses follow-up meetings at the end of each project. The purpose of the meeting is to learn from aspects of the project which went particularly well or badly.

- Use of a feedback loop after product launch can improve data integrity and enable continuous process improvement.

5.4.2.2 Decision

Husqvarna use flexible criteria to fit a specific business area's strategic goals. Even though the tools and criteria are basically the same for all projects, the weighting can be fundamentally different. This is a way of combining the formality of uniform criteria while still enabling for strategic customization.

- Flexible criteria weight at different business units allow for customization of decision making based on unit specific strategic goals.

5.4.3 Contextual Explanation

Husqvarna has a company-wide ambition to be a technology leader in the fields it operates. In combination with the new strategic initiative to increase margins of the products there is a risk of conflicting interests. The fact that high company executives go in to judge ongoing projects on primarily financial aspects could be a consequence of this conflict. The Product Managers have the ambition to be technology leaders. This might not be in line with the more financial motives of the executives making the decisions at the monthly meetings. Another explanation for this misalignment of decisions is the recent centralization of the organization. This is, according to the interviewee, something that affects product development decisions. The product management function was kept decentralized but can be overruled by decision makers on group level. This divide further strengthens the theoretical proposition to keep decision makers on a strategic level since they will have the final say in the end.

The fact that Husqvarna use a differentiated weighting of the decision criteria could be explained by the variations in industries the company operates in. They have realized that a common decision making cannot serve the purpose of all markets and products. The decision making must be different for immature, growing markets as opposed to the mature markets where Husqvarna mainly operates. This is also explained by the varying product life cycles that their products have. The products that the interviewee is responsible for have a shorter life cycle than their combustion driven lawn mowers. This is captured in the flexible criteria weight as well.

5.5 Thule Group

Thule Group has had dramatic changes during the last years with its IPO to the Stockholm stock market and a redirection of its business. Product development has had a strong impact on these changes as the company has gone into new markets and needed products to fit. Strong focus on brand and quality has meant investments in new products have received much time and resources. The interviewee stress that it is hard to build up a quality brand but easy to erase it.

5.5.1 Comparison to theory

Thule Group follow the basic ideas of theory. The company's ambition to be pragmatic in decisions does however limit formality and theoretical alignment in some aspects.

5.5.1.1 Input

Thule Group has a low level of theoretical alignment in areas of information sharing and cross functional integration, as seen in *Table 27*. Their dependence on senior management to share information is the strongest explanation for this. In the other areas there is strong support for theoretical propositions.

Table 27 – Comparison to input theory at Thule Group

Area	Proposition	Rating
Information requirement	1 – Criteria sophistication drive information need	+
	2 – Cross functional information gathering	+
	3 – Cross functional teams and integration	0
Data integrity	4 – Misaligned incentives lead to poor data integrity	0
	5 – Data integrity is critical for good decision making	+
	6 – Risk of ending wrong project is greatest at start	0
	7 – Key factors hard to financially quantify	+
Responsibilities	8 – Functions are responsible to deliver information	+
	9 – Organizational integration support information sharing	-
	10 – Management support drive information sharing	0
	11 – Project Managers should collect information	+
	12 – Marketing, design, manufacturing provide info	+

Information requirement

Information collected follows a given structure, a template for presentation. The information need is thus driven by the criteria set up from the start. That information is collected by a Project Manager who reaches out to the departments. Later the information is sanity checked by each department head and the cross functional decision meeting. It is regarded as a cross functional information gathering. However, the information gathering is not dependent on cross functional teams, other than the decision meeting itself.

Data integrity

There is no evidence to suggest misaligned incentives lead to poor data integrity at Thule Group. There are control functions in place to sanity check the information. The functional directors are reviewing data before all checkpoints and follow-up the entire project at the end. Those measures show their focus on data integrity as a means of maximizing decision quality.

There is no evidence suggesting that good projects are killed early in their development. Instead, there is strong focus on design and concept at those stages. If a project is killed, it is often due to

technical reasons. The process at Thule Group has a high focus on financial criteria. However, those factors can be overruled by qualitative, strategic factors. It is mentioned that some projects are started to fill a gap in the market or to update an existing product, if it is important to not lose market share or reputation.

Responsibilities

Information is collected from a wide range of functions including manufacturing, marketing and design. They also have these managers involved throughout the process. The Project Manager has the responsibility to collect information going in to the decision meeting with help from other functions. It is therefore deemed to be a functional responsibility in practice. However, as it is a centralized collection process controlled from the Project Manager it is not necessary to have organizational integration to get the information. There is a clear support from management to share information. However, it is not done necessarily through cross functional integration. Rather, it is the managers' responsibility to spread the information to their respective function.

5.5.1.2 Decision

Thule Group offers a relatively high level of support for theoretical propositions regarding the decision aspect, as seen in Table 28. The formality of the process is primarily related to a focus on financial aspects. Strategic aspects are brought in to the decision in the form of decision makers at the directorate level.

Table 28 – Comparison to decision theory at Thule Group

Area	**Proposition**	**Rating**
Criteria	13 – Formal criteria important for structure	+
	14 – Formal criteria drive company performance	+
	15 – Strategic goals should drive criteria	0
	16 – Financial criteria is good as a complement	+
	17 – Strategic criteria should sort out candidates	+
	17a – Use of scoring/ranking/checklists	0
	17b – Use of visualization tools	0
	17c – Use of business strategy models	0
	18 – Criteria could be understood by organization	0
	19 – Roadmaps can connect to company strategy	0
Decision makers	20 – Use of formal decision makers	+
	21 – Decision makers at strategic level	+
Variations	22 – Project importance should decide thoroughness	0

Criteria

The formal criteria and presentation tools Thule Group uses are mentioned to be very important for the structure of the development process. It appears that criteria are of great help to the company. It has enabled the quick transition to new markets and the new focus in the last few years. This suggests that formal criteria drives company performance.

There is no apparent connection between company strategy of a focused product portfolio and the formal criteria other than their gross margin goal. However, it seems there are informal criteria steering the selection of projects in a strategic direction. The company has focused its portfolio strategically through informal talks in between gates and strategic decision makers. Although they don't utilize strategic criteria, the effect on decisions is the same.

As a tool for the Product Managers to keep track of planned product introductions and development projects, a 3-5-year plan is used. The essence of it is similar to a roadmap, but without the purpose of aligning the portfolio to strategy. Rather it helps resource planning, although strategic alignment might be a positive effect.

Decision makers

Thule Group's use of a set meeting every other week with the same decision makers each time clearly signals formal decision making. The decision makers are on a high strategic level at the company, including CEO and heads of functions.

Variations

Other than very small projects, which do not go through the formal process, all projects go through the same process. No room is thus given for a general customization of the process.

5.5.1.3 Output

There is varied support for the output propositions, as seen in *Table 29*. The company utilizes a formal output to drive resource allocation. However, the decision is not a binary go/kill and no new goals are set for the next gate in the process.

Table 29 – Comparison to output theory at Thule Group

Area	Proposition	Rating
Execution	23 – A clear, formal output based on decision is vital	+
	24 – The decision should be a clear go/kill	-
Implementation	25 – Resource allocation should reflect decision	+
	26 – Goals for next gate should be set if go-decision	0

Execution

The delay option is the most common reason for not letting the project through. Even though this option sounds indecisive it is accompanied with directions for the project. It could be a pause

decision with a new start date or directives for what has to be accomplished by the project to pass. It is not a binary go/kill decision, nor are there any project specific criteria decided for the next gate. The criteria are the same for every gate but with updated information.

Implementation

Thule Group uses a clear output from its decision point which is reflected in resource allocation. A go decision means that the project will go on as planned. In the rare cases the project is killed, it will no longer receive resources. As the criteria are the same for all gates there are no new goals accompanying a go-decision.

5.5.2 Complements to theory

Thule Group offers several additional propositions. Many of the propositions are related to the high level of involvement from senior management. The company focuses on pragmatism and efficient decision making which affects the process.

5.5.2.1 Input

Thule uses a system where function heads are able to do sanity checks of assumptions ahead of decision meetings. This enable them to find mistakes early on in the process when information is uncertain and thus ensure data integrity.

- Sanity checks from relevant functions can increase data integrity in early assumptions.

Thule uses a continuous development and iteration of product concepts from early stages. They involve development resources to start prototyping during the first stages of the development process. Physical prototypes are tested and used as an input to each gate. As the prototypes grow in sophistication, so does the quality of their estimations and the certainty of a product's success.

- Early physical prototypes as input help to ensure data integrity and product quality.

To ensure continuous learning in the process, Thule use a follow-up meeting in each project. Typical points of discussion are how well the work went and the accuracy of early assumptions. As the company relies heavily on internal data and assumptions for the business case, this feedback loop is particularly important.

- Use of a feedback loop after product launch can improve data integrity and enable continuous process improvement.

5.5.2.2 Decision

Thule Group use a decision system where there are set slots for gate decisions every other Friday. The slot is booked for all relevant executives to have a fast development process and still make decisions on a strategic level.

- Use of set slots for decision making can speed up decisions and thus make a more efficient process.

The company utilizes informal strategic criteria which are not outspoken. The presence of senior personnel at the gate meeting combined with thorough communication ahead of the meeting can align portfolio and strategy.

- Strategic alignment can be achieved through project involvement of personnel at a strategic level instead of formal strategic criteria.

Thule Group uses scenario analysis in the business case to assess risk. In the analysis sales volume and price are adjusted up and down to show how they affect project profitability.

- Scenario analysis can be used as a way of assessing the risks involved with sales and price projections.

5.5.2.3 Output

Thule has an approach of rarely killing projects at the decision gates. They are questioned continually, if severe problems arise, projects are killed leading up to the gates. This approach of continuous questioning enables them not to spend unnecessary meeting time on these projects.

- Questioning and killing projects continually enables more efficient meetings.

5.5.3 Contextual Explanation

Thule has experienced high growth and profitability during the last few years. A significant part of the development can be attributed to product development. The company's focus on its core products has increased by divesting business units and more investment in R&D. The focus on product development is shown by the seniority of decision makers who are highly involved in the projects. The strategic involvement can explain the low use of strategy criteria. It is assumedly included by these decision makers anyway.

Thule Group prides itself in being a pragmatic company with a flat company structure. The ambitions for R&D is to have a fast process not hindered by too much formality. In combination with the high involvement from senior executives it can explain why the process works well without formal kill decisions. The questioning of projects, which comes naturally within the organization, sorts out poor projects even before the gate is reached. The pragmatism and small company size are likely to be strong enablers of this practice. It could also explain why information sharing does not happen through cross functional teams. Rather, it is achieved through gate meetings where top management will spread information to the rest of the organization.

6 Cross Case Analysis

The structure of the cross case analysis is to first discuss the theoretical propositions. Propositions discussed in the previous chapter, both theoretical and empirical, make up the basis for the following discussion. Through pattern matching we will compare similarities and differences between empirics and theory and how contextual aspects might explain this. After this, the empirical propositions will be discussed from a cross-case point of view to examine generalizability of the findings.

6.1 Comparisons to theory

The pattern matching is done on an aggregate level to find general patterns that could support or disprove the theoretical propositions. The propositions which received support from a majority of cases, three or more, were highlighted in dark grey. The propositions that were disproved by one or more cases were highlighted in white. Those that were proved, disproved or both were highlighted in light grey.

6.1.1 Input

As seen in *Table 30*, there are many propositions with a high level of support from the cases, marked in dark grey. In addition, several aspects get support from only some of the cases and thus warrant further discussion.

Table 30 – Cross Case analysis of input propositions

Category	Proposition	Axis	Sony	Alfa Laval	Husqvarna	Thule	Total
Information requirement	1 – Criteria sophistication drive information need	0	+	+	0	+	3+
	2 – Cross functional information gathering	+	+	+	+	+	5+
	3 – Cross functional teams and integration	+	0	0	0	0	+
Data integrity	4 – Misaligned incentives lead to poor data integrity	0	+	0	0	0	+
	5 – Data integrity is critical for good decision making	0	+	+	+	+	4+
	6 – Risk of ending wrong project is greatest at start	+	0	+	0	0	2+
	7 – Key factors hard to financially quantify	0	+	+	+	+	4+

Responsibilities	8 – Functions are responsible to deliver information	+	0	0	0	+	2+
	9 – Organizational integration support information sharing	+	0	0	0	-	0
	10 – Management support drive information sharing	+	0	+	0	0	2+
	11 – Project Managers should collect information	0	+	+	0	+	3+
	12 – Marketing, design, manufacturing provide info	+	+	+	+	+	5+

6.1.1.1 Supported propositions

Six out of twelve propositions related to decision input were supported by the case studies. The most supported were the propositions on the need to support cross functional information gathering and the difficulty to financially quantify certain data. It was supported that criteria sophistication drives information need, which is something to consider when designing criteria. The need to ensure data integrity was supported in all but one case which shows that companies see the importance of this in their decision making. Several case companies had one person responsible for gathering the information which proves this to be viable in practice. It explains why information from other functions is often provided upon request, rather than that the functions themselves being responsible for delivering it.

6.1.1.2 Unsupported or disproved propositions

Some of the unclear propositions relate to cross functional integration as an enabler for information sharing. The lack of support can be seen in that companies have people responsible for information gathering. Theory suggests that a cross functional project team should be appointed early on for the project. However, most case companies have this in place first after the studied decision point, explaining the lack of support for these propositions. It was also difficult to find support for propositions 4 and 6 which relate to the risk of misaligned incentives and premature ending of quality projects. Since these are highly complex propositions to study, the format with interview case studies did not allow for sufficient depth to prove or disprove them.

6.1.1.3 Contextual aspects

Propositions related to information sharing and organizational integration did not receive as strong empirical evidence. There is however one interesting observation to make. It seems companies have either high information sharing between functions, or a designated gatherer of

information in the form of a Project Manager. The exception is Husqvarna, which instead use Product Managers for the information gathering.

The company size, see *Figure 35*, is possibly an explanation why companies are giving functions responsibility of information sharing. It is reasonable to assume it is easier to accomplish in smaller companies like Thule Group and Axis which is suggested by the findings. The companies use different ways of ensuring the information sharing. At Thule it is dependent on upper management whereas Axis entrusts the responsibility throughout the organization. This difference could be explained by the involvement of directorate level employees, which is higher at Thule.

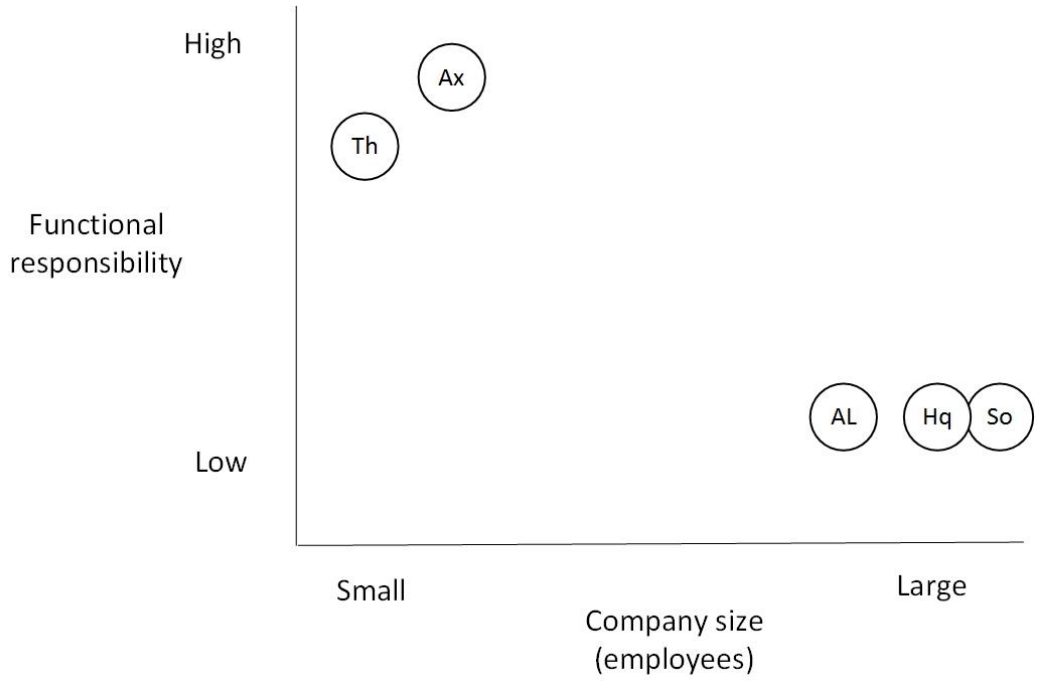

Figure 35 – Size of case companies

6.1.2 Decision

A majority of the decision propositions receive support from the case studies, as seen in Table 31. There are also several propositions which are unsupported, but not disproved, by a majority of cases. In addition, there are some which need further discussion since there is conflicting or contradictory evidence.

Table 31 – Cross Case analysis of decision propositions

Category	Proposition	Axis	Sony	Alfa Laval	Husqvarna	Thule	Total
Criteria	13 – Formal criteria important for structure	0	+	+	+	+	4+
	14 – Formal criteria drive company performance	-	-	+	0	+	0
	15 – Strategic goals should drive criteria	+	+	0	+	0	3+
	16 – Financial criteria is good as a complement	+	0	+	+	+	4+
	17 – Strategic criteria should sort out candidates	0	+	0	+	+	3+
	17a – Use of scoring/ranking/checklists	0	0	0	0	0	0
	17b – Use of visualization tools	0	0	0	+	0	+
	17c – Use of business strategy models	0	0	0	0	0	0
	18 – Criteria should be understood by organization	0	0	0	0	0	0
	19 – Roadmaps can connect to company strategy	+	+	+	+	0	4+
Decision makers	20 – Use of formal decision makers	+	+	+	+	+	5+
	21 – Decision makers at strategic level	+	+	+	-	+	3+
Variations	22 – Project importance should decide thoroughness	0	-	0	0	0	-

6.1.2.1 Supported propositions

It was clear that all cases supported use of formal decision makers as a vital part. The use of roadmaps to connect company strategy together with formal criteria to structure decision making were also supported by nearly all cases. Financial criteria was present in all cases and theory stated that overly relying on these criteria could misjudge riskier projects, which was observed as a risk in many cases. To balance this, more strategic considerations were present in several cases. It was used as a complement to the financial criteria in the form of informal criteria or in the sorting process. Many companies used roadmaps to select projects and ensure their strategic fit within the portfolio.

6.1.2.2 Unsupported or disproved propositions

Proposition 14 regarding formal criteria driving company performance was difficult to verify. Both due to the limited scope of the case study and conflicting evidence where Axis had low formality of criteria but high company performance and Sony Mobile had the opposite. Matching thoroughness to project importance was not used to any extent. The Sony case rather proved the challenges of such an approach. It could be explained by a lack of focus on data integrity which is not in line with what theory suggests. The different methods suggested by theory to score and compare projects were not found to be used to any extent in practice. The authors do not believe these are less relevant but rather that financial criteria and comparisons are relied upon instead, perhaps due to tradition.

6.1.2.3 Contextual aspects

The proposition suggesting that formal criteria drives company performance receives conflicting evidence from the case study, as seen in Figure 36.

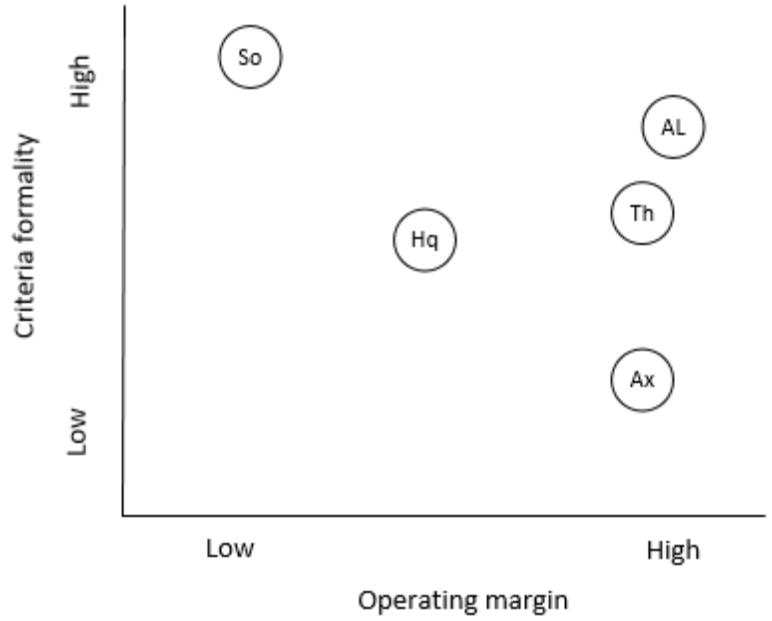

Figure 36 – Criteria formality compared against operating margin at case companies

The Alfa Laval and Thule cases suggest it is a positive aspect that contributes to the success of the companies. The Axis case instead suggests that too much formality will limit innovation and thus company performance. There is probably truth to that, which suggests it is important to consider the company's general attitude towards formality. The Sony case, containing one of the most formal processes, and their recent difficulties suggests formality is bad for performance. It is however difficult to attribute those difficulties only to product decisions. Their industry in general has had a trend where increased commoditization put pressure on margins. The contradiction of the case at Sony regarding the proposition can thus be partly disregarded.

The proposition of strategic goals driving criteria did not receive support from the Alfa Laval and Thule cases. This can be explained by the seniority of the involved decision makers. Since they are present, it is assumed they consider strategic goals when making their decisions. This explains why they were not using clearly defined strategic criteria to the same extent.

Roadmaps were another way to connect company strategy with the decision making. Thule was the only case that did not use roadmaps to the same extent, this is assumed to be due to the size of the company. They are smaller and all of the directorate, including the CEO, are present for the decisions which enables them to connect company strategy with the decision making.

The use of visualization tools is present only at Husqvarna. A possible explanation is the large variation in products and markets in which the company operates. These differences mean the decision makers need a more diverse and flexible input. In addition, the visualization's qualitative nature enables Product Managers to base input on market and industry characteristics.

6.1.3 Output

As seen in Table 32 the cases provide almost identical evidence in propositions related to the output. There are propositions with strong support and one which is contradicted by nearly all cases.

Table 32 – Cross case analysis of output propositions

Category	Proposition	Axis	Sony	Alfa Laval	Husqvarna	Thule	Total
Execution	23 – A clear, formal output based on decision is vital	0	+	+	+	+	4+
	24 – The decision should be a clear go/kill	-	-	+	-	-	3-
Follow-up	25 – Resource allocation should reflect decision	+	+	+	+	+	5+
	26 – Goals for next gate should be set if go-decision	0	0	0	0	0	0

6.1.3.1 Supported propositions

There is strong support showing that the decision should be reflected in future resource allocation in all cases. The credibility of this finding can be discussed since it, according to us, is strongly tied to the proposition to have a binary go/kill decision. If several outcomes are possible, including a greyscale in between go/kill, the decision will be reflected in the resource allocation as there is always the alternative to put the decision on hold. The formal output with a plan included also received support from almost all cases.

6.1.3.2 Unsupported or disproved propositions

The proposition to have a binary go/kill decision was least fulfilled in practice. All case companies except Alfa Laval employed at least one option to pause or hold and return to the decision point in the future. Some used this alternative of passing projects to await funding while others used it to give projects a new chance. Theory suggests this is the wrong approach since it will waste resources that could have been used for other, higher quality projects. Hence it was interesting to observe how few cases fulfilled this proposition. No evidence was found to support the proposition that new goals and criteria was set for the next gate if the project would be approved. This should be a reasonable approach but not one that is used in practice based on these findings. It is possibly due to the additional work needed to decide on new goals that most cases were found to use the same criteria throughout.

6.1.3.3 Contextual aspects

There are no major differences in the level of evidence concerning output propositions. Alfa Laval is the only company that employs a binary go/kill decision. This could be explained by the size of the company in combination with high senior management involvement. If the decision makers want to decide the fate of the project it is likely easier when there are only two clear options.

6.2 Complements to theory

There are several complements to theory found in the case study. They are found in all three components of the decision point. Their generalizability and dependence on contextual factors are further discussed below.

6.2.1 Input

A set of differentiated inputs or scenarios are very similar approaches which are both intended to examine the sensitivity of assumptions. Sony, Alfa Laval and Thule all use it which suggests it to be a value creator in the decision making. Sony is the most ambitious and creates entirely different scenarios, Thule and Alfa Laval use simple variations in price or volume as an automatic part of the input template. The practice in its simplest form should be a simple measure to increase the awareness of the assumptions made and their impact. The diversity of the companies, as seen in *Figure 37*, that use scenario analysis suggests there to be no specific contextual aspect is necessary for it to work.

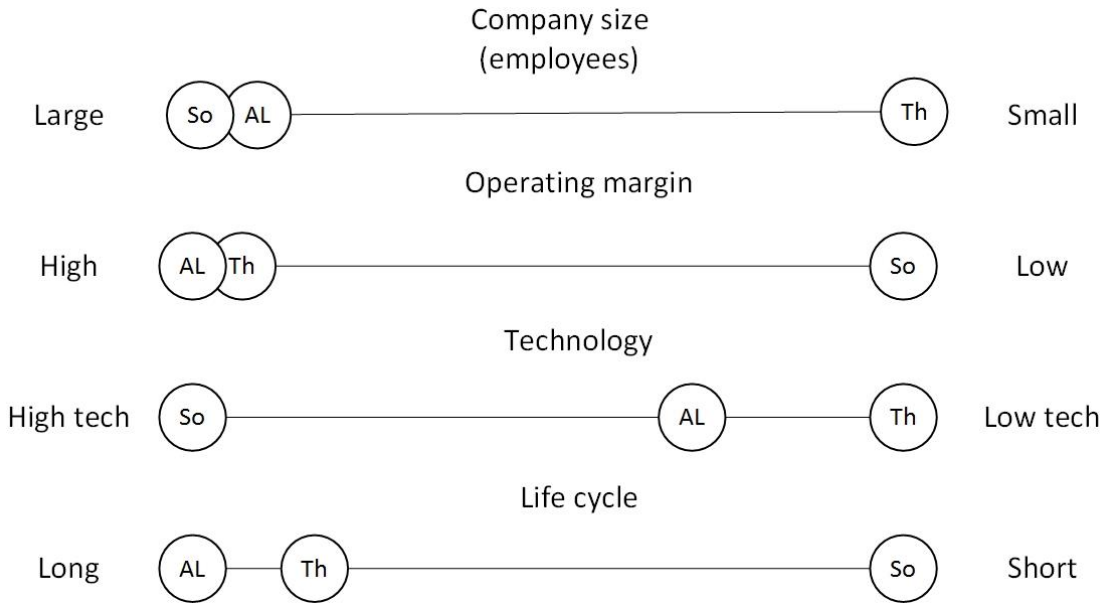

Figure 37 – Sony, Alfa Laval and Thule's contextual positioning

27. Differentiated input is a way of capturing uncertainty &

28. Scenario analysis can be used as a way of assessing the risks involved with sales projections

To ensure that time and resource plans are held in a project – Thule, Alfa Laval and Sony demand all products which are part of a project should be mentioned in the decision meeting. This can be seen as a way of minimizing unnecessary swelling of a project. It can avoid poor use of resources as the new products are not compared in terms of alternative resource use. Similarly to scenario analysis there is a diversity in the companies supporting the proposition. This would indicate it is a practice which is relatively independent of contextual factors.

29. All planned products in a project should be part of the input to the decision meeting

Thule has expressed importance of sanity checks of relevant assumptions. It is also the company which can be said to have the most ambitious preparations ahead of the meetings. In combination with the most senior decision makers this could explain why it works at Thule Group. It is likely that other companies have informal sanity checks of the information. However, a risk of not having formalized the practice could be that results, rather than the underlying assumptions, are examined. That could lead to poor assumptions slipping through. The high involvement of senior personnel is likely to be a strong enabler of this practice.

30. Sanity checks from relevant functions can increase data integrity in early assumptions

Thule Group has a high focus on product quality in R&D. This has led to a process where development and testing is done continuously using physical prototypes. A strong enabler of this practice is the focus on mechanical engineering. It is likely that this practice is harder to

implement with more complex, high tech products since more planning might be needed ahead of development. As seen in Figure 38, Thule is a stand-out in this aspect which would make for low generalizability of the proposition.

31. Early physical prototypes help ensure data integrity and product quality

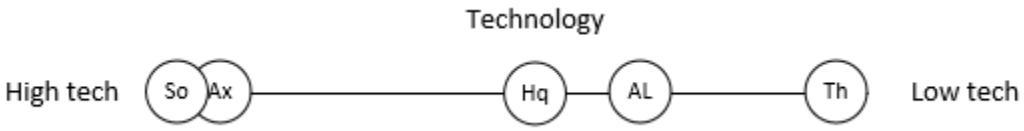

Figure 38 – Technology characteristics of case companies

All companies in the case study with the exception of Axis use a feedback loop of some sort. The main purpose is to ensure a continuously improved process and data integrity. Most of the decision making in the companies is relying on some sort of assumptions. The uncertain nature of assumptions makes it especially important to assess their quality. Having a formal assessment point in each project should be an easy way of improving data integrity and decision making. Four of the companies in the study employ a similar setup to ensure feedback. The logical reasoning and diversity of the companies suggest there is a high level of generalizability to the proposition.

32. Use of a feedback loop after product launch can improve data integrity and enable continuous process improvement

6.2.2 Decision

It seems that Axis is the company primarily valuing a looser process. There are tendencies at Thule for a pragmatic and loose process, but they still have a more formalized and ambitious data collection and follow-up. There are indications that the larger companies use more formalized processes, as seen in *Figure 39*, which could be motivated by the distance to senior decision makers. A closer distance could mean less need for formality.

33. Use of less formalized criteria enables a more innovative organization

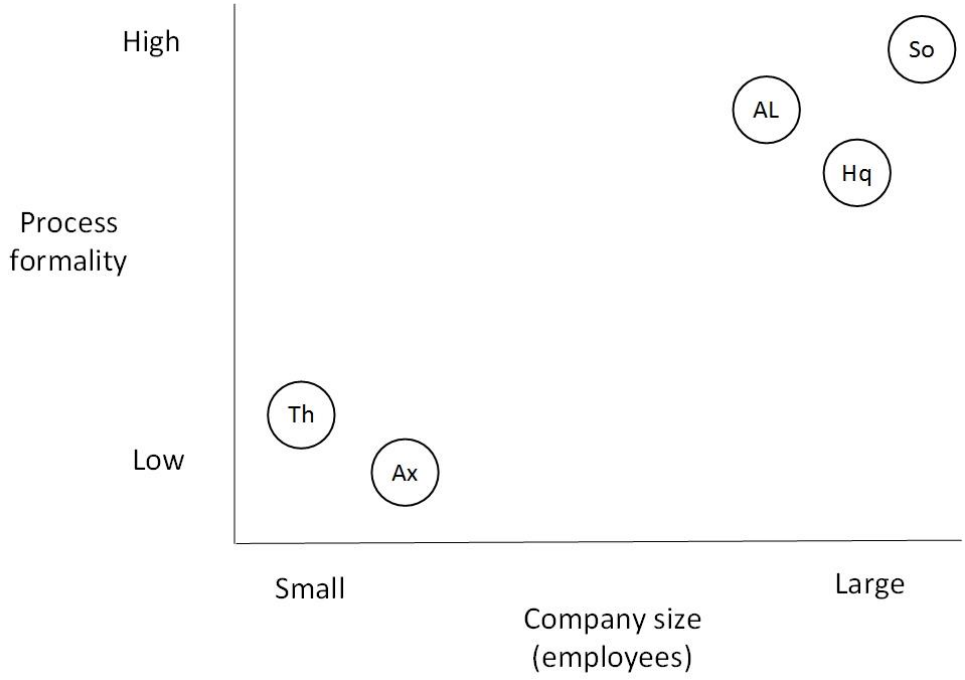

Figure 39 – Size of case companies

The companies examined generally employ the same process for all projects. This could be motivated by the potential confusion of using separate processes for different projects. Sony experienced large issues when trying to implement a simpler process since data integrity led to severe problems later on in the product's life cycle. It seems as if companies prioritize uniformity and the simplifications it brings rather than potential savings from flexible processes.

34. Loose criteria for low risk projects can lead to issues later on. Therefore, data integrity must be ensured also for these projects

Husqvarna is the company which has expressed the most flexibility in criteria weight between projects and business units. That is likely to be connected with the large size of the company, see Figure 39, and the differences between its business units. It seems however that the other companies all employ informal variations of this practice. It is most apparent at Thule and Alfa Laval where there is high involvement from senior personnel and their strategic priorities are continuously inserted into projects. There is no obvious contextual aspect which should hinder implementation of this proposition as long as the decision makers are of sufficient seniority.

35. Flexible criteria weight at different business units allow for customization of decision making based on unit specific strategic goals

All case companies use set times for decision making. Axis, Alfa Laval and Husqvarna evaluate roadmaps every six months to communicate future projects to senior personnel. Sony employed monthly decision meetings where projects could be evaluated. Thule in turn have slots every two weeks to enable continuous communication. It seems the companies are satisfied with this

structure and the quick decision making it enables. It is assumed that the frequency of these meetings should match the length of the product life cycle. As seen in *Figure 40*, it is fulfilled for Alfa Laval and Sony which have corresponding decision frequencies for the length of their product life cycles. Husqvarna and Axis are less aligned with the same decision frequency as Alfa Laval but shorter life cycles. Thule has the highest decision frequency paired with a long product life cycle, this might be explained with their relatively small company size. Overall, using set slots for decision making is used in all cases which ensures a high level of generalizability for this proposition.

36. Use of set slots for decision making can speed up decisions and thus make a more efficient process

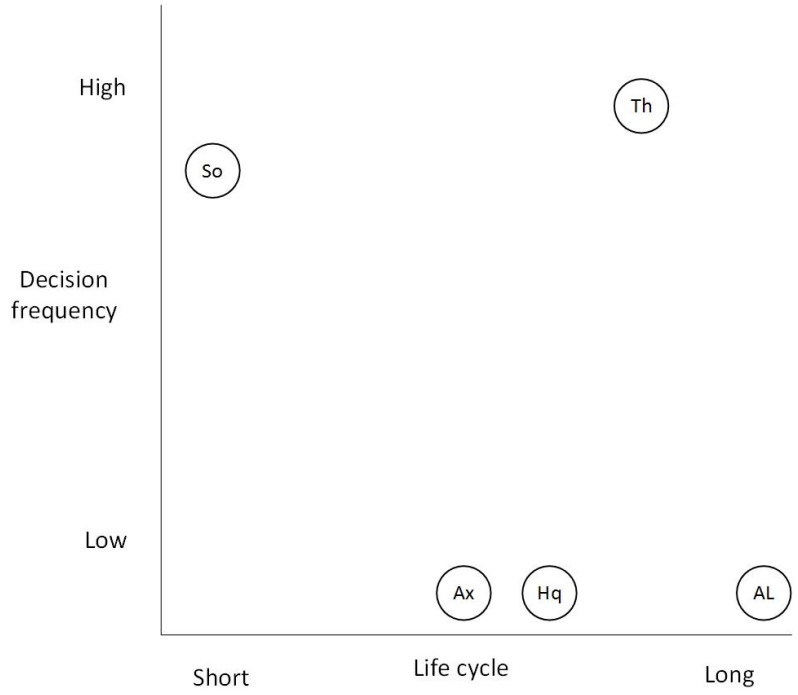

Figure 40 – Length of product life cycle and frequency of decision meetings

Formal strategic criteria with corresponding input seems to be implemented only at Husqvarna. There are however several companies using informal strategic criteria. Thule and Alfa Laval both use their high involvement of strategic decision makers to ensure strategic alignment of new products. Sony are considering strategic aspects although they do not have decision makers at the highest seniority level. Companies are thus employing either set strategic criteria or decision makers at a strategic hierarchical level.

37. Strategic alignment can be achieved through project involvement of personnel at a strategic level instead of formal strategic criteria

The increased margin for error Alfa Laval gets when using a higher goal for breakeven should not be a problem to implement at any other company even though it is not found anywhere else.

It appears to be a clever way of ensuring that each project is be able to cover the indirect costs resulting from the project that are not accounted for after the development stage. These criteria are strongly connected to limiting the number of projects, something which is a vital part in Alfa Laval's strategy.

38. *Time-to-million and time-to-two-times-investment can ensure that a project covers the hidden costs it drives*

6.2.3 Output

There are several companies that use roadmaps. However, Axis is the only company which has implemented roadmaps to communicate the decision making to the company. In other cases such as Sony, Husqvarna and Alfa Laval, the roadmap seems to primarily be a tool for the Product Managers to plan resource use. There seems to be no apparent reason for the roadmap not to be displayed to the rest of the company which suggests it could be implemented with gains in communication at a small cost.

39. *A roadmap can provide valuable cross functional communication after a development decision has been made*

Only Alfa Laval is using strict go/kill decisions while the other companies include a grey area in between. It could be a good addition to include a formal option to increase flexibility without losing structure. Thule's option of giving projects a go or hold decision with restrictions could be an addition to a structured grey area. As almost all companies employ some sort of grey area, it should be a good idea to formalize the option, regardless of contextual aspects.

40. *A formal hold decision option can increase the binary go/kill decision's flexibility and reduce the number of poor kill decisions due to bad timing*

Thule's high involvement of strategic decision makers, high frequency of decision meetings and structured preparations ahead of meetings enables it to function well without many kill decisions. The option of questioning projects continuously seems like a good option. However, it is probably dependent on the structure and involvement at Thule. In the structure of the other companies in the case study it might not be possible to implement this practice without changing other aspects as well. In addition, there is a risk that the informality of the decision is not providing enough transparency in a larger organization.

41. *Questioning and killing projects continuously enables more efficient resource use*

7 Modified decision model

A modified decision model will now be presented based on the empirical findings. Its components will be described and how they fit together. The propositions found to be the most relevant, based on theory and the cross case analysis, will be included in this modified decision model. This can be used to structure the decision making ahead of product development.

Based on theoretical propositions and the analysis of empirical evidence a modified version of the decision model, including propositions, is constructed. Some of the propositions are difficult to confirm or contradict on the basis of five case studies as discussed in the analysis. The propositions which are represented in the model are those which have the most theoretical and empirical evidence. Empirical propositions with proven generalizability have also been introduced into the model.

7.1 Model Description

The model, presented in *Figure 41*, has its starting point in company strategy which should drive the criteria to use. The criteria in turn decides decision makers and input needed for the decision. Output is then decided by the decision makers.

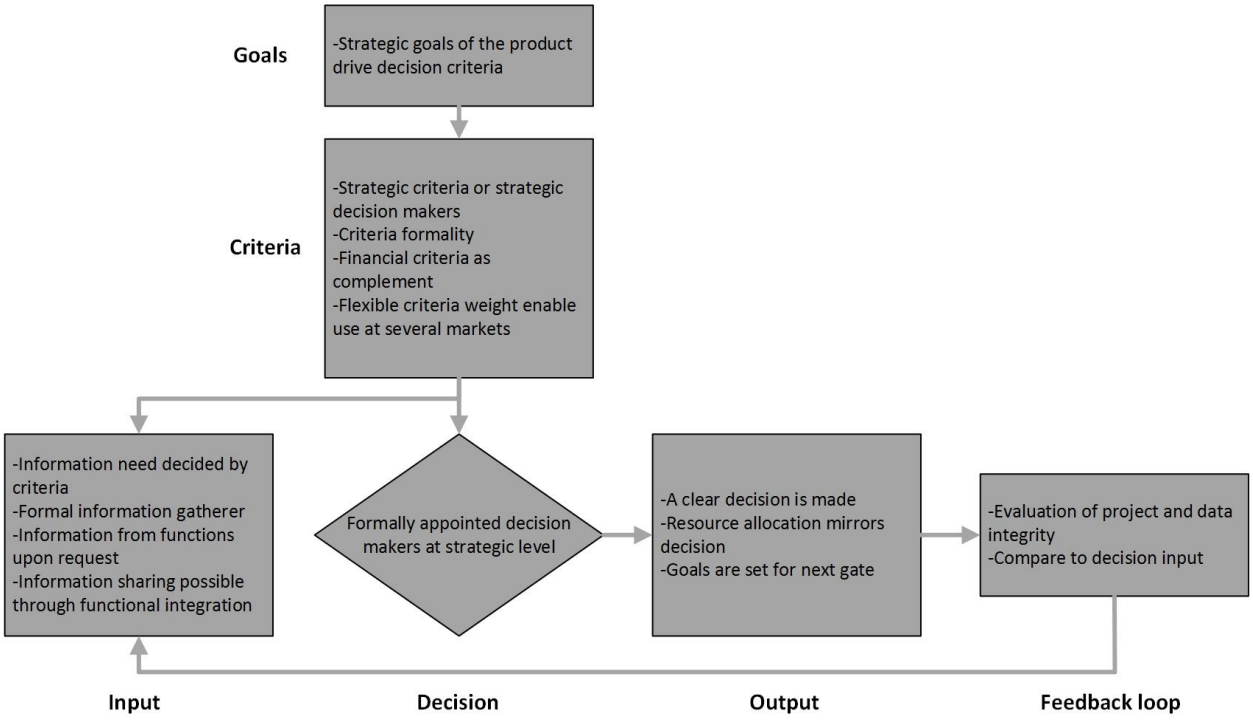

Figure 41– Updated decision model based on theoretical and empirical findings

7.1.1 Goals & Criteria

The overall goal of portfolio management is to connect the product portfolio and company strategy. Therefore, choosing criteria that are aligned with company strategy is important

according to theory (Cooper, et al., 1999; Kaiser, et al., 2015; Ulrich & Eppinger, 2012). It has been supported by the case studies that either use specific, strategic criteria, or use senior decision makers that are able to make decisions in line with company strategy. Using roadmaps is another way of connecting the company strategy together with these decisions (Cosner, et al., 2007).

Formal criteria are important to structure the decision making and enable comparison of projects (Cooper, 2011). Further, financial criteria is commonly used but should be used as a complement to other criteria (Jugend & da Silva, 2014; Cooper, et al., 1999) since the data is complex to quantify (Ulrich & Eppinger, 2012). The ideal combination is to use strategic criteria to sort out strong candidates and then using additional criteria to distribute resources between projects (Cooper, et al., 1999). Scoring/ranking/checklists (Jugend & da Silva, 2014; Lin & Hsieh, 2003; Bitman & Sharif, 2008; Cooper, et al., 1999), visualization tools (Mikkola, 2001; Jugend & da Silva, 2014; Cooper, 2011) and business strategy models (Cooper, et al., 1999; Jugend & da Silva, 2014) are examples of additional criteria to use. Empirical evidence has proved that visualization tools can be a flexible way to compare projects, for example by using matrices.

Empirical findings suggest that flexible criteria weights can be used as a way to tailor decision making for different business units where some units require differently weighted criteria. Ensuring that a project covers the hidden costs it drives after development can be done by use of criteria such as time-to-million and time-to-two-times-investment. These can also help to reduce the number of small projects.

7.1.2 Input

The information need is decided by the criteria, a higher number of criteria and higher sophistication increases the information need (Kaiser, et al., 2015). This information comes from different departments which is why collaboration is needed to gather it (Jugend & da Silva, 2014; Kaiser, et al., 2015). The case studies and theory show this can be ensured by an appointed information gatherer (Cooper, 2011), then departments should provide this information upon request (Ulrich & Eppinger, 2012). It can also be fulfilled by a high level of functional integration (Jugend & da Silva, 2014; Kaiser, et al., 2015). In this case, information sharing can increase and be more spontaneous.

The case studies further show the importance that all relevant products, including accessories, are specified in the project proposal. This to ensure that the project will be evaluated correctly and finished in time.

7.1.3 Decision Makers

Having formal decision makers is important for the process (Cooper, 2011; Jugend & da Silva, 2014), the strategic alignment of the decisions is also dependent on the seniority of the decision makers (Kaiser, et al., 2015; Seifert, et al., 2016). Regarding the decision meetings, empirical

findings show that the use of set time slots where senior decision makers are gathered can be used to speed up the decision process.

7.1.4 Output

Having a clear and formal output from the decision is important, this should include a plan for the continuation of the project (Cooper, 2008; Chao, et al., 2014). Emperical findings have proved it difficult to employ a binary go/kill decision, hence a formal hold alternative can be used to increase formality but still allow flexibility. Resources should then be allocated depending on the outcome of the decision (Cooper, 2008; Chao, et al., 2014). This means that a go-decision leads to that the project receives its allocated resources and a kill-decision strips the project of its resources. A formal hold alternative can be used if the project needs to be paused due to budget reasons. New goals to be reached by the next gate should be agreed upon when a project receives a go-decision (Cooper, 2008).

When the decision has been made, the roadmap is updated. Empirical evidence shows that this roadmap can then be used to communicate new products with the rest of the company.

7.1.5 Feedback loop

Data integrity is another critical aspect since the decisions made can only be as good as the information they are based on (Kaiser, et al., 2015; Cooper, 2011). This can be ensured through a feedback loop where initial estimates are compared to the actual results 6-12 months after the product has been launched. Several cases prove this to be an effective way to implement learning elements into the process to ensure improved data integrity. Scenario analysis and varying input variables is another way of assessing uncertainties in the estimations which is used in practice.

8 Construction of Decision Support Model at Axis

The chapter will describe the data collection at Axis based on interviews with different functions and a workshop with Product Managers. The data from the interviews and the workshop will then be used to construct an Axis-specific model. Finally, the proposed model is tested with relevant stakeholders at the company.

The focus of the chapter is on the R&D process rather than the roadmap process. The reason for this decision is to enable an implementation. The Product Managers will be the recipients of the recommendation and since the R&D process is the one they control; it is where our focus will be.

8.1 Current processes at Axis

The data collection on Axis' current processes is conducted through formal and informal interviews with employees. That information was complemented with data from the company intranet and discussions with company supervisors.

8.1.1 General process

Axis currently develops accessories through two different channels, essential accessories within camera projects and complementary accessories in separate projects. Accessories which are part of a camera project are developed by the camera team. Product Managers for the camera lines are the owners of these projects and decide which accessories are needed. There is a separate channel for accessories which are developed independently. The two accessory Product Managers are project owners and decide which projects to initiate. Accessories within these projects are evaluated and scrutinized to a larger extent than those within camera projects.

Axis conducts an ongoing roadmap process which results in a roadmap that is updated every six months. The purpose of the roadmap is to plan resources and communicate R&D efforts to the company. When a product has made it into the roadmap it is given an initiation date, when the project starts. The decision for cameras is made at project level and does not dig into each specific accessory included within the project. The focus is on the "main product" of the project which for camera projects is the new camera.

Figure 42 describes the process structure for R&D projects at Axis. There are seven stages, each followed by a tollgate. Each project is evaluated as one unit when decisions are made at important gates, similar to the roadmap process.

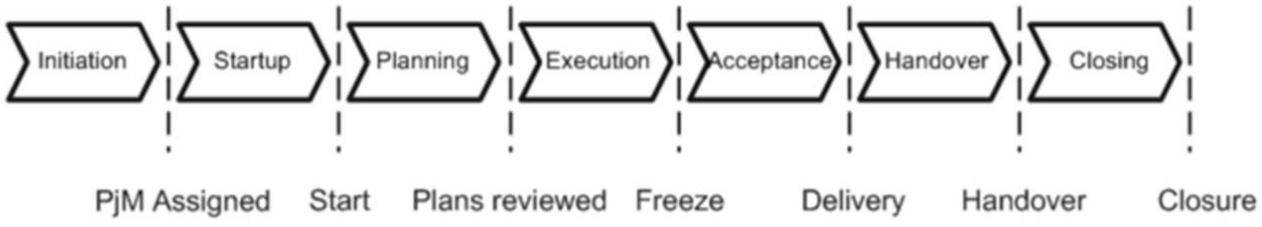

Figure 42 – Project process at Axis

There is a steering group that controls the tollgates within the R&D process. Members of the steering group normally include an Engineering Manager, Product Manager, Operations representative and a project sponsor, appointed by the CTO. The relevant tollgates, where the decision model can be applied, are Start, Plans reviewed and Freeze. After the Freeze tollgate, the design is set and industrialization starts.

At the *Start meeting*, the project presents the following deliverables:

- Business case – A financial assessment of the project, focuses on payback time
  - *COGS*
  - *Retail Price*
  - *Project cost and investments*
  - *Expected sales volume*
- Time plan – A schedule for the primary product's tollgates
- Resource need – How many and what type of resources are needed

At the *Plans reviewed* meeting there is a large focus on planning the upcoming project. The purpose of the meeting is to approve a time plan, Product Requirement Specification (PRS) and evaluate risks involved in the project. If changes have been made to the deliverables from the start meeting, they are brought up here.

At the *Freeze* meeting, the final design is set and no more changes are allowed. Now, the focus will be on securing the quality of deliverables and industrialization. When frozen, tools are ordered for production of the process.

8.1.2 Accessories in camera projects

As mentioned, project related decisions are focused on the primary product of the project. For camera projects, this results in a low focus on accessories. The significantly higher complexity of developing a camera leads to higher resource use. The budget impact of introducing an additional accessory is therefore limited. However, at an aggregate level, the development of accessories can consume a lot of the project's development resources. For some up to 30% (Lundqvist, 2016), although the average is lower.

The focus on the cameras adds difficulties in other aspects as well. The accessories are usually only mentioned in the form of a list at the start meeting. If changes are made to that list it should

be brought up to the steering group. However, interviews suggest that this is not always the case. Project schedules are normally not taking accessories into account which can lead to shortage of resources and delays. *Figure 43* describes what deliverables related to accessories is currently required in the camera projects.

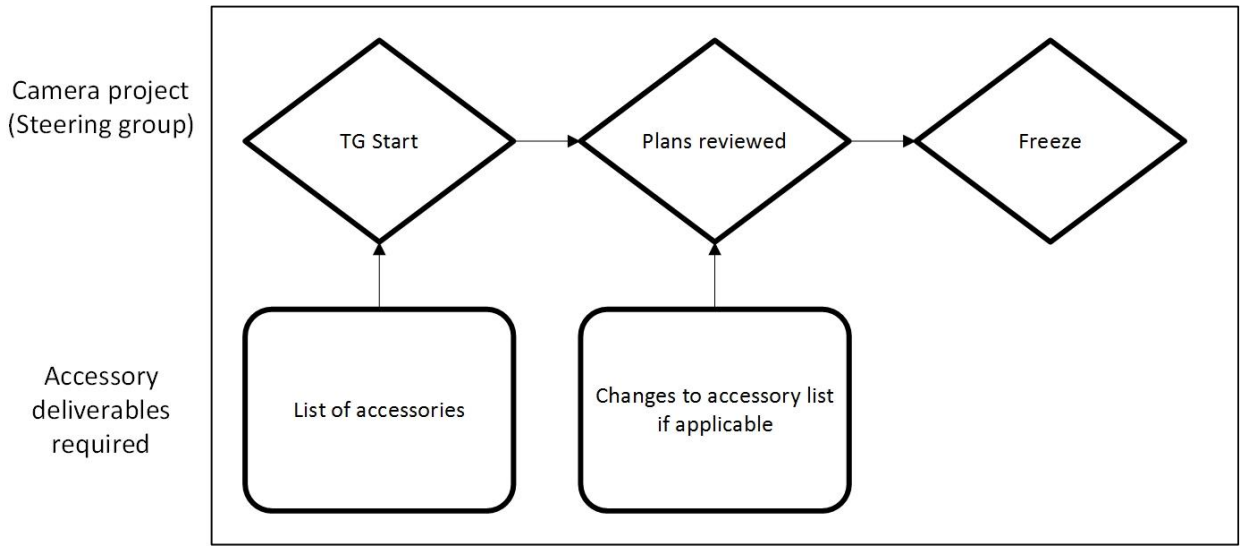

Figure 43 – Description of accessory data required in the camera projects

8.1.3 Accessory projects

In accessory projects the focus on accessories is forced to be higher. The project goes through the same stages and tollgates as a camera project. The primary product of such a project is the accessory and as such it receives all of the focus.

The process and decision makers are the same in an accessory project as the general process model. *Figure 44* describes the deliverables required for an accessory to go through the tollgates.

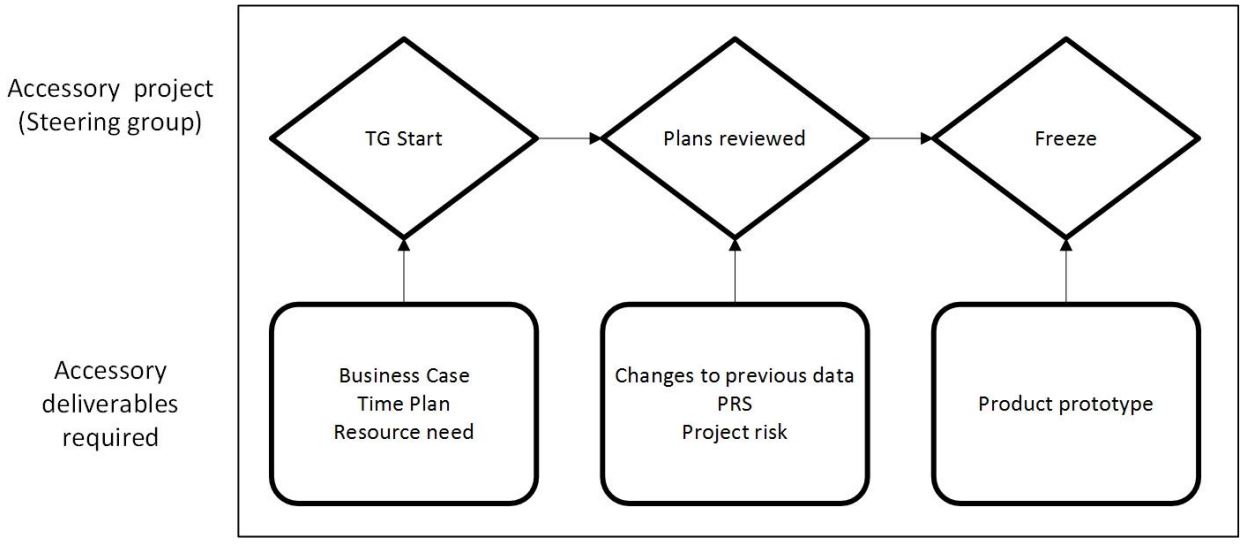

Figure 44 – Description of accessory data required in the accessory projects

8.2 Interviews

The purpose of the interviews was to get a cross-functional view on accessories. A number of functions contributed with their view on accessories, see *Appendix III: Interviews conducted at Axis* for a full description of the interviews. The focus in the interviews came to be on accessories developed within the camera projects as they were found to contribute to the majority of the problems.

8.2.1 Accessory purpose

The interviewees had a consistent view on the purpose of accessories. They all mentioned all or several of the following reasons:

- *Ensure complete solutions.* Axis as a market leader are expected to deliver full solutions and act as a single point of contact for their customers. Accessories help tailor the cameras to each application and thereby expand their range of use.
- *Ensure quality of the entire solution*. By developing accessories themselves, Axis can ensure a high quality and fit with their cameras.
- *Make additional money*. Accessories developed by Axis can be upsold together with the cameras. These bear their own costs and contribute to company profit.

8.2.2 Problem description

The range of problems mentioned in the interviews were wide spread. To structure them, they were divided into categories. Table 33 describes the problems mentioned and the categories they belong to. It also marks out which function(s) mentioning them.

Table 33 – Summary of problem descriptions from interviews

Category	Problem	Industrial Lead	Product Manager	Supply Accessories	EM Accessories	Project Manager	Mechanical Engineer	Demand Planning	Sales
Data integrity	Data quality	x	x			x			
	Uncertain gross margins due to promotions		x						
	No sanity check until ramp up		x						
	Unclear market need	x					x	x	x
Stock keeping	High stock levels			x					
	High MOQ requirements			x					
	Prognosis difficulties			x				x	
Project planning	Optimistic/no time tables			x	x	x	x	x	
	No technical specification					x	x		
Follow-up	No R&D resource tracking					x			
	No data feedback loop	x	x		x	x		x	
Number of products	Too many products	x	x	x	x			x	x
	Low product kill rate	x		x					
Low priority	Low priority	x	x		x		x	x	x
Product owners	Different project owners				x				
	Poor overview of products				x				x

8.2.2.1 Data integrity

Data integrity is related to the quality of the information that current development decisions are based on. The interviewees which bring up these aspects are primarily those with insight into the deliverables. Product Managers, together with the Project Manager, are responsible for providing these deliverables to the decision makers. It seems the information which is currently used is uncertain. This leads to decisions based on gut feeling in many situations. Industrial Lead is the function responsible for communication between R&D and operations They state that this uncertain information leads to problems in the product industrialization stage.

8.2.2.2 Stock keeping

The large number of accessories in Axis' system is causing difficulties for several functions. Demand Planning are experiencing trouble with projecting the often volatile sales. The interviewee from supply experiences that the combination of high minimum order quantities (MOQs) and uncertain projections leads to high stock levels.

8.2.2.3 Project planning

The planning of accessory development within camera projects is considered a problem by several interviewees. Generally, they believe the projects would be more efficient if resource planning was done more thoroughly for accessories. The interviewees directly involved in camera projects, the Project Manager and Mechanical Engineer, press the need for a technical specification of the accessories. This is always done for the cameras but more seldom for the accessories.

8.2.2.4 Number of products

All functions who deal with day-to-day activities consider the high number of accessories a problem. Two functions mention the low product kill rate as a strong contributor. The result is a general increase in the complexity related to operations and administration.

8.2.2.5 Low priority

The low priority of accessories in camera projects is thought to cause problem by most functions. It has a strong connection to many of the other problems brought up in the interviews. By many, it is mentioned as a root cause for most other problems.

8.2.2.6 Product owners

The engineering manager, who coordinates R&D resources, mentions the different project owners as a problem cause for accessories. The setup where all Product Managers are able to develop accessories leads to poor portfolio overview. This in turn leads to unnecessary development of accessories and a lack of holistic thinking.

8.3 Focus group – Workshop 1

In addition to the interviews, a focus group was held together with two Product Managers at Axis with the purpose to assess and prioritize input from the interviews. Another purpose was to gain more insight into the future users of the model and also what barriers might exist to implement such a model. The results will be presented below, for a more detailed description, see *Appendix IV: Workshop 1, Product Management.*

8.3.1 Strategy and Purpose of Accessories

At first, the purpose of the accessory portfolio was established. It was agreed that the strategic goal of product accessories is to ensure complete, high quality, solutions to the customer. This is in line with Axis market leader strategy which focuses on complete solutions.

8.3.2 Discussion and Prioritization of Problem Areas

The problem areas encountered in the initial interviews were:

- Stock keeping
- Number of products

- Product owners
- Data integrity
- Project planning
- Low priority

From these, it was agreed that stock keeping and number of products were problem areas that are difficult to affect in the short term. Rather, these could be affected in the long term through the use of a more formalized way of working with accessories. Difficulties regarding different product owners were considered a deeper rooted problem. It was thought to be difficult to address without significant, organizational changes. Therefore – data integrity, project planning and low priority were seen as the problem areas which should be prioritized initially.

8.3.3 Possible Criteria

Based on these problem areas, we started discussing possible criteria that could address them. Two types of criteria were discussed, checklists and stricter financial criteria. Checklists could be used to formalize the decision making by ensuring that certain input is collected before the accessories proceed to development. Stricter financial criteria could be used to compare different accessories against each other and also to ensure the financial viability of each accessory. Additionally, having a separate freeze meeting for accessories was discussed to increase focus.

8.3.4 Contextual Aspects & Implementation Challenges

During these discussions, a few contextual aspects regarding accessories were encountered that would affect the design of our model. It was clear that there is a resistance to having too much formality in the process. This was encountered during the case study at Axis and was even more prominent when discussing accessories. The current structure gives the Product Managers few or no requirements for how they develop accessories within camera projects. One of the participants said the less “paperwork”, the better. This suggests that introducing too strict demands will only ensure the model will not be used at all.

There is currently no decision point where accessories are evaluated and approved within the camera projects. The format used for their cameras is integrated in the roadmap decision. This is not a viable alternative for accessories due to the amount of new introductions and low financial priority of each accessory. Therefore, a new decision point needs to be introduced and integrated within the camera projects to function properly.

Other contextual aspects such as company size and operating margin are considered to affect cameras and accessories in the same way. Therefore, the company wide figures are used. The life cycle follows the life cycle of the camera and since it is short, the decision making needs to be swift to cope with this fact. Regarding technology, a majority of accessories developed at Axis involve more mechanical elements and less technological elements than their cameras, the technological sophistication is therefore lower. This mapping can be seen in Figure 45 and Figure 46.

Figure 45 – Axis wide contextual aspects

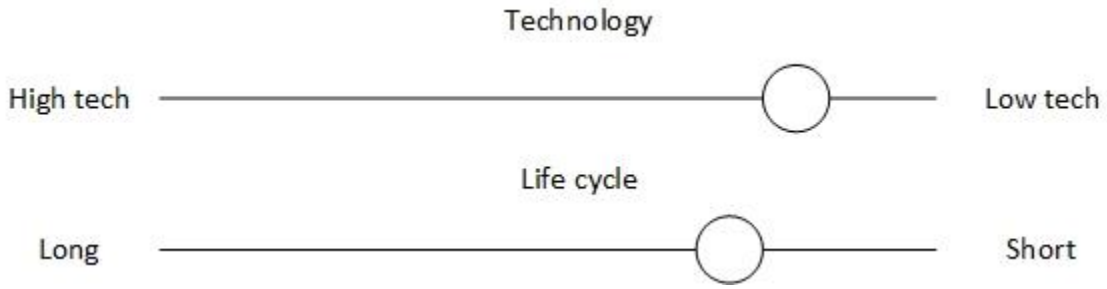

Figure 46 – Accessory specific contextual aspects

8.3.5 Choice of Criteria

The strategic purpose of accessories, as an enabler of complete solutions, can usually only be fulfilled if the accessories are developed in time to be released with the cameras. The problems related to project planning and low priority of accessories are in conflict with this purpose and needs to be addressed. The same goes for data integrity, if this is not ensured accessories will have the wrong prognosis which affect the availability to the customer.

At the same time, the contextual aspects need to be considered. These suggest that the criteria cannot be too arduous to conform to or else the old way of working will prevail. Introducing too much formality and criteria is therefore seen as the most prominent risk to be considered.

Theory suggests that relying too much on financial criteria will limit innovation (Jugend & da Silva, 2014; Cooper, et al., 1999). Therefore, a combination of strategic and financial criteria should be used.

At the freeze meeting, there will be no new criteria. It will be the same setup as currently employed for cameras and accessories but at a separate accessory meeting.

8.4 Construction of Model

Through discussions with the Product Managers, who are the recipients of the model, the focus is decided to be on accessories within camera projects. Accessory projects are already evaluated and contribute to a minority of the new accessories. An important aspect of this model is therefore to align these two channels.

8.4.1 Strategic goals

Through the interviews and discussions in workshop 1, a number of strategic goals for accessories were established:

- Increase the priority level of accessories
- Increase data integrity to reach better decisions
- Structure resource planning of accessory development

8.4.2 Criteria

To satisfy the strategic goals, criteria were decided upon in order for an accessory to pass into development. The criteria are of three different kinds:

- Checklist
  - Classification
  - Early Product Motivation (EPM)
  - Product investigation
  - Time plan
  - Technical specification
- Business case
- Investment/benefit matrix

The *checklist* will increase priority level for accessories by forcing the project to consider them earlier. The time plan ensures the project inputs each accessory into the project plan which makes the resource use more efficient. The classification is assessing product criticality for essential accessories. If the accessory is absolutely necessary for the camera to be sold, it is critical. If the accessory is not expected to drive camera sales at all it is classified non-critical. There is also a semi-critical option which is introduced to ensure not all accessories are classified as critical.

EPM motivates the development of a new accessory. This is required for the cameras today and the accessories should be no different. The product investigation forces the project to examine what types of current accessories the company already has. This because it is more efficient to remodel an existing one than to start from scratch. It should also be examined what other cameras a new accessory could be compatible with. Finally, a technical specification should be required. It specifies what requirements the product should live up to when it is developed. It is done for cameras and some accessories and is requested from people working in the projects.

The *business case* is a sanity check of how profitable the accessory will be. It focuses on what attachment rate, percentage of cameras are sold with the accessory, is needed for a pay back of one year. There is no required attachment rate, the purpose is rather to make a quick assessment of how financially viable the product is. Another purpose is to have numbers to compare with after the accessory has been released, this feedback loop will be described later on. The model is made as simple as possible to make it user friendly and easy to implement.

The *investment/benefit matrix* is a way for the project to communicate a cost-benefit analysis of the accessory. The dimensions of customer value and investment level together with the classification of the product are used for this qualitative assessment. An example of the matrix is seen in *Figure 47*.

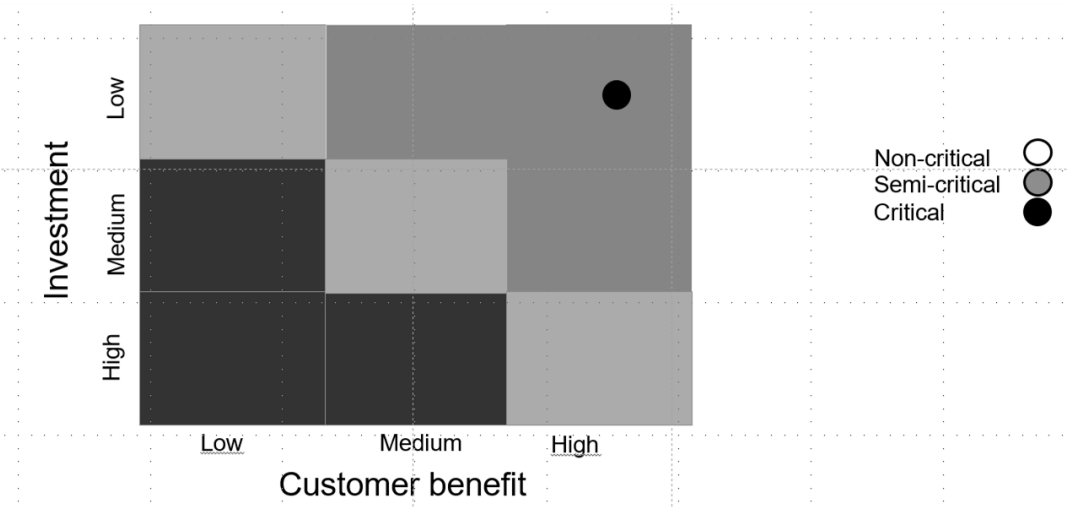

Figure 47 – Investment/benefit Matrix as a suggested deliverable

8.4.3 Input

To assess the criteria, certain information is required, as described in *Table 34*. The sources describe where the information can be found at Axis. Input with previous experience are criteria which can be assessed by the project itself.

Table 34 – Input to criteria, including sources

Sources	**Input deliverable**	**Criteria**
Qualitative - previous experiences	Level of criticality	Classification
Qualitative - previous experiences	Purpose of the product	Early Product Motivation (EPM)
Current product portfolio Product Managers	Applicable cameras and products	Product Investigation

Qualitative - previous experiences	Plan for development and toll gates	Time plan
Previous projects Product Manager for accessories	COGS Investment & resource use Retail price Sales volume of camera	Business case
Previous projects Qualitative - previous experiences	Investment & resource use Customer value	Strategic product matrix

8.4.4 Decision makers

To ensure a strategic level of the decision making a certain seniority is necessary. At Axis, the steering group is deemed an appropriate forum for the decisions. It includes Engineering Manager, Product Manager and representatives from Operations and CTO.

8.4.5 Output

The output of the decisions regarding accessories should have three formal options when in camera projects:

- *Go* – The product is developed according to plan
- *Kill* – The product is not deemed attractive enough and will not be developed
- *Go to new project* – The product will be developed but within another project. This can be applied to accessories that are developed for more than one camera.

8.4.6 Feedback loop

To ensure continuous learning and improve data integrity, it is proposed that a post-launch review is introduced to the current process. Twelve months after a product launch the original deliverables should be revisited with key stakeholders. Suggested participants are the Project Manager as well as Product Managers for accessories and the camera. By doing this, the quality of information and decisions is believed to increase over time. It is proposed that this should be done for the entire project, including the camera, since it is not done today at all.

8.5 Model in Current Structure

To implement the model at Axis it is important to consider where in the current process the proposed actions will fit in. Through discussions with the main parties involved, primarily Product Managers and Project Managers, a structure has been developed. *Figure 48* describes in which stage each aspect will be taken into account.

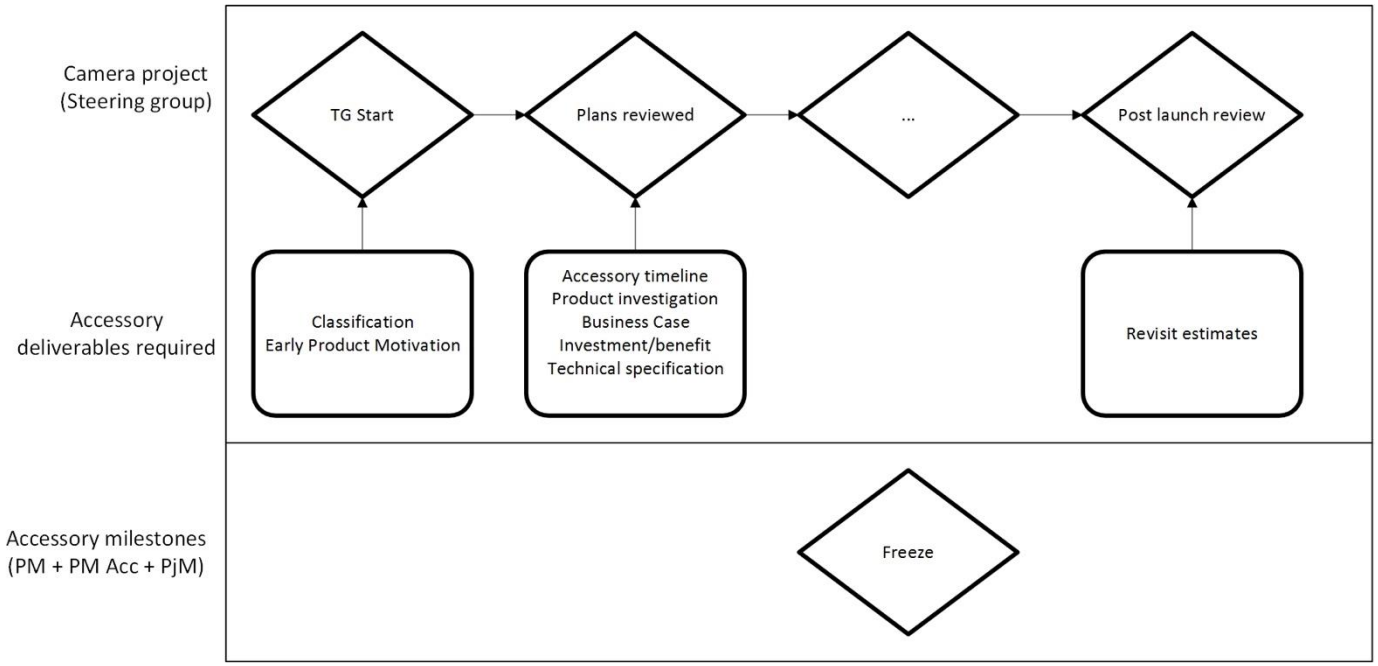

Figure 48 – Implementation plan at Axis

At the start meeting of the project, a list of accessories with classification and EPM is required. It is preliminary and serves as a measure to raise early accessory awareness in the project. The plans reviewed meeting for cameras is where accessories are examined more in depth. Here the deliverables are a time plan, business case, product investigation and strategic product value matrix. At this point the project should know which accessories are needed for the camera.

In addition to the criteria based decisions there will be a freeze meeting for each separate accessory. The aspects of the meeting will be the same as for a camera, mainly to have a formal point where no further changes are allowed so that tooling can be ordered. Today, there is only a freeze meeting scheduled for the camera and nothing for accessories. To increase the efficiency of these meetings, only the Project Manager and Product Managers for the camera and accessories need to be present.

Finally, there will be a post launch review meeting for the entire project. This will take place 12 months after product launch to revisit the project and enable a continuous learning.

The suggested model is not consistent with the unit of analysis as described ahead of the case study. However, to fit in with Axis current structure and process it is necessary to spread the suggestions over several decision points. The post launch review can be argued to be out of scope. Based on case studies it was deemed important enough to be suggested anyway. The same goes for the dedicated freeze meeting which takes place after a product has been developed. The meeting is important to avoid unnecessary tooling costs based on the interviews at Axis.

8.6 Validation at Axis

A workshop was held with the people affected by the suggested new way of working. The purpose was to validate the model and promote the suggestions to gain support for implementation. A description of the workshop and the attendees is seen in *Appendix V: Workshop 2, test and validation at Axis.*

8.6.1 Evaluation of model

After a presentation and ensuing questions regarding the model components, the attendees gave their feedback on two dimensions:

- *Value creation,* evaluate how the component will help make better decisions or create value for the process in other ways.
- *Resource use,* evaluate how complicated and time consuming the component is to realize for each accessory.

These dimensions were chosen to handle the aversion to formality that was encountered in the interviews and workshop. For the model to be used, it was important that the users perceived it to create more value than the resources it consumed.

Figure 49 describes the average scores for each component. The darker fields in the matrix indicate favorable areas, they create more value than the resources they consume.

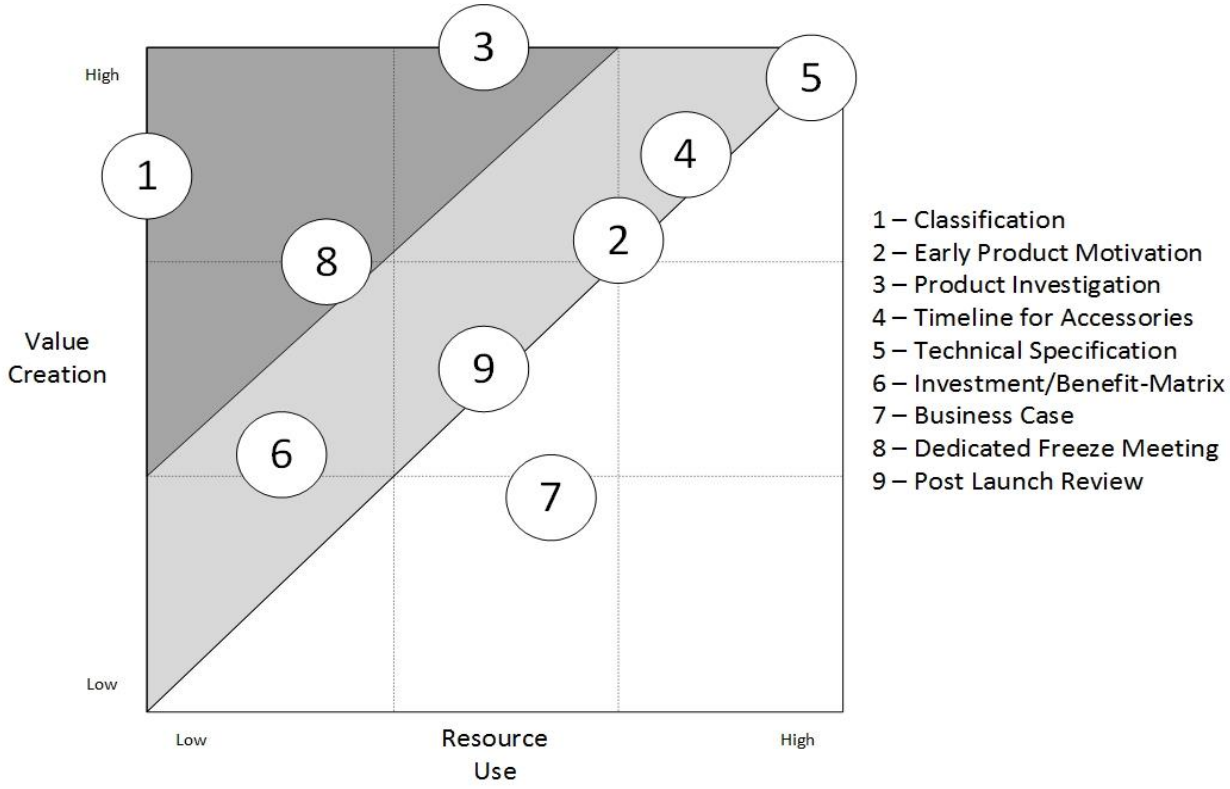

Figure 49 – Evaluation of suggestions in workshop 2

8.6.1.1 Evaluation of suggestions

Classification of accessories with regards to their criticality for camera sales is a simple measure. The workshop attendees believe the data is already available and can easily be presented. They also believe this will improve decision making since it will increase focus on accessories early on.

Early Product Motivation (EPM) is believed to create value but at a relatively high price in resource use. The attendees did however accept the suggestion after we clarified that technical aspects will be part of the technical specification. An EPM describing the purpose of the accessory, expected COGS and release date was deemed simple and effective in the beginning.

Product Investigation was judged a vital deliverable which is shown in the high value creation. The attendees agreed there is a lot of potential of introducing wider portfolio perspective early on in the accessory development.

Timeline for accessories is already supposed to be a part of the deliverables but is rarely present. The participants agreed it is creating value but see it as a relatively time consuming task. The Project Manager present saw the most value in the suggestion. When agreeing on that the Project Manager should be responsible for creating it, everyone voted for implementation.

Technical specification was agreed to be the most resource consuming of the suggested deliverables. At the same time, it is deemed essential since other deliverables such as timeline and product investigation are dependent on it. It was agreed to be the Product Manager's responsibility to request it and the Project Manager's responsibility to supply it. Since the project and Product Managers attending the workshop were pushing for implementation and saw great value in it, this suggestion was agreed upon.

Investment/benefit matrix received moderate but positive reviews. It was seen as a low investment in resources that could provide some value. The attendees were questioning the value of doing one for each accessory and considered it to be of more value if all of the project's accessories would be in the same matrix. Then, comparisons and discussions about the relative value of each accessory would be possible. This was agreed to be a valuable tool after making this change.

Business Case was the suggestion which received the lowest grading in terms of value creation versus resource use. Attendees did not see a great value since the project is currently evaluated through a business case already, but only for the project as a whole. When discussions continued it was concluded the data needed would be available "for free" when other deliverables were gathered. The conclusion was that the business case should be used as well, since it would add no additional work and enable more transparency for the project financials.

Dedicated freeze meeting was seen as a good value creator without too much resource use needed. Skepticism was directed against adding another meeting to the process. It was agreed that physical meetings would be required only when deviating from the agreed deliverables at the

plans reviewed meeting. Introducing a formal point is important to ensure an informed decision before ordering tooling since these comprise the bulk of an accessory's costs.

Post launch review received a varied response. Some Product Managers did not see much value as they look at old projects before starting a new, similar one. It was discussed that it could be valuable to the people involved in the project, engineers and Project Manager. Although it is an additional meeting to the Product Manager's schedules it was considered relevant. The formalization is important to ensure a learning organization.

8.6.2 Validation summary

Axis' general aversion against too much formality was present during the workshop. The suggested model was however well received overall. Also, the discussions were more focused on implementation issues than on questioning the model components. A majority of them were agreed upon and a meeting with the R&D directors was booked to initiate an implementation of the changes into Axis current process.

9 Conclusion & Contribution

This chapter will present a summary of findings from this study. Conclusions based on purpose and research questions will be presented. Contributions to the body of knowledge are summarized. Finally, limitations of the study and suggestions for further research are discussed.

9.1 Conclusion

The steps of the study and its methods have been designed to fulfill the master thesis' purpose:

"To design a practically viable decision support model that enables more informed decisions with regards to accessory development at Axis Communications."

To make informed decisions is a vital part of any company's operations. In the context of development decisions and their inherent uncertainties it is particularly important and difficult. Theory suggests processes and formality to structure decisions and enable comparison. Formalized decision criteria, data collection and decision makers are widely mentioned as success factors.

The case study companies and their practice introduced additional ideas and concepts. There was a higher focus on practicality and pragmatism since theoretical concepts need to fit with the company's operations. In addition to new ideas, the multiple case study made it possible to enhance credibility of the suggestions to Axis. Although the focus was on a general decision point rather than accessories specifically, it provided examples where theoretical concepts were used in practice.

The study then shifted focus to Axis and its two separate flows of accessories, camera and accessory projects. The large differences in formality quickly focused the study on accessories within camera projects. They have a very limited focus on accessories which enabled a higher improvement potential. The aim of the final suggestion was to enhance its practical viability by integrating it within their current process. In interviews with important stakeholders it was clear that it would not be possible to remake the camera process for the sake of accessories. This limitation made it important to fit the suggestions into the current structure and process at Axis in order to gain acceptance.

Research questions have been answered continuously through the report and are summarized below.

RQ1 – "What does the decision point look like according to theory?"

A conceptual model of the decision point was developed based on findings within the areas of portfolio management and the Stage-Gate perspective on NPD. This resulted in a model (*Figure 50*), consisting of the components input, decision and output. Theoretical propositions were developed to describe each component.

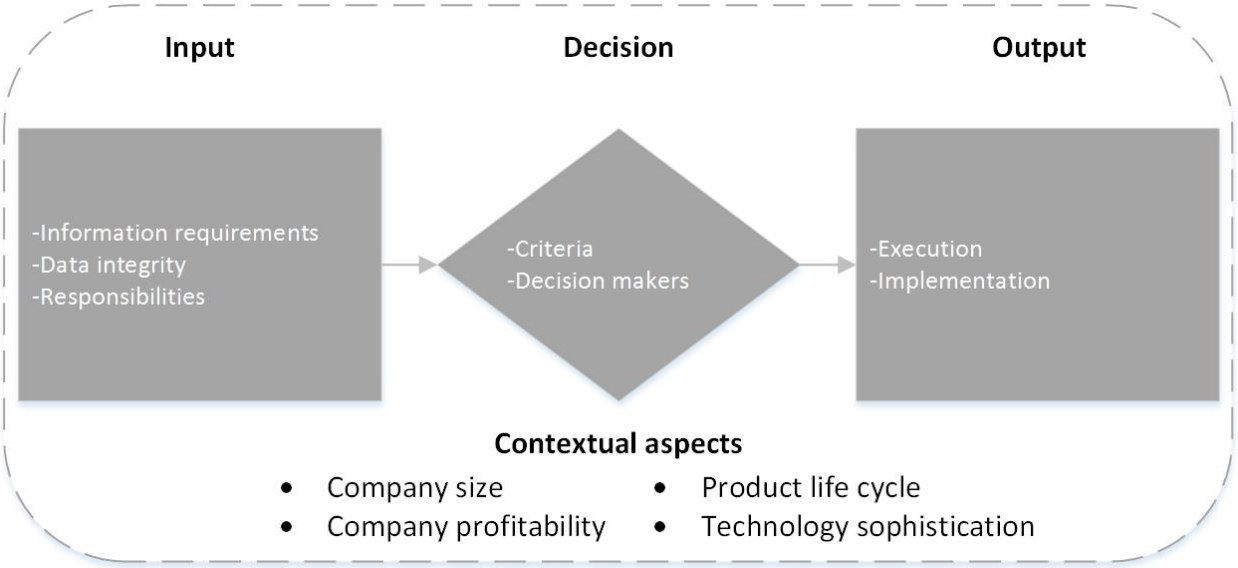

Figure 50 – Theoretical framework used in the study

Input consists of the information required to make the decision, the quality of that information and the people responsible for gathering it. Theory stresses the need for high quality information to make the right decisions. This information collection requires functional integration and collaboration across departments.

Decision describes the criteria used to evaluate projects and the decision makers involved. The criteria range from financial criteria to other qualitative and strategic criteria. In literature, the use of formal criteria is essential for company performance. While financial criteria remain the most commonly used, aligning and introducing strategic aspects is essential. Decision makers should be formally appointed and be on a corresponding seniority level as the decisions they make.

Output describes the outcome from the decision. Firstly, in terms of its execution which we have defined as making the decision to let the project through the gate or not. Secondly, in terms of implementation which we have defined as the continuation of the project. Theory stresses the need for a formal output where a project either receives a go or kill decision. This output should be reflected in the future resource allocation and goals for the project's next gate, if it receives a go decision.

Contextual aspects were introduced to the model to help explain similarities and differences that later would be found in the case study. Company size and profitability, product life cycle and technology sophistication were found to be relevant aspects.

RQ2 – "What does the decision point look like in practice?"

Findings from the case study were used to confirm or disprove the theoretical propositions. In addition to this, new propositions were developed based on empirical findings. Combining the

theoretical propositions supported in practice with empirical propositions that had high generalizability resulted in the model described in *Figure 51*.

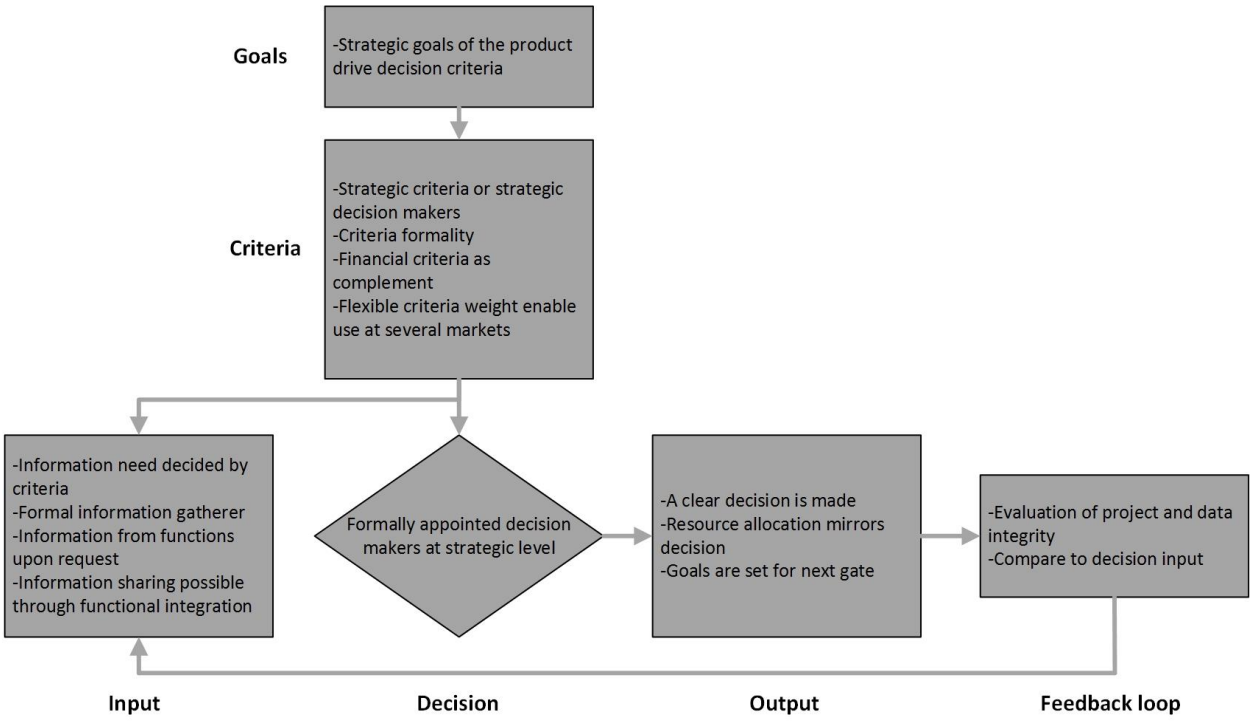

Figure 51 – Conceptual model of the decision point after the multiple case study

Important components that were added to the theoretical model were *goals*, *criteria* and *feedback loop*. The updated model describes the preferred order for how to design the decision point. Starting with the strategic goals of the product, these should decide what criteria to use to reach these goals. The criteria then decide required input and what decision makers are needed to make the decision. Following the decision, a formal output and new goals are set for the next gate. When the product is released, a post-launch review is held which compares the initial input deliverables to the actual outcome. This way, the decisions will become better over time since learnings from previous projects will be formally introduced into the decision point.

RQ3 – "How can these findings be implemented in the context of Axis' accessories?"

Interviews with various functions were held to gain an understanding of current processes as well as the purpose and current challenges with accessories. A workshop with Product Managers used these findings as well as the empirical and theoretical results to distil the most important aspects. Focus of the workshop was on the overall goals and which criteria should be used in order to reach them. We then came up with suggestions that would fit into Axis' context and current operations. Since much emphasis was put on solutions which would be possible to implement, all suggestions would have to work in Axis' context. Through continuous discussions with our

stakeholders, the recommendations were anchored in the organization. Figure 52 describes how the final recommendations are placed within the current process for camera projects.

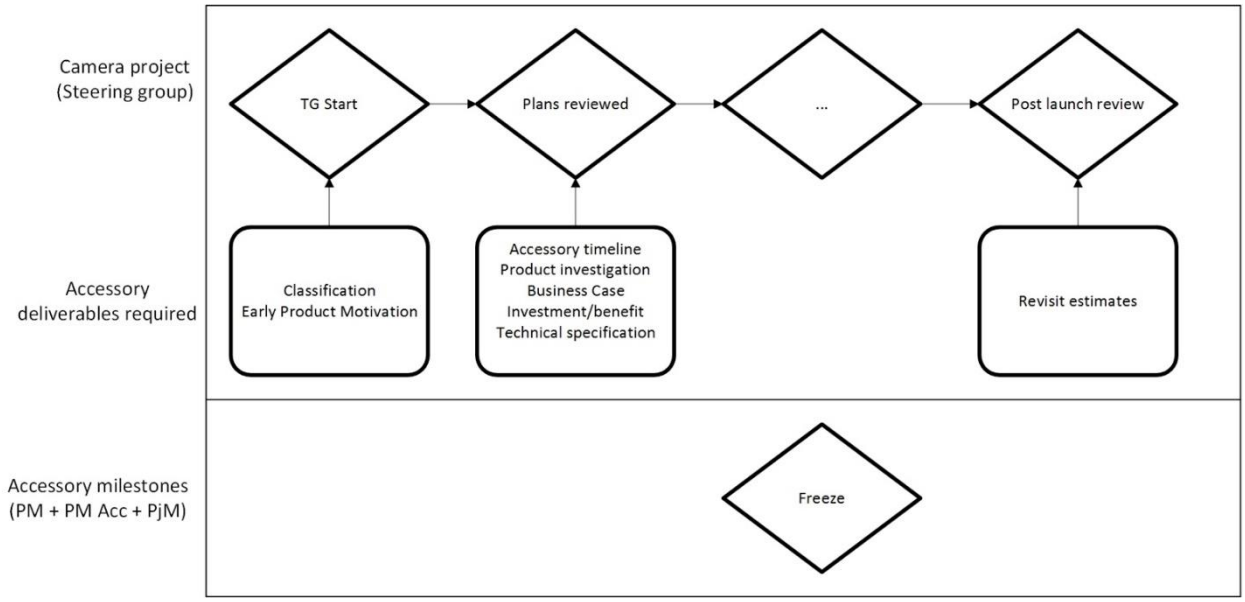

Figure 52 – Suggestions for Axis and their place in current structure

There are three main recommendations:

- Introduction of *accessory specific deliverables* at the start and project review meetings.
- Formalize the *freeze meeting* for all accessories before ordering tools.
- Introduce a *post launch review* of projects to enable a learning process.

These recommendations were tested with important stakeholders at a separate workshop. They evaluated and discussed how they would work in practice and how their day-to-day work would be affected. The overall assessment was positive and the recommendations were accepted.

9.2 Contributions

To examine contributions to the body of knowledge we have compared our findings to existing theory. This chapter discusses the report's contributions on a high level and does not go down to proposition level. That discussion concerning generalizability can be found in the *Cross Case Analysis.*

This research has been focused on providing a viable model for making more informed decisions within accessory development. The empirical research was not focused on accessories but on general product development. It did however add interesting ideas that were tested for their generalizability and added to the model. The importance of having a feedback loop in the decision making process was stressed in all cases to enable a learning process. Several researchers stress data integrity as an important aspect in decision making (Cooper, 2011; Kaiser,

et al., 2015; Jugend & da Silva, 2014; Chao, et al., 2014; van Oorschot, et al., 2010). Our findings suggest that a feedback loop is a good way to operationalize the data integrity aspect.

The generic decision model and how to decide on criteria to use at a company have been conceptualized in the study. It contributes to theory by suggesting a way to decide criteria, input and decision makers by starting with the strategic goals of the company. These aspects have been examined separately by several authors (Cooper, 2011; Ettlie & Elsenbach, 2007; Jugend & da Silva, 2014; Cosner, et al., 2007; Patterson, 2005).Our model suggest a way to operationalize the practices. The combination of theory and practice adds a dimension of credibility to the model.

By introducing the model in Axis' accessory development it was necessary to include goals for Axis at large and accessories. The fact that accessories are not the primary product mean they have to adjust to the cameras. This study has started to look into some of the aspects to consider in decision making for accessories, a field with limited previous research.

9.3 Limitations

As time is limited in a master thesis, simplifications and delimitations have to be made. This leads to limitations in the results, some of which are presented here.

The time limitation in the study made it necessary to choose and contact companies early for the multiple case study. The ambition of interviewing senior personnel made this even more important. The short time frame limited the possibility to choose companies based on contextual aspects, as they were chosen before the theoretical framework had been fully developed.

The study and its unit of analysis had a rather large scope. As companies work differently it was not always evident what aspect should be analyzed. It is possible that the answer would have been different if a different person would have been interviewed. We tried to handle this by interviewing senior personnel. However, more time and more interviewees would probably have given deeper and more accurate insights.

As the model was adapted to Axis' operations, company stakeholders stressed the importance of fitting it into the current processes. By limiting solutions to their current context, the probability of implementation was increased at the cost of a more innovative, ground breaking solution. Some ideas which could have been introduced with a freer approach are discussed in future research.

9.4 Future research

Future research is divided into recommendations for Axis, the principal company, and academic literature.

9.4.1 Principal company

Recommendations for Axis' handling of accessories are based on our findings from the company study. There were aspects which did not fit into the scope or within the company's camera

project structure. As mentioned, the focus on implementation meant there were recommendations which were not considered in the initial adaptation. These suggestions can be seen as interesting next steps to follow the initial recommendations.

- Introduce a portfolio planner for accessories to enable a better overview of projects and product development.
- Develop all accessories in their own projects to increase focus on these products. Resources should then be allocated from camera projects to these projects.
- Examine the possibility to modularize accessories to limit the need for new products and increase supply chain efficiency.
- Portfolio analysis, this to challenge current preconceptions on what accessories create the most value for the end customer. A more detailed cost/revenue analysis would be rewarding here.
- Involve full life cycle aspects into product decisions. Now, much focus is early in the product life cycle when making decisions. Expanding that view into considering the full life cycle, including operational challenges and end-of-life considerations, would likely be beneficial

9.4.2 Academic Literature

The academic research has been focused on generic solutions to decision making. Some ideas to further develop the body of knowledge are suggested:

- Further examine how development decisions should be made for accessories that support a company’s main product.
- Further study what contextual aspects are most relevant when designing a decision model for product development. We believe our study only scratched the surface.
- Study how companies should work with projects including multiple products in a stage-gate setup.
- Examine how to consider supply chain aspects in product development. What is the potential for improvements and cost savings if the entire life cycle is considered?

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Appendix I: Case study protocol

To be prepared for the multiple case study a case study protocol is constructed where the logic is planned and presented. This includes research questions and how they will be answered.

Research question

The case study is made to answer RQ_2 and parts of RQ_3 presented in the introduction:

> *RQ_2 "What decision criteria do companies use in practice?"*
>
> *RQ_3 "How can these findings be implemented in the context of Axis' accessories?"*

RQ_2 Will be answered in full by the data collected in the case study whereas RQ_3 will be partly answered by putting the criteria the companies use into context. Contextual aspects to study are company size & profitability, product life cycle and technology sophistication. It will not answer the question entirely but enable the question to be answered later.

The decision point is conceptualized based on theory in *Figure 53*. It is thought of as a system with the components input, decision and output. Input contains the deliverables, decision the criteria and decision makers and output the execution and implementation of the decision.

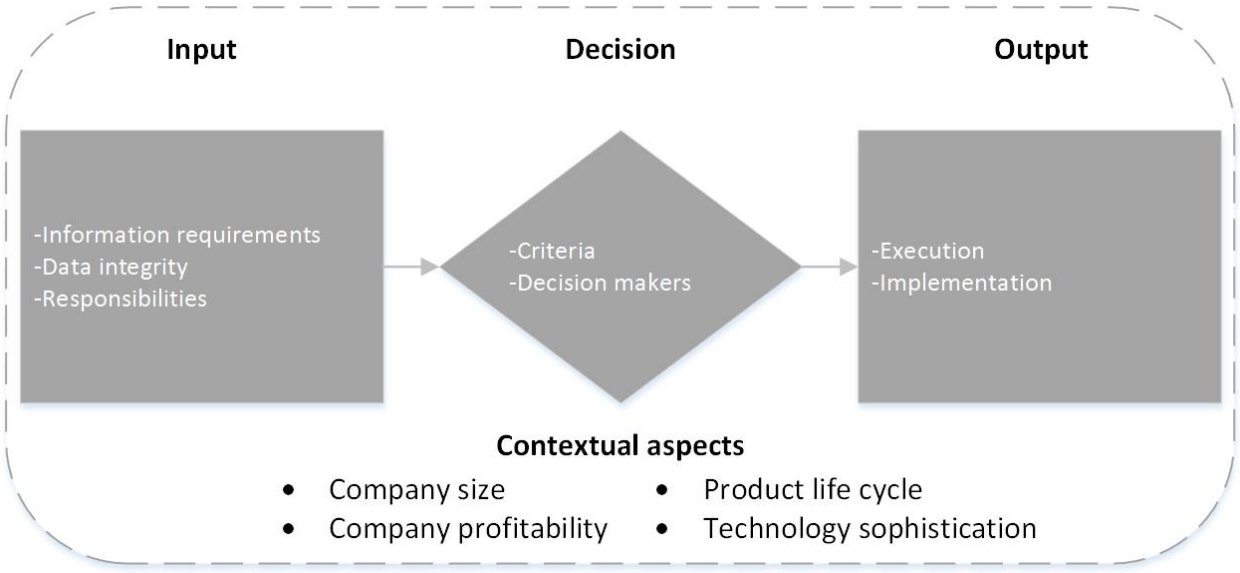

Figure 53 - Decision point aspects studied in case study

Credibility

As a means to ensure validity and reliability in the case study measures will be taken, described in *Table 35*. The tactics are based on 3.5 Reliability and validity.

Table 35 - Credibility tactics used in the case study:

	Tactic	**Description**	**Applied in**
Construct Validity	Triangulation	Multiple sources of evidence for vital data	Data collection
	Establish chain of evidence	Plan data collection based on research questions	Data collection
	Draft report reviewed by key informants	Supervisors at Axis and LTH read report	Composition
Internal Validity	Pattern Matching	Evidence from study is compared to theoretical framework	Data analysis
	Explanation building	Create understanding by analyzing links between factors found	Data analysis
External Validity	Replication logic	Cross case analysis to motivate recommendations	Research design
Reliability	Case study protocol	Planning of case study prior to execution	Data collection
	Summary sent to interviewee	Interviewee reads and approves case description	Data collection
	Case study database	All interview notes and open sources are saved	Data collection

Data collection

The data will be collected through research and interviews based on a four step approach:

1. Research through open sources prior to interview(s)
2. Interview(s) conducted based on interview protocol
3. Additional research conducted to complement interview
4. Interviewee review and comment on case description to ensure reliability

Case selection

The companies used in the case study were selected based on a few core criteria. Given these criteria, the authors and employees at Axis contacted relevant companies.

1. *Access.* The company and relevant interviewees were interested in participating. There was data available about the companies' operations and characteristics.
2. *Internal R&D.* The company had internal R&D and took development decisions in-house.
3. *Sells their own developed products.* In line with the internal R&D criteria, companies which were only trading products were not considered.
4. *Use decision criteria before R&D.* The companies used decision criteria to choose which products to develop. There was a point before development where the decision was made.

In addition to these core criteria, additional dimensions were considered that would serve to give a variety of companies to compare.

5. *Variation in contextual aspects.* To get a broad view, cases representing variations in the contextual aspects were used. These were discussed in the theoretical chapter and were used in the case study to explain patterns and differences between the cases. The contextual aspects were:
    - *Company size*
    - *Operating margin*
    - *Technology character*
    - *Length of product life cycle*
6. *Customized criteria.* It should be tested if companies work differently with different kinds of products and what those differences are based on.

The companies which fulfilled core criteria are listed in Table 36, including interviewees and industry. To provide further credibility to the study, Axis was used as a test case. This to provide credibility to the study and ensure the quality of the data collection protocol (Yin, 2009).

Table 36 – Companies participating in the multiple case study, PM – Product Manager

Company name	**Industry**	**Interviewee(s)**	**Criteria Fulfilled**
Axis (Camera R&D)	Electronics	-Kent Fransson, PM -Andres Vigren, PM -Petra Bennermark, PM	1,2,3,4,5
Thule	Consumer Goods	Eric Norling – PM Director	1,2,3,4,5
Sony	Electronics	P-O Bergkvist – Former purchaser Sony Sara Wall-Sörensen – Former PM at Sony	1,2,3,4,5
Husqvarna	Construction and Gardening	Anna Annvik – Director PM	1,2,3,4,5
Alfa Laval	Process industry	Anna-Maja Eriksson - PM	1,2,3,4,5

The characteristics of the case companies are described in *Figure 54*. As seen there is a significant variation in the relevant aspects. The aspect of customized criteria was not reached as it was difficult to examine ahead of interviews.

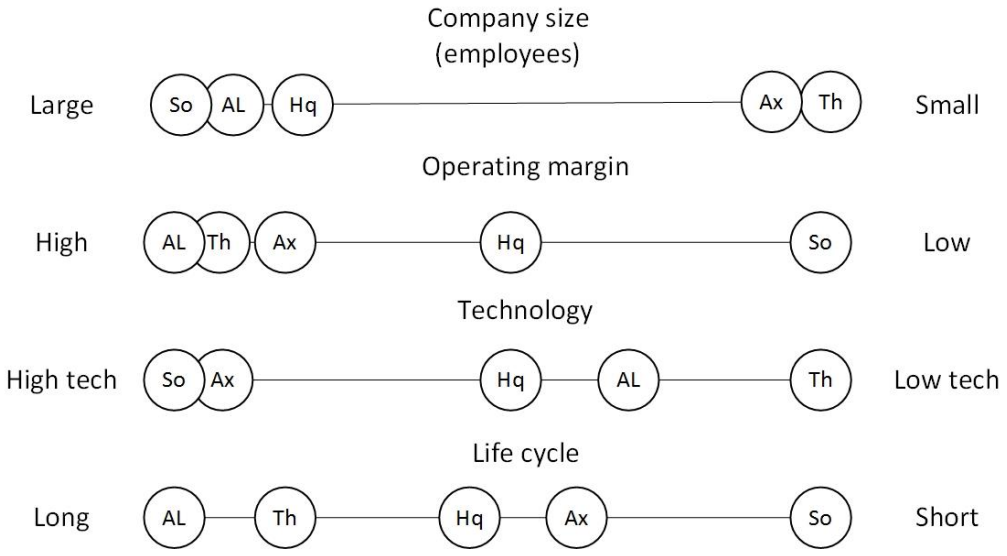

Figure 54 – Case company characteristics. Ax=Axis, AL=Alfa Laval, Hq=Husqvarna, So=Sony, Th=Thule

Expected findings

The motivation of the study is to examine the decision point ahead of product development. To put the findings into context, information regarding the contextual aspects was gathered to map and compare them against each other.

Outline of case study report

- Presentation of the company and people involved in the study
- Identification of the decision point within the specific case
- Description of how they work with the decision point - based on framework
    - *Input*
        - Information required – what deliverables do they gather?
        - Data integrity – how is data quality ensured?
        - Responsibilities – who gathers the information?
    - *Decision point*
        - Criteria – what criteria are used to evaluate the project?
        - Decision makers – who evaluates the project?
        - Variations – Are project treated differently?
    - *Output*
        - Execution – what decisions are available?
        - Implementation – what are the next steps after the decision?
    - *Satisfaction*
        - What is the degree of satisfaction with current way of working?
- Description of contextual aspects and how they are impacting how the company works with the decision point
- Summary of the above in the format seen in *Table 37.*

Table 37 – Conceptually clustered matrix display used for individual case analysis

Input	Decision	Output	Contextual Aspects
Information requirement	**Criteria**	**Execution**	**Strategy, Market and Company**
Data integrity	**Decision makers**	**Implementation**	**Product & technology**
Responsibilities	**Variations**		

Interview guide

The interviews start with a contextual introduction of the company to get a background for the following questions. A first version of the interview guide was written based on theory. That version was tested on the Axis case and further developed before being used in the other cases.

The interview is semi structured and held based on the structure:

- First question, let the interviewee speak freely
    - Complimentary questions if not covered

Each interview is recorded to enable verification and replay parts of the interview when doing the write-up. One of the authors is responsible for interviewing and the other is responsible for taking notes.

Contextual aspects, if not answered before interview

- Company background
    - Turnover, number of employees
    - Company profitability
    - Strategic goals/priorities
    - R&D spending
- Product characteristics
    - Product life cycle
    - Technology sophistication
- Organization
    - Structure of company
    - NPD's place in structure
    - People responsible for NPD decision
    - Level of priority

Decision point aspects

General questions

1. How do you decide which products to develop
2. Describe the decision making process before a product is going into development
    a. If possible using a process map drawn or based on company guideline
3. What are the typical steps
4. Are they always the same or vary between products
    a. What determines the variation
    b. Do you distinguish between important/not important products
5. Who is responsible for the decision point

(Show the theoretical decision point in a Stage-Gate system to make them understand that we are looking for the decision point ahead of NPD)

Input

6. What information is required
    a. How long does it take to gather
    b. Is it always the same information
7. How do you ensure data integrity
    a. How reliable is the information gathered
    b. Do you follow-up on the information after launch
8. Responsibilities
    a. Where does it come from
    b. Who is gathering it
    c. Is it always the same people
    d. Other variations
9. Can we see an example of input deliverables to a typical decision meeting

The decision

10. Who are the decision makers
    a. Who is involved
    b. Roles in the company
    c. Who makes the decision
    d. Who has final say if there are different opinions
11. Explain the decision making and what it is based on
    a. What are the decisions based on
    b. Is it always the same criteria
    c. Is there a clear structure to the decision making
12. What types of criteria is used
    a. One or several
    b. Weight of each criteria
    c. Are there tools to help in the decision making
    d. Do everyone understand why the criteria are used
    e. What is the motivation behind them

Output

13. What are possible outcomes from the decisions
    a. Are there several
14. What happens for each outcome
    a. Is there a structure to what comes next in each outcome
15. Who is responsible to implement the decision
    a. Role
    b. Always the same person
    c. Variations

Satisfaction

16. What is the main purpose of the decision structure
    a. Why was it implemented
    b. What are the goals
17. How do you rate your process
    a. What is good
    b. What could be improved
    c. Does it serve its purpose
    d. Are the goals reached
    e. Does everyone understand the structure
18. Is it aligned with the rest of the company's operations
    a. Strategic goals
    b. Other goals
    c. Have you had to make concessions in the decision making due to other goals
19. What would you change
    a. Improvement opportunities
    b. What are the weaknesses
20. Do you see any trade-offs that you have to make when designing:
    a. The process as a whole
    b. The decision point itself

Research Timeline

Activity	Time Period	Description
Research Initiation	18 Jan – 29 Jan	Pre-study to define scope of the study
Develop RQs	25 Jan – 29 Jan	
Develop methodology	25 Jan – 19 Feb	Reviewing methodology literature and setting up constructive approach and multiple case study method
Literature review	25 Jan – 12 Feb	Reviewing portfolio management and the Stage-Gate perspective
Synthesis of literature	12 Feb – 26 Feb	Reviewing literature findings and constructing theoretical framework
Find and contact case companies	15 Feb – 26 Feb	Contacting relevant persons at
Develop interview guide	22 Feb – 4 Mar	Develop interview guide for case study
Seminar with supervisor	2 Mar	
Conduct case study interviews	**Axis** (26 Feb, 4 Mar, 14 Mar) **Husqvarna** (15 Mar) **Sony Mobile** (16 Mar, 17 Mar) **Alfa Laval** (16 Mar) **Thule** (31 Mar)	Interviews focused on the companies' development decision point
Documentation of interview study	26 Feb – 25 Mar	Case descriptions, single case analysis
Constructing modified decision model	28 Mar – 8 April	Cross-case analysis, pattern matching and new version of model
Develop interview guide	4 April	For interviews at Axis
Interviews at Axis	Cathérine Welander & Mattias Forsmark (6 April) Erik Mårtensson (6 April) Calvin Lee (8 April) Åsa Strömblad (8 April) Janne Lundqvist (12 April) Larissa Eng (14 April) Lena Kastor & Tobias Gard (14 April) Markus Lai (25 April)	Discuss purpose, challenges and solutions of accessories at Axis
Workshop 1	15 April	Discuss interview findings and accessory specific decision model
Constructing accessory specific decision model	11 April – 2 May	Developing the final construct
Workshop 2	29 April	Demonstrating and testing final construct

Appendix II: Interview guide, interviews at Axis

Introduction

1. How do you come in contact with product accessories in your daily work

Problems with accessories

2. What is the main purpose of the product accessories in your opinion
3. What problems do you see with product accessories in your daily work
    a. What do you hear from colleagues from different departments
    b. Are these problems linked to accessories developed within camera projects or those developed within their own projects

Which can be affected in the development stage

4. Based on these problems, which do you believe can be affected in the development stage

Criteria needed in decision

5. Would it be possible to sort out certain accessories in the development stage
    a. What criteria would then be needed
6. Are there risks present with applying stricter criteria to product accessories
    a. What risks would that be

Information need

7. What information would be needed for the suggested criteria
    a. Is this information available
    b. Is it credible

Other questions

8. Do you think change takes a long time in your organization
9. How are new ways of working acknowledged by the employees
10. What format do you think the powerpoint should be in
    a. Powerpoint/Excel
11. Is there anyone else we should speak to

Appendix III: Interviews conducted at Axis

Table 38 – Summary of interviews conducted at Axis

Function	Problems	Possible Criteria	Information need
Cathérine Welander & Mattias Forsmark Industrial Lead Accessories 2016-04-06	-Too many -Data integrity -Low product kill rate -Unclear market need -No data feedback loop -Low priority	-Market need -Need for NEW product? -Rigid business case -Multiple use	-Market analysis -Current portfolio -Historical data
Erik Mårtensson Product Manager, Accessories 2016-04-06	-No data feedback loop -No sanity check until ramp up -Data integrity -Uncertain margins due to promotions -Low priority	-Margins -Need for NEW product? -Multiple use	-Pricing data -Current portfolio
Calvin Lee Purchaser Supply Accessories 2016-04-08	-Too many -Low product kill rate -Partly high stock levels -High MOQ requirements -Prognosis difficulties -Optimistic time tables	-Market need -Need for NEW product? -Rigid business case -Up sales potential -Multiple use	-% of total camera sale -Current portfolio
Åsa Strömblad Engineering Manager, Accessories 2016-04-08	-Too many -No data feedback loop -Optimistic/no time tables -Different project owners -Poor overview -Low priority	-Need for NEW product? -Multiple use -Project schedule -Attachment rate -Rigid business case	-Current portfolio -Historical data -Old projects -Accessory selection tool
Janne Lundqvist Project Manager	-No data feedback loop -No business case -Optimistic/no time tables	-Project schedule -Rigid business case -Technical specification	-Current portfolio -Historical data -Old projects

2016-04-12	-Low priority -No technical specification -Data integrity -No R&D resource tracking	-Portfolio analysis	-R&D resource use
Larissa Eng Mechanical Engineer 2016-04-14	-Low priority -Optimistic/no time tables -No technical specification -Unclear market need	-Project schedule -Rigid business case -Technical specification	-Historical data -Old projects -Market analysis
Lena Kastor & Tobias Gard Demand Planner 2016-04-14	-Too many -No data feedback loop -No business case -Low priority -Optimistic time tables -Unclear market need -Prognosis difficulties	-Project schedule -Rigid business case -Need for NEW product? -Multiple use -Attachment rate -Market need -Sanity check of business case	-Market analysis -Historical data -Old projects -Current portfolio -Attachment rate
Markus Lai Technical Sales 2016-04-25	-Too many -Unclear market need -Low priority -Poor overview	-Need for NEW product? -Multiple use -Market need -Rigid business case	-Current portfolio -Market analysis -Accessory selection tool

Appendix IV: Workshop 1, Product Management

Information	Participants
Workshop 1 – discuss problem areas and accessory specific decision model 2015-04-15	• Erik Mårtensson (Product Manager Accessories) • Petra Bennermark (Product Manager Fixed Dome Cameras)

This workshop was held in addition to the initial interviews to gain acceptance and explore news way of working, together with the main stakeholders of the decision model.

Participants

The Product Managers are the main stakeholders in these decisions. The Product Manager for accessories was the supervisor for this thesis and well informed about the need for the study and its progress. The Product Manager for fixed dome cameras is in charge of the product line that contributes the most to the creation of new accessories. She was therefore an important stakeholder to get on board and involved to increase the model's chance of success.

Workshop Format

In line with our generic decision model, the strategic goals of Axis and its product accessories were discussed and established first. Then the problems encountered in the individual interviews were discussed. This to gain acceptance for a new way of working and also determine which problem areas were the most important. Based on these problems and strategic goals, new criteria were generated to best solve these issues.

Criteria

Criteria of two types were discussed, checklists and financial criteria. Checklists meant to ensure certain information should be gathered before the decision meeting. This included detailed project schedules, a business case, searching for current accessories that can solve the same problem etc. In addition to these, stricter financial criteria were also discussed. It was deemed important to introduce financial thinking into the camera project's accessory development, which is currently not done.

Appendix V: Workshop 2, test and validation at Axis

Information	Participants
Workshop 2 – Demonstrate and evaluate accessory decision support model 2015-04-29	• Erik Mårtensson (Product Manager, Accessories) • Petra Bennermark (Product Manager, Fixed Dome Cameras) • Kent Fransson (Product Manager, PTZ Cameras • Andres Vigren (Product Manager, Fixed Box Cameras) • Janne Lundqvist (Senior Project Manager, Fixed Dome Cameras) • Sara Jacobsson (Demand Manager, Demand Planning)

This workshop was held to evaluate our proposed model for accessory development.

Participants

Our main stakeholders who determine if the model will be used or not are the camera Product Managers. Therefore, we invited the ones responsible for the product lines responsible for the most accessories – fixed dome, PTZ and fixed box cameras. The Product Manager for fixed box cameras was however briefed individually due to scheduling issues. A senior Project Manager was invited to contribute with a more direct involvement in the development process. In addition, our supervisors were invited to contribute with their view from an operations and accessory specific standpoint.

Workshop Format

First we presented our suggestions and allowed time for questions to ensure that everyone understood the deliverables of the model. After this, we handed out summaries describing each deliverable together with an evaluation form. The participants were asked to rate each of the 9 deliverables along the dimensions of value and effort. This was important to counter the risk of the model being perceived as too formal and not value adding. After the results were gathered, each deliverable was discussed based on the individual and aggregated results from the evaluation. This enabled a valuable discussion around each deliverable and clarified any misunderstandings that might have occurred.

Evaluation form

The evaluation form in Table 39 is used to ensure a balance between resources spent to gather each deliverable and the value it will contribute. Each attendee will have their subjective opinion but is asked to keep a holistic view when grading. This means that even if you are not responsible for gathering the deliverable, don't put a low value for resource use but see to the resources for the project in its entirety.

1 = Low resource use/value creation

2 = Medium-low resource use/value creation

3 = Medium-high resource use/value creation

4 = High resource use/value creation

Table 39 – Evaluation table

Deliverable	**Resource use**					**Value creation**			
	1	2	3	4		1	2	3	4
1. Classification									
2. Early Product Motivation									
3. Product Investigation									
4. Timeline for Accessories									
5. Business Case									
6. Investment/Benefit-matrix									
7. Technical Specification									
8. Dedicated Freeze Meeting									
9. Post Launch Review									