CHALMERS
UNIVERSITY OF TECHNOLOGY

Aligning Innovation with Technology Strategy and IP Management

A case study in the Aerospace & Defense industry

Master's thesis in Entrepreneurship and Business Design

AMANDA AXMAN
ELIN BLOMBERG

DEPARTMENT OF TECHNOLOGY MANAGEMENT AND ECONOMICS
DIVISION OF ENTREPRENEURSHIP AND STRATEGY

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2020
www.chalmers.se
Report No. E2020:094

REPORT NO. E 2020:094

Aligning Innovation with Technology Strategy and IP Management

A case study in the Aerospace & Defense industry

AMANDA AXMAN
ELIN BLOMBERG

Department of Technology Management and Economics
Division of entrepreneurship and strategy
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2020

Aligning Innovation with Technology Strategy and IP Management
A case study in the Aerospace & defense industry
AMANDA AXMAN
ELIN BLOMBERG

Report no. E2020:094
Department of Technology Management and Economics
Chalmers University of Technology
SE-412 96 Göteborg
Sweden
Telephone + 46 (0)31-772 1000

Gothenburg, Sweden 2020

Aligning Innovation with Technology Strategy and IP Management
A case study in the Aerospace & Defense industry

AMANDA AXMAN
ELIN BLOMBERG

Department of Technology Management and Economics
Chalmers University of Technology

Abstract

As technology is the driving force of innovation, connecting the innovation process to the technology strategy is essential. It is also important to recognize the need to capture ideas generated from the innovation process and shape them into transactional assets in order to create commercial value. Therefore, connecting the three areas of Innovation, Technology Strategy, and Intellectual Property Management is necessary. Innovation, with a focus on cutting edge technology, is driving and continuously development of the Aerospace and Defense (A&D) industry. As future products are expected to have more requirements of customization, companies in the A&D industry need to be adaptable, more agile, and ready to adopt new technologies. These changes also demand new ways of handling IP, due to changing corporate strategies.

Based on a multiple embedded case study on a single organization the question of how companies, within the A&D industry, can capture commercial value from innovation through alignment with existing technology strategies and intellectual property management was answered. The study found that an alignment between innovation, technology strategy, and intellectual property management is what enables the creation, and the ability to capture commercial value for companies within the industry. The study further found the need for a common definition and objective of innovation, both in research and within the host company. Three different types of innovation processes were found, where a funnel structure was the most common. The competence composition of a decision-making council was shown to be of great importance for identifying crucial aspects of potential innovations.

In addition, the study also found that, in order for the innovation process to support the technology strategy, an innovation strategy needs to be established. To ensure the capturing of commercial value from the innovation process, intellectual property management needs to be incorporated in the innovation process.

Keywords: *Innovation, Innovation Process, Innovation Strategy, Technology Strategy, Intellectual Property Management, Commercial Value, Aerospace and Defense Industry, Case Study*

Preface

This master's thesis represents the last semester of the Master of Science in Entrepreneurship and Business Design at the Department of Technology Management and Economics, at Chalmers University of Technology, Gothenburg. The research was conducted during the spring of 2020, through a case study at the host company, Saab AB. The report is written by Amanda Axman and Elin Blomberg, students at the Intellectual Capital Management track of Chalmers' School of Entrepreneurship.

We are truly thankful for the opportunity to carry out a case study on the topic of innovation, within a company that belongs to an industry with high-security demands. It has been a rewarding experience to learn from the industry, especially from the perspective of our education within Intellectual Capital Management. A special thanks to our supervisor Maria Lanne, for support, guidance, and a terrific introduction to Saab and its industry attributes. We would also like to thank all interview respondents and participating departments for providing valuable information.

From the academic perspective, we would like to thank Bowman Heiden, our supervisor at Chalmers, for valuable insights on the topic and how to conduct research. Additionally, thanks to Karla Soler Riba, for further support on research matters. Finally, we would also like to express our gratefulness to Malin Stenbom and Amanda Lindenmeyer Asadi for the critical evaluation of the research to ensure a qualitative thesis result.

Lastly, we want to show our gratitude to friends and families, as well as to each other, for inspiration and motivation during this thesis work.

Gothenburg, June 5th, 2020

Amanda Axman & Elin Blomberg

Definitions

Commercial Value	The authors define the term commercial value as; what a company seeks in terms of maximizing the value of commercial appeal and worth of a customer offering and product portfolio. Either by cost efficiency or value-adding features of a product or service for the customer.

Abbreviations

A&D	Aerospace and Defense
IAM	Intellectual Assets Management
IP	Intellectual Property
IPRs	Intellectual Property Rights
PLCM	Product Life Cycle Management
R&D	Research and Development
R&T	Research and Technology

Contents

Figures

Tables

Chapter One

1. Introduction

This introduction chapter presents a background of the research topic. The problem statement is defined together with the research questions. Further, prior research, delimitations, as well as the outline of the thesis, is included in the chapter.

1.1. Background

Today, most companies are faced with the challenge of handling the fast pace of technology development. Innovation and technical advantage are crucial components to successfully handle the competition. The majority of the investments made in technological innovation comes from industrial firms, and industries' technological innovation is currently one of the most important drivers of competitive advantage (Schilling, 2017). In particular, technology-intensive industries operating in a multinational arena are vulnerable as the global environment is speeding up the pace at which innovation is turned into profitable businesses (Lengnick-Hall, 1992).

From an ecological perspective, the wellbeing of the employees can be increased since striving for innovation will increase creativity (Pinto, 2016). Being a creative and innovative company also shapes a competitive advantage from the aspect of employer branding. Furthermore, establishing collaborations with academia, government, and industry to create an innovation system that fosters results by joint forces between the stakeholders. By doing so, innovation contributes to national economic growth as technology transfers is an important attribute within the industry.

Innovation, with a focus on cutting edge technology, is driving and continuously developing the Aerospace and Defense (A&D) industry (Elkington, 2012a). Deloitte (2020) agrees with Elkington (2012a) that innovation and technological development continue to shape the industry. Future products are expected to have more requirements for customization, companies within the A&D industry need to be more agile and be ready to adapt to new manufacturing technologies (Lineberger, 2019).

Another acknowledgment of the changes in the industry and the increased importance of innovation is stated by Cipher (2018). The reasoning is based on the changing climate within the branch and the characteristics of the actors. New, non-traditional actors are entering the market as new technologies arise. For example, the use of robotics, autonomy, and human-machine interfaces opens up for new technology companies and start-ups to enter the market. These changes demand new ways of handling IP, due to changing corporate strategies (Cipher, 2018).

1.2. Prior Research

Form the review of the literature, it is concluded that the topic of innovation is a well-researched area. On the topics of technology strategy and intellectual property management, there is also a solid body of research. However, a gap in understanding how the three concepts of innovation, technology strategy, and intellectual property management can work together has been identified.

Several researchers have described the phenomena of innovation from different angles and various perspectives. Innovation is an old term, which has been tied to business since the 20th century when the economist Joseph A. Schumpeter stated the process of taking ideas and knowledge into new successfully commercial products and services (Schramm, 2017a). Nowadays, innovation becomes even more essential due to globalization (Schilling, 2017), which may increase the amount of research within the area.

Another well-researched topic is the different types of innovation and its implications for the management of technology. Bagno, Salerno, and da Silva (2017) have conducted a review of the existing innovation processes in the literature. However, a study on which types of innovation processes are used in the A&D industry has not been researched before. Especially not the topic of innovation processes in relation to technology strategy and Intellectual Property (IP) management.

Dasgupta, Sahay, and Gupta (2009) describe the importance of fitting the technology strategy with other strategies, such as business strategy, in order to gain a competitive advantage on the market. The main function of a technology strategy has been described by several authors where the definitions of it vary depending on the integrated subjects. The technology strategy's relation to the innovation process and IP management has not been studied. According to Dasgupta et al. (2009), prior research on innovation and technology strategy has been of a general nature. The authors identify a gap in understanding the relationship between innovation and different dimensions of technology strategy. From the review of the literature, no other research results were found on this topic and the gap is therefore considered confirmed.

The majority of research within the IP area studies how to set up a strategy or how to execute it. Another area of intellectual property management, which is not as well researched, is the identification and capturing of a potential knowledge asset. Petrusson (2015) describes the process of Intellectual Capital Management (IAM) in a framework consisting of four parts: Claim, Position, Decide, and Organize. The Claiming part of the framework focus on how to capture potential valuable knowledge assets within a firm and how to connect the assets to potential stakeholders. This part of the framework also assesses the claiming of eventual control positions. However, the framework does not elaborate on any connections to other business strategies such as technology strategy or how to incorporate it with innovation work.

In conclusion, the trinity of the innovation process, technology strategy, and IP management have not been studied before in the context of the A&D industry. Nor has it been studied from the perspective of how to capture commercial value since IP management in early phases is not a well-researched area.

1.3. Problem Definition

The reason for setting up an innovation process is often to increase its innovative power by setting up an innovation process to stay ahead of the competition, be at the forefront of technological development and provide competitive offerings to its customers. To research this several samples are needed, which is why there is a need to compare the current work within separate cases. As technology is the driving force, connecting the innovation process to the technology strategy is essential. It is also important to recognize the need to capture the ideas created in the innovation process and transform them into transferable assets in order to generate commercial value. Therefore, connecting the three areas of innovation, technology strategy, and IP management is needed.

To increase the innovative power and be a competitive actor in the A&D industry, the trinity of innovation, technology, and IP management can enable more agile and adaptable technologies that respond to the customization demands. Additionally, handling the competition of new entrants by adapting new disrupting technologies. However, the hosting company believes that there is a potential to further increase the coordination and efforts, in order to improve the innovation power, which is why this issue needs to be addressed.

1.4. Purpose

The aim of the study is to understand how an innovation process and can support technology strategies and IP management in the context of the A&D industry to capture commercial value from innovation efforts.

1.5. Research Questions

To achieve the purpose of the study, the main research question was formulated. In order to enable a thorough answer to the main question, it has been further divided into three sub-questions.

MRQ: How can A&D companies capture commercial value from innovation through alignment with existing technology strategies and IP management?

The first sub-question answers the question of which innovation processes exist within the industry. This creates the base from which the second and third research question can be answered.

RQ1: What innovation processes are used in the industry?

Research question two aims to find out how the innovation process can support technology strategies. The findings from the study will enable an understanding of how the innovation processes are aligned and how they support the existing technology strategies.

RQ2: How can innovation processes support existing technology strategies?

The third research question will assist by generating findings on how commercial value can be captured from the stated innovation process through the use of intellectual property management.

RQ3: How can commercial value be captured from innovation processes through intellectual property management?

1.6. Delimitations and Scope

This thesis will present findings from a case study within Saab, where the results can be generalized to the larger context of companies within the A&D industry. The case study covers different parts of the organization and inherently different parts of Saab's product portfolio. The impact of the types of products that the different cases are developing is not considered in this report. Further, the report will neither take an external view of how innovation processes have been set up in other organizations within the industry. Hence, the report only looks to find learnings and understanding of the topic from an internal perspective.

The study will focus on how the cases in the case study have structured the innovation process or innovation work and how this has been aligned with the existing technology strategy. In addition, how IP management is used to capture the outcome of innovation in order to create commercial value will also be studied. However, the detailed content of any strategy has not been studied due to secrecy, although the technology strategy framework from Saab is used. There is also a delimitation to IP management, where the thesis only focuses on the capturing of intellectual assets; identifying, defining, and deciding strategic control mechanisms, such as patents, trade secrets, or publishing. Hence, the thesis does not consider other parts of IP management such as how an asset can be positioned or utilized on the market.

The scope of this thesis will emphasize the integration and alignment between the technology strategy, the use of IP to capture results, and the innovation process within technology-driven companies. Thus, it will not consider the customer- or market perspective of innovation. Meaning, this thesis takes a starting point from a technology perspective and not a customer or market perspective.

1.7. Thesis Outline

Chapter 1- *Introduction*

Provides an overview of the research topic, a background of the problem statement, prior research, research questions, purpose, and delimitations.

Chapter 2- *Aerospace & Defense Industry*
Describes the A&D industry and its particular characteristics within the areas of intellectual property control mechanisms, aspects of security, and its development.

Chapter 3- *Methodology*
Presents the research philosophy, research approach, data collection, data analysis together with a discussion of quality issues.

Chapter 4- *Theory*
Presents a review of the literature on the topics of innovation, innovation strategy, innovation processes, technology strategy, and intellectual property. The chapter finishes with a theoretical framework for the case study.

Chapter 5- *Case Study*
The chapter gives a brief introduction to Saab and the conducted case study.

Chapter 6- *Analysis*
In this chapter, the cases are analyzed by comparison. More, the first, second, and third research question is answered from the learnings of both the case-and literature study.

Chapter 7- *Discussion*
A discussion regarding the limitations of the study and the implications of the results are presented in this chapter.

Chapter 8- *Conclusions*
In the concluding chapter, the main research question is answered using learnings from the case-, documentary-, and literature study.

Chapter 9- *Further research*
Further research that can be explored on the topic of the thesis is provided.

Chapter Two

2. Aerospace and Defense Industry

To give an understanding of the essential characteristics of the A&D industry, this chapter seeks to explain how the industry has developed over time and how it differs from other branches. A short notice on the regulatory framework for such industry will also be given, as well as a minor insight into the attributes of intellectual property management within the industry.

2.1. Defining the A&D Industry

The companies within the A&D industry can be both defense and commercial contractors who provide defense products, such as ammunition, military ships, and electronics, or commercial products like aircraft or satellites. Aerospace products can be a part of a defense product, but the aerospace segment can also include aviation and space-related products for both civil, defense, and commercial use (USC Libraries, 2020).

To measure the defense market, military spending by country is often used as a metric (USC Libraries, 2020). According to Lineberger (2019), the value of the defense industry has increased during the latest year while the aerospace industry has slowed. However, the aerospace industry is forecasted to stabilize again in the upcoming year. The defense industry's growth can be explained by the intensified security threats which require governments worldwide to increase the defense investments. A decline in the aerospace industry is thought to be due to production-related issues in certain commercial aircraft models. But, as long-term demand still exists, the industry's recovery is forecasted in the short-term (Deloitte, 2020).

2.2. IP Management within the A&D Industry

Intellectual property management within the A&D industry differs from other industries as the products handled can be connected to national security. Hence, the decision regarding the publishing of inventions and products includes more perspectives than in other branches. Elkington (2012a) highlights some attributes of IP management within the A&D industry. The first attributes are the collaborative development environment as well as the technology transfers. Further, Elkington (2012a) elaborates on the patents' secondary importance to the business within the industry due to the great importance of know-how, trade secrets, and copyright which are essential control mechanisms. Therefore, in short, the IP currency in the A&D industry is the proprietary information, while other high-technology industries use patents to a greater extent (Elkington, 2012b).

To create control positions within the branch, the focus of IP management should be on the transactions of information between suppliers, competitors, and customers (Elkington, 2012a). To be an established actor on the market, a great understanding of the IP landscape is needed. In addition, an understanding of the A&D industry attributes is also crucial to be able to ensure

that IP exchanges with other actors are advantageous from a business perspective. In order to manage this, a proactive approach is needed in IP management. Elkington (2012b) and Fisher and Oberholzer-Gee (2013) argue that legal, technical, and business resources need to be allocated for IP management to understand all perspectives of innovation.

A usual challenge experienced within the industry, regarding IP management, is the education and information spread among the organization. Often, the firms are large and geographically spread, which creates difficulties in updating and educating the employees on such a legally based theme. Elkington (2012b) stresses the importance of seeing this as a never-ending, but crucial process of IP management.

When development work is performed to meet essential requirements from a customer, all Intellectual Property Rights (IPRs) need to be extracted and ascribed before launch to avoid other actors from getting such information. These IPRs can be negotiated with partners or customers, where solutions such as licenses can be an alternative. Fisher and Oberholzer-Gee (2013) bring up the vital difference continuous communication between business executives, lawyers, and engineers can do for identifying potential opportunities for deploying IP. Additionally, Elkington (2012b) emphasizes that IPRs are crucial for the maintenance of upholding a technology and product edge within the A&D industry.

2.3. Industry Development

The A&D industry has historically had a tight connection to the high-technology and telecommunication industries. During the years, the A&D industry has developed several known products within those industries, as a solution to an industry-specific problem. Due to the characteristics of today's A&D market the connection to high-technological products is not as well recognized anymore. However, Elkington (2012a) states that innovation is still ongoing in the industry, with a focus on cutting edge technology.

Deloitte (2020) agrees with Elkington (2012a) that innovation and technological development continue to shape the A&D industry. Some forecasted innovations within the upcoming years for the industry are electric propulsion aircraft, urban air mobility, and automated flight deck. Future products are also expected to have more requirements of customization, the producers of products within the A&D industry need to be adaptable, more agile, and be ready to adapt to new manufacturing technologies (Lineberger, 2019).

Another acknowledgment of the changes in the industry and the increased importance of innovation is stated by Cipher (2018). The reasoning is based on the changing climate within the branch and the characteristics of the actors. New, non-traditional actors are entering the market as new technologies are used. For example, the use of robotics, autonomy, and human-machine interfaces opens up for new technology companies and start-ups to enter the market. Moreover, Cipher (2018) also predicts the next industrial revolution is likely to demand a new way of doing IP strategies due to changing corporate strategies.

2.3.1. Implications for Saab's Business

When Saab was founded, the company had only one customer, the Swedish military air force. The customer expressed the requirements and need for certain products and from that, the technology was developed. Saab became an important part of the industry that sprang up to guarantee neutrality, independence and self-sufficiency, and as a cradle for Swedish engineering. Intelligent and cost-effective solutions were required from the start. Since this was on a national level, the IP protection perspectives differed, and the most important was to keep the solutions and products secret.

Since then, Saab has progressed through generations of military jet aircraft, introducing world-leading technology. Today, Saab is a multinational company with customers ranging from the globe. The Swedish military is still one of the customers, but not the only one. The technological challenges throughout the years have driven and developed Saab into a broad-based Swedish innovative company. Through organic growth and acquisition, a broad base of knowledge and innovative thinking has been brought together.

With this change and growth in mind, the business perspectives have changed over time. The competitive situation for Saab has changed and the importance of management of technology as well as IP development have increased. To be a competitive actor on the market, Saab works continuously by iterating improvements. Technical development within research and technology is the first part together with competence enhancement to work with other industries, academia, research institutes as well as governments to create new thinking and new ideas.

The financial situation for Saab has also changed since the customer base has expanded to a global market from one single customer. This change primarily means that development costs have to be covered by Saab on a long-term perspective as the product life cycles are long and the products are sold to various customers. Another issue connected to the globalization of the company is the patent landscape's widening into an international perspective. The technology strategy also becomes broader in the sense of where the business and operations should be placed. In turn, this has implications on where tests of products can be executed due to regulations.

Chapter Three

3. Methodology

The chapter describes the chosen research methodology by using a pedagogical illustration to depict the issues underlying components of research. This description includes the research philosophy, research approach, data collection, and data analysis used are presented. Finally, quality issues and how it can be handled to ensure high-quality research are discussed.

3.1. Research Philosophy

The research philosophy was built on the outer layers of the research "onion" from Saunders, Lewis, and Thornhill (2012), see Figure 1. Research philosophy, the first layer of the "onion", relates to the development of knowledge and its nature. During the research, different assumptions were made, and the nature of those assumptions affected the interpretations of how to understand human knowledge. Therefore, it can also affect the research questions, methods, and analysis of the result. This shows the great importance of research philosophy because the chosen philosophy might affect the results (Saunders et al., 2012).

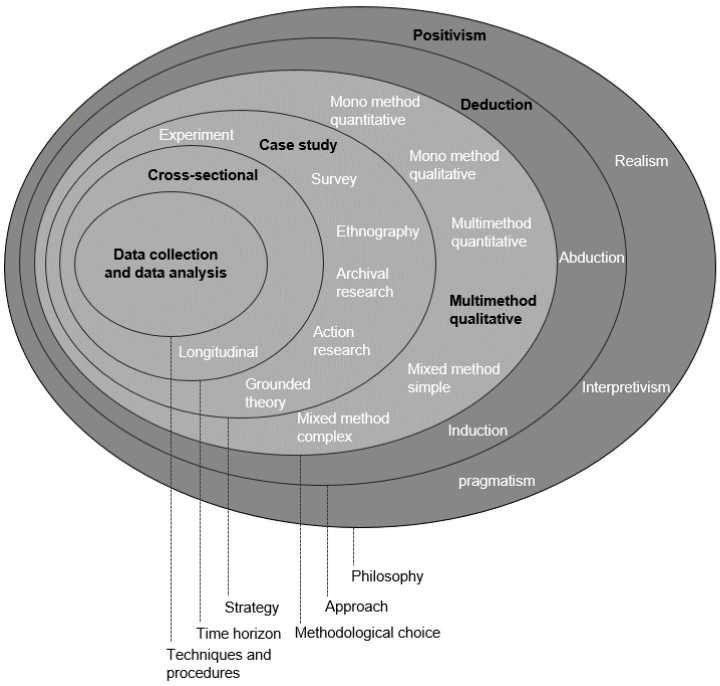


Figure 1. Modification of The research "onion" (Saunders et al., 2012).

When considering the research philosophy, the nature of research also has to be examined. The research subject in this thesis work is the construction of innovation processes and its alignment with technology strategy and IP management. According to Bryman and Bell (2011), the nature of research is important, and therefore it is also important to distinguish between epistemological and ontological research philosophy. Although, Saunders et al. (2012) mean

that the choice of philosophy is rather a choice between positivism and interpretivism philosophy.

Intellectual properties, one of the research subjects in this thesis, are the new era's tradable goods and services in the market economy where the knowledge-based businesses are increasing. In the context of business and innovation, Petrusson and Pamp (2009) identify intellectual property as a social construction built on other constructions such as the firm structure, financial institutions, markets, etc. A challenge identified in relation to this is how to manage these non-physical existing assets (Petrusson and Pamp, 2009). Therefore, the claiming of these assets including knowledge and intellectual processes will never be dealt with in the same way as physical assets. This fact will also give new restraints when claiming control for such assets since there will always be a dilemma on how to construct these concepts and how to use them in various contexts. In addition, this socially constructed phenomena also have to deal and interact with other social constructs, for example, innovation or ventures.

Since the concerned research subject, in this thesis, is not something that describes the nature of reality, the ontological philosophy cannot be used. Epistemology concerns what can be seen as acceptable knowledge within a certain research area. Within epistemological studies, the research subject can be a social phenomenon without external reality, but the researcher can still treat the data as something objective. When doing so, a positivist philosophy can be used to develop knowledge around the social phenomena (Saunders et al., 2012).

The philosophy in this research is based on a positivistic approach to the case studies conducted. Bryman and Bell (2011) state that the philosophy of case studies is influenced by an epistemological tradition. In positivistic research, data can be collected through an observable reality where regularities and connections are searched for. To be able to generate such knowledge, existing theory can be used in order to explain and understand connections to reality.

Moreover, in the second layer of the research "onion", a deductive approach was used in the thesis as theory guided the research in comparison to an inductive approach where theory is the outcome of the research (Bryman and Bell, 2011). The thesis took a starting point in theory by the use of a theoretical framework established from the review of the theory that generated findings from the cases in the empirical study. The epistemological orientation of positivism was also connected to the use of a deductive approach.

3.2. Research Approach

The research approach chosen was a qualitative study. The empirical findings were generated through the performance of multiple cases within a single organization, where interviews were the main source of information. In addition to interviews, documentary analysis, and a comprehensive review of the literature were used as data collection techniques. Therefore, according to Saunders et al. (2012), a multimethod qualitative research methodology was used in this thesis.

A case study research design is suitable when the research questions are phrased with "why", "what" or "how" since the method is gaining depth in the research understanding (Saunders et al, 2012). A case study differs from other research designs due to the bounded situation or system. This kind of research enables several methods for data collection to be combined, both qualitative and quantitative methods can be applied. When using a case study research design, the case itself is an object of interest and the aim is an in-depth analysis thereof (Bryman and Bell, 2011).

The selection of cases should be based on the opportunity to learn from them (Stake, 1995, see Bryman and Bell, 2011). Further, Stake (1995) also defines instrumental case studies which focus on understanding the case in order to adapt this knowledge into a wider generalization. Also, "multiple or collective cases" are solely used to explain and investigate a general phenomenon. Although, the lines between these kinds of cases are often unclear.

Moreover, case studies can be divided into four different kinds; single or multiple cases, and holistic or embedded cases (Yin, 2009, see Saunders et al., 2011). According to Bryman and Bell (2011), the basic case study often includes a detailed analysis of a single case where the complexity and particular nature of the case is essential. A single case study can be categorized depending on its nature, it can either be done in a single organization, location, person, or an event. In this thesis, the case study was conducted at a single organization, Saab. However, it included multiple cases within the organization of Saab with examples of business areas and units that have implemented an innovation process. Therefore, according to Yin (2009, see Saunders et al., 2012), this was a multiple embedded case study. Further, the study was also defined to be instrumental as it aimed to increase the understanding which later can be generalized from a broader perspective. Therefore, it can be argued favorably to use a multiple embedded case study as results from multiple case studies are more generalizable than from a single case study (Saunders et al., 2012).

3.3. Data Collection

The data was collected through three different methods; case studies, document analysis and theory review. All three methods are presented in the sections below.

3.3.1. Case Studies

Both Saunders et al. (2012) and Bryman and Bell (2011) emphasize the need for an interviewer to be knowledgeable within the topic. Therefore, fifteen pre-interviews were held to gain an understanding of what work has been done on the topic of innovation, get to know the company and its organizational structure and the industry. These interviews were done in combination with a documentary analysis on internal documents concerning the area of research. Further, the insights gained from the pre-interviews assisted in finding cases for the case study as well as relevant persons to interview. Before starting the case study, a pilot interview was conducted as recommended by Bryman and Bell (2011), this enhanced the quality of the interview guide

questionnaire for the formal interviews and enabled improvement of the formulation of the questions and helped to identify need for clarification.

When conducting qualitative research, semi- or in-depth interviews are commonly used to enable an understanding of a complex issue or situation better than other methods, such as surveys (Saunders et al., 2012). Semi-structured interviews give the opportunity to further explore and understand the interviewees' answers. It is also useful from an exploratory perspective as the interviewee may bring up topic and issue not thought of by the interviewer which further deepens the knowledge and understanding of the research questions examined (Saunders et al., 2012), a semi-structured interview also allows for more flexibility (Bryman and Bell, 2011). According to Saunders et al. (2012), semi-structured interviews should be used when the research questions are open-ended, when there is a need for flexibility in the order of the questions, and when the interviewer will benefit from being able to further explore and probe the answers from the interviewee.

To create an understanding of the complex issue, a case study was performed on five identified cases at the host company where structured innovation work had been initiated. A sampling of the cases was based on the information gathered from the pre-interviews. During the case study, semi-structured interviews were used to collect data. The interviews from the case study included interviews with persons responsible for each topic of the theoretical framework, presented in Chapter 4, Innovation Process, Innovation Strategy, Technology Strategy, and IP Management. From each case, an interview was conducted with one person from each area. In total twelve persons from five different cases were interviewed for one hour each.

Within the interviews, questions were asked in accordance with the theoretical framework, which will be presented in Section 4.6, to ensure continuity among the interviewees. To cover all topics and be able to compare the answers from the semi-structured interviews, an interview guide was created by the authors and used in all interviews, see Appendix 1.

3.3.2. Document Analysis

Data was also collected through document analysis, a systematic procedure for reviewing and evaluating documents to deepen the knowledge used in qualitative research (Bowen, 2009). These documents contained text and pictures, such as, policy documents, internal presentations, conference papers, intranet webpages, and organizational reports from the host company. The document analysis provided supplementary research data in the case study.

The documentary analysis is an efficient method since it is less time consuming than most other research methods and less dependent on other actors. Additionally, the availability of the information was be an advantage as the documents are distributed through the intranet of the host company or through the public domain. Although, the limitations of this data collection lack reactivity, stability, and sometimes a risk of insufficient details. Also, there is a risk of biased selectivity since the document collection can never be seen as totally complete (Bowen, 2009).

The documentary analysis served as a way to increase the initial understanding of the host company. Also, to discover what innovation processes exist within the divisions, and understand the structure and usage of the Technology Strategy Matrix. Finally, the documentary analysis gave more detailed information regarding the present IP management, IP policies, and identification of new innovations.

3.3.3. Theory

Lastly, data was also collected through a review of the literature. This type of data collection was the starting point of which this thesis' research questions and critical literature, as described in Chapter 4. As described by Saunders et al. (2012), the literature review is an iterative process that is refined for each iteration as more knowledge and information about the topic is consumed. The literature review first gave directions on which issues have a research gap and is also a concern at the host company, which indicates a need to research the topic. When the research questions are in place and an initial understanding of the topic is gained, the critical literature review is built and defined from the use of the research questions which are in line with the suggested method by Saunders et al. (2012).

3.4. Data Analysis

The empirical findings from the case study were analyzed, in accordance with Yin (2003), by conducting an individual and a comparative analysis. Using a comparative analysis is also supported by Bryman and Bell (2011) since conducting a multiple case study allows for comparison and identification of commonalities and dissimilarities among the cases. A comparative analysis also enabled generalization of the results as multiple cases might have experienced similar issues. The individual case analysis was used to synthesize the results from each case study, and enabled the later step of the comparative case analysis.

When the data had been collected from the case study, a theoretical framework, presented in section 4.6, was used to examine the cases. The framework was used to first analyze the cases individually, and later by comparison. The individual case results are presented in Chapter 5, and the comparative analysis in Chapter 6.

3.5. Quality Issues

Saunders et al. (2012) describe that there is a frequent questioning of the generalizability of qualitative studies as such methods often consist of small samples, in comparison to quantitative studies. With regards to the choice of case study as a research strategy, the critique on generalizability is stated by Saunders et al. (2012), however, as a multiple case study was conducted, in comparison to a single case study, the generalizability increase. A case study also has a high level of validity as it takes an in-depth approach to a specific case and issue.

According to Saunders et al. (2012), the main quality issues that arise from conducting semi-structured and in-depth interviews are; reliability, forms of bias, generalizability, and validity.

Reliability refers to how easy or difficult it is for another researcher to repeat the study and get the same results (Saunders et al., 2012). As a semi-structured interview lacks standardization, this may lead to a low level of reliability. The issue of reliability, in relation to interviews, is also connected to biases of the interviewer and interviewee. As semi-structured interviews aim to explore more than a structured interview, the interviewee could choose not to discuss a topic that could have been of interest. Validity means the extent to which the researcher has fully received the knowledge of the participant or interviewee. This quality factor is generally considered to be high in relation to the semi-structured interviews.

Semi-structured interviews are often used to analyze and understand complex and changing situations. Therefore, a counter-argument to semi-structured interviews as a research method, the intention of the interviews is not mainly to be repeatable but to be used as an effective tool to understand and explore complex issues. Saunders et al. (2012) argue that making this point explicitly clear, mends the issue of reliability.

To overcome the issue of biases, the preparation and conduction of the interviews were important. For example, making sure that the authors' knowledge in the context of the organization, location of the interview, nature of opening comments etc. (Saunders et al., 2012).

Generalizability refers to the extent to which it is possible to apply the results in other settings. The generalizability concern of qualitative research is based on the low number and unrepresentative number of cases. Saunders et al. (2012) argue that a single case study can encompass a large number of settings. In relation to the interviews planned, to overcome this issue, the authors performed as many interviews as the time frame allowed for, as well as making sure to convert many different employees at the host company with different positions and knowledge.

The documentary analysis was mainly based on internal documents of the host company, therefore, in order to overcome the issues of generalizability, it is important to bear in mind the one-sided view of only receiving internal information. When a high quality of the theory review can be ensured, the issues of credibility arise. These issues can be overcome by the quality of the sources that will be measure by, for example, the number of citations.

To further ensure high-quality research, the method of triangulation was used. By conducting both a case study, documentary analysis as well as a comprehensive review of the literature, triangulation was achieved (Saunders et al., 2012). According to Bowen (2009), the use of triangulation enhances the quality of the research as the researcher avoids the bias that can arise from the use of only one source of information. Bowen (2009) also suggests documentary analysis and interviews as methods that can be used to triangulate the results where the multiple sources of evidence may confirm the findings from the research. Denzin (1991, see Bowen, 2009) also argues for the increased credibility of the research as triangulation and multiple

sources of information have been used. Triangulation is a protection against the occurrence of a single case finding that cannot be found in any other case.

Chapter Four

4. Theory

The following chapter aims to provide a review of the literature in the areas of Innovation, Innovation Strategy, Technology Strategy, and Intellectual Property Management. First, an introduction to the term innovation is presented with definitions and different types of innovation. Second, innovation strategy, and the link between technology and innovation is described. Further, technology strategy and intellectual property management are presented. The chapter finishes with a theoretical framework, created from the review of the literature, built by the authors for the case study.

4.1. Innovation

The term *Innovation* derives from the Greek word "*Kainotomia*" which means "*new*" in English. Originally, the term referred to new thoughts with both neutral and positive associations, however, more often negative associations. Since innovation is an old term the interpretation and usage of it have varied over time. During the 19th century, the term innovation was tied to negative aspects of unwanted changes. Later on, during the 20th century, the term was strictly related to the economist Joseph A. Schumpeter who used the term to describe the process of taking ideas and knowledge into new successfully commercial products and services (Schramm, 2017b). Further, the term innovation was onwards used to describe the introduction of novelty to the commercial marketplace as a positive, but disruptive connotation.

The usage of the term innovation has further evolved, during the 21st century, to nowadays also include organizational processes, marketing and social structures. With this in mind, Schramm (2017b) defines innovation as "*An innovation is the implementation of a new or significant improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*" (Schramm, 2017b, p. 5). The perspectives on how innovation can be used to bring value to society have also been broadened since the term is wider and includes more activities and actors. New products and services make companies grow and expand their operations and can therefore also employ more people. When doing so, more jobs are created in the private sector which adds to an economic growth for society. Employed individuals and prosperous companies contribute revenue to governments which in turn can lead to improved services to the public, such as healthcare, education, and safety. Revenue might also be re-invested in further research, development, and encourage technological innovation (Schramm, 2017a).

4.1.1. Different Types of Innovation

Innovation can arise from many different sources, such as, individuals, universities, firms, private non-profits, or government-funded research. Another efficient and important source of innovation can be the linkage between these actors since that maximizes the competence and

resources (Schilling, 2017). Therefore, such innovation networks among these actors are considered the most powerful agents of technological advance.

Van de Ven and Garud (1989) describe innovation as new ideas that can be technical, such as products, services, and administrative procedures, policies, and organizational structures. Schilling (2017) further divides technological innovation into different categories of innovation; product versus process, radical versus incremental, competence-enhancing versus competence-destroying, and architectural versus component.

4.1.1.1. Product versus Process Innovation

The level of technicality is one way of categorizing innovation (Schramm, 2017b). Product innovation regards innovation in a company's goods or services. Process innovation refers to innovation in how a company conducts its business, for example, the process of how a certain product is produced or how the process around marketing the product is conducted (Schilling, 2017). The different types of innovation can have a positive effect on each other, a new product might lead to the development of a more effective and innovative process, and the other way around (Schilling, 2017).

4.1.1.2. Radical versus Incremental Innovation

The outcome of innovation can be used to categorize the type of innovation that has been created (Schramm, 2017). Another dimension used to categorize innovation is radical versus incremental innovation. The definition of radicalness is a combination between "newness" and "differentness", defined by Schilling (2017, p.48) as "*An innovation that is very new and different from prior solutions"*. Hence, for something to be a radical innovation it must be both new and different. A technology can be significantly or marginally different either from a specific industry or to the whole world (Schilling, 2017). On the other hand, Schramm (2017b) uses the term "disruptive innovation" for the same meaning as Schilling (2017) uses for radical innovation. The meaning of disruptive innovation is described as an innovation that *"changes (disrupts) a market niche, or even an entire market*" (Schramm, 2017b, p.54). Incremental innovation, on the other hand, is minor changes or stepwise improvements to an existing product or process. It is further defined as *"An innovation that makes a relatively minor change from (or adjustment to) existing practices."* (Schilling, 2017, p.48).

4.1.1.3. Competence-Enhancing versus Competence-Destroying Innovation

If innovation adds on to and extends the firm's existing knowledge base, the innovation is considered a competence-enhancing innovation. Opposite, if innovation rather renders the competence and knowledge obsolete, it is defined as competence-destroying. Competence-enhancing and destroying innovation is defined by Schilling (2017, p.49) as "*An innovation that builds on/renders obsolete existing knowledge and skills. Whether an innovation is competence enhancing or competence destroying depends on whose perspective is being taken. An innovation can be competence enhancing to one form, while competence destroying for another."*

4.1.1.4. Architectural versus Component Innovation

A product or process is often built from different sets of systems. The difference between architectural versus component innovation depends on whether the innovation is created in a component of an existing system or the entire construction of the system itself (Schilling, 2017). Schramm (2017b, p. 19) describes architectural innovation as "*Innovation in which improvements are made to the linkage(s) between the components in a product, process, or service, but not to the components themselves".* Further definitions have been made by Schilling (2017, p.50), where architectural innovation is defined as *"An innovation that changes the overall design of a system or the way its components interact with each other."* and component innovation is defined as *"An innovation to one or more components that do not significantly affect the overall configuration of the system".*

4.1.1.5. Ten Types of Innovation

Innovation can appear in several shapes and must not only include technology innovation. The term *Ten Types of Innovation* was coined by the management consultancy firm Deloitte, and describes ten different types of innovation; Profit Model, Network, Structure, Process, Product Performance, Product Systems, Service, Channel, Brand and Customer Engagement. Further, these categories are divided into broader ones; Configuration, Offering, and Experience (Keeley, Pikkel, Quinn, and Walters, 2013). Configuration refers to the types of innovation that are centered on the internal structure and processes of the firm and how it conducts its business. Offering focuses on the firm's products and services and Experience focus on innovation within the customer-facing part of the firm (Keeley et al., 2013). The authors mean that a more sophisticated way of conducting innovation work is to be innovative within many types of innovation. Ten Types of Innovation is also a tool that can be used to identify gaps in the existing innovation strategy as well as analyze competitors.

4.2. Innovation Strategy

The importance to have an innovation strategy is argued by Pisano (2015). It is argued by Bowonder, Dambal, Kumar, and Shirodkar (2010) that an innovation strategy may assist a firm by enabling the company to provide the customer with new offerings. Further, it enables the company to build a competitive advantage in the market place as well as penetrating new markets, market segments, or creating new business. The choice of strategy is influenced by several factors, according to Gilbert (1994), who states that the industry, the firm's history, and present strategy, and both human and material resources are determinants.

However, a strategy in itself is not valuable until it is communicated and aligned with diverse groups within the organization as well as define clear objectives and priorities, the strategy becomes a powerful tool. Pisano (2015) also points at the necessity for an innovation strategy to be aligned with the business strategy. The full effect from the innovation does not come from the individual innovation efforts, but from a system of the innovation effort which is clearly aligned with the strategy and strives towards the same goal. Without an innovation

strategy, the efforts might even pursue conflicting priorities. Defining what type of value innovation should create is crucial when setting an innovation strategy as the different types require different capabilities (Pisano, 2015; Henderson and Clark, 1990; Abernathy and Clark, 1985).

4.2.1. Innovation Matrix

The Transilience Map, shown in Figure 2, is one way of illustrating different types of innovation. The framework presented below is the foundation of many other innovation strategy matrices, for example Henderson and Clark (1990) and Pisano (2015). On the vertical axis of the linkages between customers and markets are represented. The horizontal axis presents a firm's technology and production capabilities.

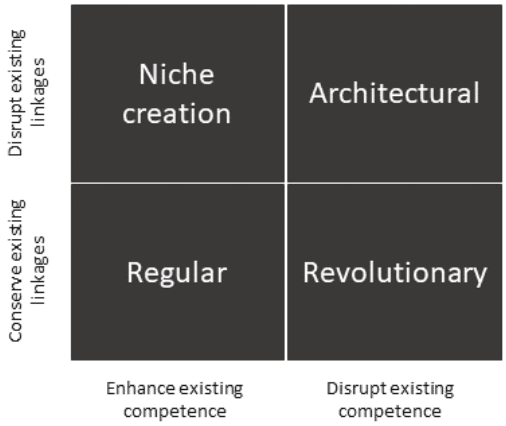


Figure 2. "Transilience map" (Abernathy and Clark, 1985).

Architectural innovation is described by Abernathy and Clark (1985) as new technology that does not make use of existing competence within the firm, or standards on the market. This creates new linkages to the market and customers. Niche creation rather makes use of the existing technology and competence and innovate by finding new market opportunities. Regular innovation is based on both existing technology competence as well as the existing market and customer relationships. This type of innovation is often not as clear, however, these types of changes can have a dramatic effect on, for example, production cost and performance (Abernathy and Clark, 1985). Revolutionary innovation is further described as an innovation that renders existing technology and competence obsolete but is applied to the existing markets and customers.

As the nature of the four different types of innovation in the Transilience Map is different, the effects on each organization and market vary. Therefore, to handle the different types of innovation requires different types of managerial and organizational knowledge and strategies.

With regards to architectural innovation, to spur this type of innovation a creative and learning attitude must be in place (Abernathy and Clark, 1985). The organization needs to be able to gain insights into customers' needs and new technological possibilities. In the niche phase, on

the other hand, timing is an important factor to be able to find new market opportunities and develop product concepts for that particular market. Methodical planning and structured processes are crucial to have in place to facilitate regular innovation. Resources and stable processes are needed to support the process development, technology improvement and refinements of the market. Finally, for revolutionary innovation, technology-push is of the essence. Thus, there must exist management support and long-term goals for the development of new technology through resource commitment and investments.

4.2.2. Innovation Processes

As shown in Chapter 2 on the A&D industry, most effort and investments in technology innovation come from industrial firms striving to create a competitive advantage within the branch. Although, what many firms miss when heading for innovative ideas too soon is having a strategy for how to proceed with new product development without a process for choosing and managing innovation. Therefore, firms tend to start more projects than they can actually manage and support effectively which results in poor fit with the firm's objectives. The consequence of this is a higher project failure rate (Schilling, 2017).

Innovation is often viewed as a process without limitations or boundaries (Schilling, 2017), but several studies have proved that not to be the case. To succeed with innovation, a clearly defined innovation strategy and management support are needed. It takes hundreds, or sometimes even thousands, ideas to result in one feasible product with a commercial run. Hence, patience and structure are important factors when working with innovation in large organizations. Schramm (2017b) presents several types of processes for innovation. The most cited and commonly spread are the *Innovation Funnel* and the *Stage-gate Process*. The two processes are both linear processes.

4.2.2.1. Innovation Funnel

One way of viewing an innovation process is by using the Innovation Funnel where many ideas reach the wide front (see Figure 3) but only a few make it through to the end of the process (Schilling, 2017). The funnel logic of an innovation process is often used in environments with limited resources as all ideas cannot be developed into projects or products. Moreover, the funnel process can also be used in other innovation settings, such as open innovation, which require changes in terms of resource allocation, intellectual property management, and competence outsourcing. In such situations, a broader view of the initial innovations is proposed by Bagno et al. (2017).

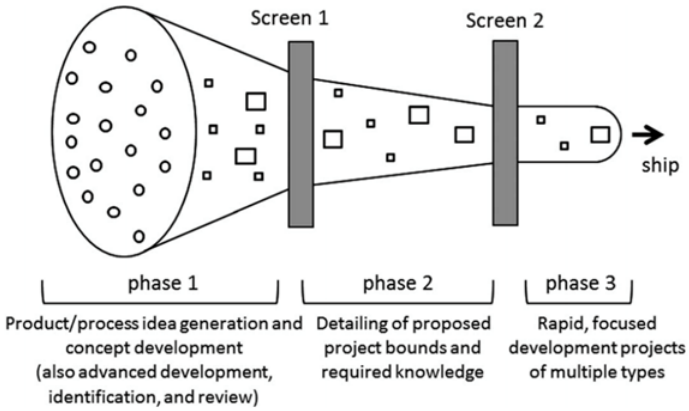


Figure 3. An example of an Innovation Funnel (Bagno et al., 2017)

A classical description of the Innovation Funnel was made by Clark and Wheelwright (1992, see Bagno et al., 2017) where the selection of ideas characterizes the model. Clark and Wheelwright (1992) describe the process in three different phases where the ideas are screened along the way. Phase one includes idea generation of products and processes including concept development. The second phase contains a detailing of each proposed project to meet the requirements. For those projects reaching the third phase, rapid and focused development of projects is done. This suggested process has later been widely accepted and used in several adapted models.

4.2.2.2. Stage-gate Process

Another way of viewing a linear innovation process can be through the Stage-gate Process where go or kill decision points are used to avoid the cost of pushing poor projects too far. This process is built as a linear process with gates (see Figure 4) where a cross-functional team decides whether the project can move on (go) to the next phase or not (kill) (Schilling, 2017). The general trait for a Stage-gate Process is that it follows a certain set of stages and the decisions range from the initial idea until it is fully developed into launch (Bagno et al., 2017).

One of the most famous Stage-gate Processes was developed by Cooper (1993, see Bagno et al., 2017). Cooper's (1993) process emphasized a set of steps where every step includes a set of presets with parallel and cross-functional activities. Each stage is controlled by the input of the processes since evaluation and monitoring can be done. Further development of the Stage-gate Process was done by Thomas (1993, see Bagno et al., 2017) where each step of the process was assigned with the different dimensions of; ideas, concepts, prototypes, products, and marketing programs. In addition, Thomas (1993, see Bagno et al., 2017) also claimed that each specific new product development require a dynamic maturity for every dimension.

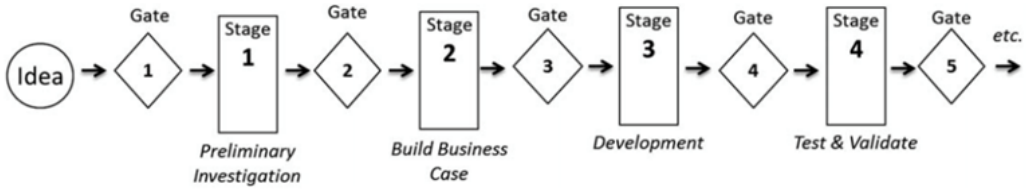


Figure 4. An example of a Stage-gate Process (Bagno et al., 2017).

A risk identified with using the Stage-gate Process is that the model is developed with the assumption that all innovations that go through the processes are defined by the firm's existing technology capacity, strategy or its market (Bagno et al., 2017). Therefore, greater effort needs to be put on the step-by-step process for innovation to gain aligned output from the process.

4.3. Linking Technology and Innovation

The quote *"Innovate or die"* is a classic saying made by the innovation guru Peter Drucker. It has been well established by research that technical innovation is a source of competitive advantage and financial business performance. "*A company can use technology to create a competitive advantage by creating barriers that deter entry of rivals, introducing novel products or technology processes that attract new customers, or changing the rules of competition in the industry (Golder & Tellis, 1993; Zahra, Nash & Bickford, 1995).*" (Dasgupta et al., 2009, p.3). Hence, the importance of innovation is clear. Dasgupta et al. (2009) further describe that the technology strategy can reflect a company's attitude towards innovation and the role it plays for the company's development and claimed position on the market.

A technology strategy is defined as "*a portfolio of choices and plans that a firm uses to address the technological threats and opportunities in its external environment."* (Dasgupta et al., 2009, p. 9). According to Meyer (2008), the development of a strong technology strategy is one of the most important parts of innovation management.

The connection between innovation and technology has throughout the years developed into a research area named management of technology and innovation. Durand (2004) explains the two separate terms. Technology refers to science and techniques. In turn, science refers to basic research and knowledge of natural phenomena. Techniques refer to the accumulated knowledge built by human experience and learning. Technology combines these two sub-terms, thus, it relates to the creation, production, and distribution of products and services as demanded by the market. Innovation can be defined as the creation of the new (Durand, 2004). There is arguably a difference between invention and innovation as an invention has a restricted meaning of a new idea or concept. However, no requirement of being technically feasible nor requested by the market (Durand, 2004). Innovation, on the other hand, requires commercialization potential and technical feasibility. Thus, innovation "*bridges the gap between the idea and its real implementation to serve a human need*" (Durand, 2004, p.48).

The difference between management of technology and management of innovation is also described by Durand (2004). Management of technology focuses on identifying and evaluating competing technologies, the strategic selection of technologies to sustain a competitive advantage, and assure access to knowledge required for the selected technologies through internal development, Research and Development (R&D) partnerships, or acquisitions. In addition, it focuses on the management of research activities and feasibility studies together with the development of product and process technologies comprised in the firm's portfolio. Finally, the decision of abandonment of obsolete technologies as new technology develops is under the management of the technology strategy.

The management of innovation is focusing, according to Durand (2004), on the facilitation of idea generation, selecting relevant innovations, and managing the portfolio of innovation opportunities that have commercial and technical feasibility. Further, the focal point of innovation management is also ensuring access to the resources and knowledge needed for innovation. Together with managing the social and organizational implications of innovation as there might exist tension and resistance in the organization for the, perhaps new, structures needed for enabling innovation.

From the definition of innovation management and technology management, it is clear that innovation management regards the change in general whereas technology management manages the shift from old to new technology. Hence, the management of innovation is not restricted to technology innovation but also includes, for example, organizational innovation. Innovation incrementally improves technology and therefore also forms the technological course of direction (Durand, 2004).

According to Dasgupta et al. (2009), technical innovation is steered by the technology strategy, which in turn is steered and defined by the firm's business strategy. The technology strategy should be revised by the feedback gained from implementing innovation projects and the development of technology. In addition, Davenport et al. (2003) point at the necessity to adjust the technical capabilities by using feedback loops to handle the ever-changing environment. Figure 5 illustrates the dynamics between the different strategies and technology innovation.

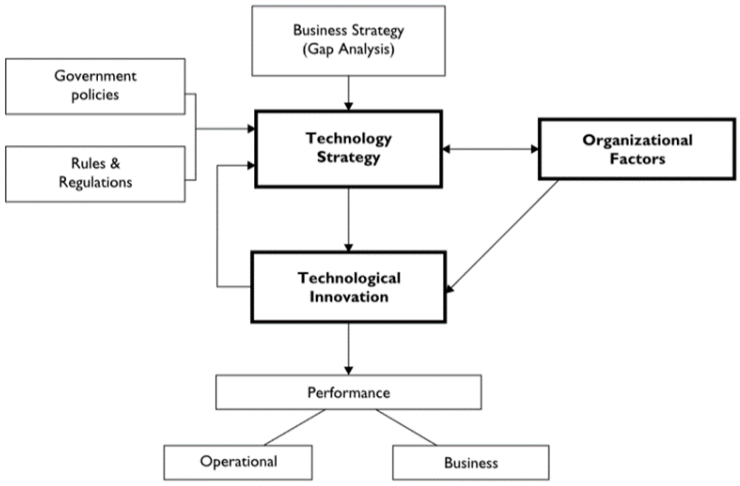


Figure 5. Describing the connection between strategies (Dasgupta et al., 2009).

4.4. Technology Strategy

The main function of a technology strategy is argued to be "*to guide technology diversification and to promote technology integration*" (Christensen, 2002, p. 269). Further, Davenport et al. (2003) suggest that the three main focuses of a technology strategy lie in the acquisition, management, and exploitation of technical knowledge and resources that the company comprises in order to reach its goals. Dasgupta, et al. (2009) construct a technology strategy with four components; competitive strategy stance, value chain stance, resource commitment stance, management stance.

The competitive stance means using the technology strategy as a crucial component within a more comprehensive corporate strategy. Dasgupta et al. (2009) describe the importance of fitting the technology strategy with other strategies, such as business strategy, in order to gain a competitive advantage on the market. "*A fit between strategies enables an organization to improve its business performance. (Dowling & Gee, 1994; Nambisan, 2002; Chamanski & Waago, 2006; Zahra & Covin, 1994).*" (Dasgupta et al., 2009, p.11). The competitive stance also handles the term technology leadership and technology-follower. A company that focuses on technology leadership use their innovative capabilities to research and develop completely new technologies and products in the hope of gaining a first-mover advantage. A company that focuses on technology-following rather aims its strategy on developing already existing, proven technology and products.

The value chain stance sets the scope of the technology strategy. Depending on where the company is placed in the value chain, the placement determines which capabilities the firm need to develop internally, versus what can be sourced externally (Dasgupta et al., 2009). The technologies that need to be developed internally are defined as core technology. After this, the company needs to decide whether to be the leader or the follower of technology development. The scope of the core technology, therefore, guides the content of the products and process technologies that builds the company's portfolio. From this, the company can decide on

whether it should focus on a few technical capabilities or if it should have a more diversified portfolio.

Resource commitment stance defines the depth of the technology strategy. If the scope is slim, and the resource commitment is large, a great depth of the technology strategy can be established. This means that large resources are committed to a small focus leads to the ability to focus on a strong development of that specific field of technology. This also allows for flexibility and an ability to respond to the changing market conditions and demands of customers (Dasgupta et al., 2009). With a broader scope, it requires more resources to keep the same flexibility, on the other hand, it allows for broader in-house competence.

Management stance, or organizational fit, refers to the ability of the organization to structure itself to support the demands from the competitive-, value chain, and resource commitment stances. Dasgupta et al. (2009) discuss the implication of choosing centralized versus decentralized R&D and technical innovation. Decentralizing R&D is generally not suitable for the development of new technologies but rather the development of already existing technology.

Technology sourcing is an important part of the technology strategy (Dasgupta et al., 2009). The decision on whether to source the knowledge needed internally or externally depends on several factors. Whether the knowledge can be sourced internally depends on the firm's internal R&D capabilities. If the knowledge does not exist within the firm, external sourcing can be conducted through recruitment of personnel with a particular skill set, mergers and acquisitions, strategic technology agreements as well as licensing of technology.

When conducting external sourcing, the firm also needs to consider whether to single source or use multiple sources. A single-sourcing might imply a closer and longer-term relationship in comparison to using multiple sources where competition between the knowledge suppliers may arise. A mixture between internal and external sourcing can also be achieved by using forms of collaborative research, investing in joint ventures or setting up strategic alliances with other companies or universities. The decision on whether to internally or externally source technology depends on two crucial factors. First, the ease or difficulty for the organization to capture the result of research activity. Second, the transaction costs, how easy or difficult it is to set up purchase contracts that incorporate all technology needed to a reasonable price, and avoid unexpected costs (Dasgupta et al., 2009).

Organizational factors' effect on the technology strategy is also declared by Dasgupta et al. (2009) and shown in Figure 5. Strategic direction, effective communication and integration of efforts are mentioned as important organizational factors. The organizational structure is one organizational factor that has an effect on the innovative capability of a firm. Dasgupta et al. (2009) present the implications of innovation between using a decentralized and centralized structure. It is argued that decentralization of, for example a laboratory, is not suitable for the creation of new technology but rather for the application of existing and proven technologies.

4.4.1. Saab's Technology Strategy Matrix

At Saab, one component in the technology strategy is the *Technology Strategy Matrix* (Saab, 2020a), visualized in Figure 6. The matrix categorizes technology into four different types depending on how it contributes to capability and competitiveness. The competitiveness axis varies from standard to differentiating, meaning that standard is something every actor in the industry can develop while differentiating includes technology details that are unique. On the other side, the capability axis ranges from external to internal and separates whether the technology is available internally or needs to be externally sourced.

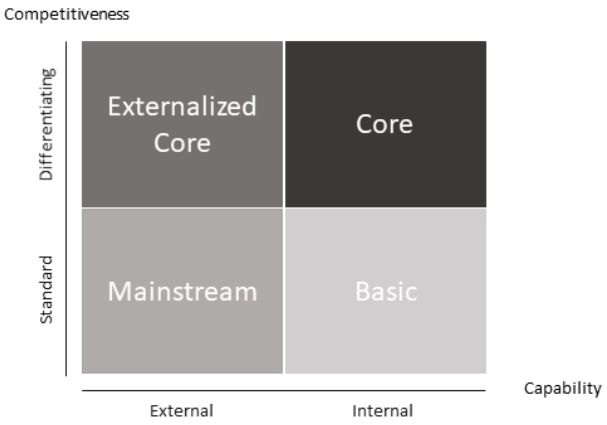


Figure 6. Visualization of Saab's technology strategy matrix (Saab, 2020a).

4.5. Intellectual Property Management

To manage intellectual property one must first understand the contained concepts; *intellectual capital*, *intellectual assets,* and *intellectual property*. Intellectual capital exists within every firm, but the concept is most widely used in knowledge firms since this capital is often their most valuable asset for value creation and innovation. Knowledge companies might even see knowledge, together with structural and human capital, as its main capital since it is the major source of competitive advantage. Intellectual capital can be defined as *"knowledge that can be converted into profit"* (Sullivan, 1998, p.21), which includes both tacit and codified knowledge. Tacit knowledge is something the employees at a company know and have learned and is therefore embedded within their workways, while codified knowledge is transferred to a communication media such as a written document or a computer program. Inventions, data, skills, databases, ideas, creativity, drawings, and designs are some examples of intellectual capital within a knowledge firm (Sullivan, 1998).

Further, Sullivan (1998) suggests that the intellectual capital of a firm is first created through the human capital containing the employees' experiences, know-how, skills, and creativity. Therefore, human capital is the creator of the intellectual assets, such as documents, drawings, programs, data, inventions, and processes. These assets can be turned into intellectual property in the shape of copyright, patents, trademarks, and trade secrets.

In comparison, Petrusson and Pamp (2009), describe the intellectual capital as a process where knowledge-based businesses transform knowledge into assets, property, and capital. Therefore, the first step is to claim what is valuable for the company (assets), identify what is tradable objects (property) and afterward be able to recognize objects in a financial aspect (capital). But, the authors also highlight the importance of how to adapt this framework to the ever-changing future knowledge-based market economy.

Additionally, Idris (2003) describes intellectual property as "*the ideas, inventions, technologies, artworks, music and literature, that are intangible when first created, but become valuable in tangible form as products*" (Idris, 2003, p. 9). In relation to this, the author also points at the importance of defining the IP as the essential idea behind a product together with the way it is expressed and named, not the product itself. The word property is therefore used to describe the value of the invention, work, or name of something that a person can claim ownership for. Further, ownership becomes important since the potential economic gain can be an incentive to innovate. Finally, Idris (2003) also defines the most generally common forms of IPRs as patents, trademarks, and copyright.

4.5.1. Value Creation and Innovation

For knowledge companies that are profiting from commercialization of innovations and ideas, there are two fundamental sources of value according to Sullivan (1998). These are the innovativeness and the business creation around the innovations. Further, Sullivan (1998) states that there are seven ways of turning an invention into a profitable business; sale, out-licensing, joint venture, strategic alliance, integrate with current business, create a new business or donate.

Moreover, Petrusson (2004) means that due to globalization, the competitive landscape has widened and therefore also the pressure to adopt an IPR focus is increasing. This can be seen as an evolutionary path that will lead us into an intellectualized economy. The result of this will be a business sphere, focused on intellectual capital and intellectual property. Therefore, it becomes crucial for managers to analyze the company's transformation process to ensure the demanded ability and skills in this new era. The more attention this transformation gets, the more important it becomes for multinational companies to develop skills and tools for IPR management (Petrusson, 2004). This progression will eventually lead to a new era, where creation of value and wealth has to be reconsidered. But, Idris (2003) points out the fact that economic growth is tightly connected to knowledge, and innovation has been known for long. Moreover, Idris (2003) suggests that economic policies should encourage investment in new R&D and subsidize initiatives that develop human capital. Rapid knowledge creation including new technologies might result in policy changes for IP and the adaption of new knowledge assets management.

The emerging importance of IP is also identified as a result of the global trading trends by Idris (2003). Also, the increased realization of IP as one of the most valuable assets in commercial

transactions such as license, manufacture, purchase, distribution or mergers and acquisitions also makes the IP management even more important. By managing IP, competitors can be blocked and competitive advantage can be achieved. For example, through licenses to patented technologies that prohibit others from using them. When companies recognize this, IP is becoming a major element in corporate business management. The intellectual capital management is, according to Petrusson (2004), a set of activities including knowledge management, innovation management, and IP management. In this context, the use of structural capital becomes important because of the important concept behind it, which can be used as a tool to capture the function of economic change and business transformation.

Economical change of growth can also be tied back to the changes in the value chains. When assessing the internal environment of the firm the strengths and weaknesses of the company can be analyzed by examining each step in the material value chain (Porter, 1998 see Schilling, 2017, p. 115). In this value chain, the activities are divided into primary and support activities. The primary activities are inbound logistics, operations, outbound logistics, marketing, and service. The support activities are firm infrastructure, human resource management, technology development, and procurement (see Figure 7). Each of these activities can be considered regarding how it contributes to the value produced by the company.

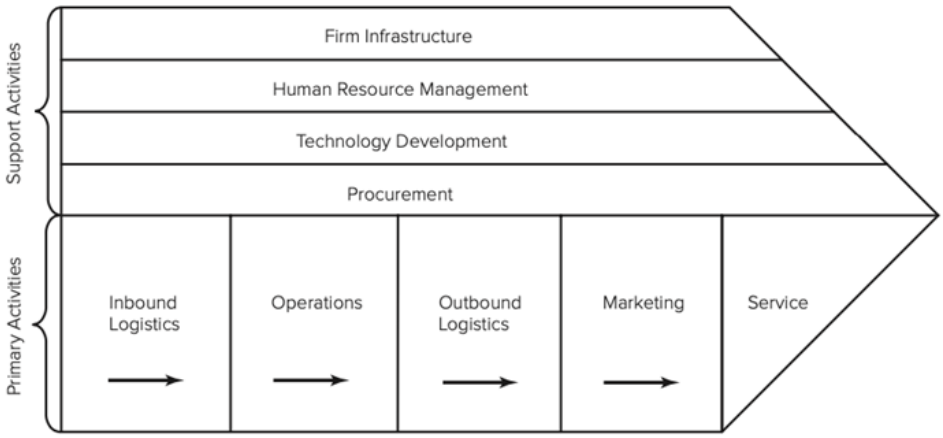


Figure 7. Material value chain (Porter, 1998 see Schilling, 2017, p. 115).

Even if the model is adaptable, this value chain is primarily focused on material production companies (Schilling, 2017). When the economy is becoming intellectualized there is also a need to find new value chains since value is created through new fundamental concepts. Petrusson and Heiden (2008) present the *Intellectual Value Chain* where the basic idea is to explain how other phenomena than physical products can create value for the company. Therefore, the starting points of the intellectual value chain are human resources and a value vision which together creates intellectual assets, property, and capital. These assets can be leveraged through either physical products, virtual products, license offers, or service in order to create new market structures (see Figure 8).

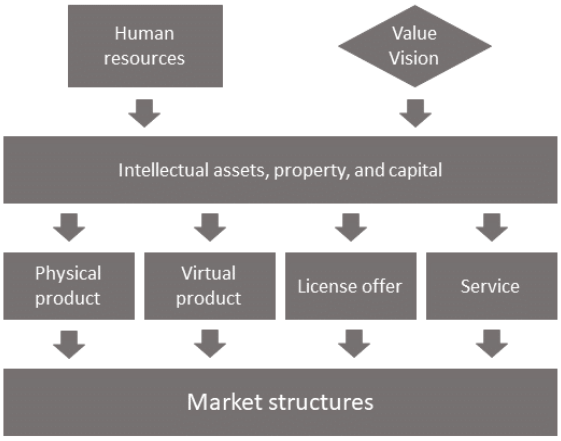


Figure 8. Intellectual Value Chain (Petrusson and Heiden, 2008).

4.5.2. Intellectual Property Strategies

Historically, IP strategies referred to the understanding of which inventions could be protected by patents and where it could potentially be protected geographically. However, this kind of strategy only involved the patent attorneys and the patent council, which created divergence between the rest of the company's stakeholders' support in the IP strategy work (Croning and DiGiammarino, 2009). Today, Intellectual Property is viewed differently, especially within the A&D industry. To be able to develop new products, collaborations must be established which means that the intellectual property have to be shared with suppliers, competitors and customers. Usually, this also includes highly proprietary trade secrets to enable success (Elkington, 2012a).

Therefore, an IP strategy nowadays need to take several potential revenue streams into consideration when knowledge is shared in collaborations. This can be done through, for example, patent licensing (Palfrey, 2011). To succeed with an IP strategy, the support of enough personnel, resources and legally from the functions within the company are crucial. The alignment of IP strategy within the company is also important since this is one of the most common reasons for failure due to extensive costs and poor protection for some business units (Germeraad, 2010).

IP strategies can be developed on various levels depending on the industry and settings that the firm exists within. In this thesis, only the first steps towards an IP strategy will be included. More precisely, only the Claiming part of Petrusson's (2015) Intellectual Assets Management framework, which will be presented below.

4.5.3. IAM Framework

The *Intellectual Assets Management* (IAM) framework was originally a support system developed for collaboration between academia and the innovation office to enable primary missions of research and education. Therefore, the framework aims to define a pedagogical

way of explaining the process of support and models needed to enable the key processes. Within the framework, there are four main areas (see Figure 9), the claiming of intellectual assets process, the evaluation and positioning in relation to the outside world, a process of decisions regarding utilization, and the last process of organizing knowledge assets, IP and contracts within the organization (Petrusson, 2015).

Figure 9. IAM Framework (Petrusson, 2015).

The first main area, the claiming process, includes the identification of potential knowledge assets in order to be able to understand the value of the research results. For this to be relevant for the company, the claiming process also includes claiming benefits and addressing relevant stakeholders as well as ensuring the ownership of intellectual property rights. The positioning process is thought to be a support system to evaluate how the organization can position itself in national and international utilization, collaboration and research. Hence, a larger amount of external data needs to be gathered to determine how to position. To be able to do this, tools such as knowledge trees, research maps, utilization maps, control maps can be used to create a clear road map to work with (Petrusson, 2015).

These first two areas lay the foundation, with collected data, to enable the third step's decisions on how to promote and utilize or collaborate within and outside the organization. This third step seeks to enable knowledge and information on how other actors operate in the external landscape. Further, this process also sets the boundaries for collaboration with other actors and decisions regarding what type of information should be shared or not, including terms, due to competition. The fourth, and the final main area for the IAM framework, is the organizing process. This step includes the administrative governance of the organization regarding transactions and established relationships. To establish this kind of protection, this main area handles knowledge assets, intellectual property assets, and contractual relationships as well as claims in external collaborations (Petrusson, 2015).

As mentioned before, this framework was originally designed to assist the collaboration between academia and an innovation office. To set the framework in a commercial setting,

Hermansson (2019) presents how the tool can be used for commercial businesses. Here, the first area, claim, is similar as it identifies the resources and intellectual assets of the company or project in question. The second area, positioning, has a greater focus on the market and how the companies, with is intellectual assets and resources, could strategically place itself in relation to competitors and market structures. In the third area, the decisions on how to leverage and utilize these assets and resources are made. In the commercial setting, this usually means setting up a business model. The fourth area, organize, is where the decisions on how the company should be organized in order to realize the business model and positioning on the market while setting up and upholding control over the identified assets (Hermansson, 2019).

As the third research questions is "*How can commercial value be captured from innovation processes through intellectual property management?",* the theory regarding intellectual assets management will be focused on the claiming process of the IAM framework. Hence, the main area C*laim* from Petrusson's (2015) IAM framework will be described in further detail below (see Figure 10).

Figure 10. Claim, the first main area in the IAM framework (Petrusson, 2015).

Within the first step of the IAM framework, Claim, Petrusson (2015) states the four steps that have to be worked through to be able to claim the rights to any intellectual property. These are:

1. Identification of the knowledge assets
2. Defining technical solution
3. Claiming benefits
4. Claiming control position

The first step is the identification of the knowledge assets. This practice involves the tasks of identifying what is thought to create value and the potential thereof. To be able to do this, Petrusson (2015) suggests using systematic categorization to define the assets, these are stated in Table 1.

Table 1. Suggestion on how to categorize knowledge assets (Petrusson, 2015).

Data	Research results in the form of unstructured data	**Solution**	Research results in the form of an engineered solution to a problem
Database	Research results in the form of a structured and searchable dataset	**Visualization**	Research results in the form of a visual presentation
Observation	Research results in the form of an empirical conclusion	**Instruction**	Research results in the form of a description of how a task should be performed
Theoretical framework	Research results in the form of a general theory	**Software**	Research results in the form of data code
Narrative	Research results in the form of a narrative	**Creation**	Artistic creation

When this categorization is completed, each knowledge asset needs to be described in order to define the technical value of the results. In this step, the description of the technical solution is important as it clearly defines what the asset really is. This is useful since it makes the asset manageable, particularly in future collaboration as the asset can be clearly communicated (Petrusson, 2015). Next, the research result needs to be described from a utility and usage standpoint to appoint what benefit it offers for the firm. Therefore, this stage is about claiming benefits. This step should also include the determination of which stakeholders, such as customers, that exist for the asset. The fourth step of the process includes claiming control position of the identified and defined asset, this can be done in aspects of intellectual property rights, confidentiality, relationships, technology, and dependence on an individual. The final step of the process includes the creation of an asset list with gathered information from the four steps to make it usable, see summary in Table 2.

Table 2. The four steps of Claim, IAM framework (Petrusson, 2015).

Identification of knowledge asset	Identifying and categorizing value-creating assets
Defining technical solution	Defining and describing the technical solution or scientific value
Claiming benefits	Describing utility and stakeholders of the asset
Claiming control position	Establishing control over assets through, for example, IPRs

The purpose of the asset list is to tag the knowledge assets to an IPR, the background of it and information on how to utilize it. This tagging can also be done to link assets to certain people or organizations. By doing so, the research results will move from knowledge assets to technology assets which later can be turned into data assets. These *Intellectual Assets* (IAs) can later be tagged to IPRs, such as patents, trade secrets, trademarks, etc., to ensure legal status and property claims (Petrusson, 2015).

4.6. Theoretical Framework

To generate empirical findings in order to answer the research questions, a theoretical framework was set up. Each part of the framework was also used as a guideline for setting up the questions for the semi-structured interviews conducted in the case study. To answer the first research question, "*What innovation processes are used in the industry?"* a combination of the results from the case study together with the theory and the documentary analysis was used. The theory contributed to an understanding of the findings in the case study.

To answer the second research question, "*How can innovation processes support existing technology strategies?"* The Innovation Matrix (The Transilience map from Abernathy and Clark, 1985) and the Technology Strategy Matrix theories were used and together these two theories generated the empirical finding needed in order to provide an answer to the question. All of the Innovation Matrices presented in Section 4.2.1 are built on the same logic, but takes on different perspectives. The Transilience map compares the most suitable factors for this study, which is why it is used in the theoretical framework. Moreover, the Innovation Matrix contributed to the viewpoint of innovation strategy that was needed in order for innovation to support the technology strategy.

Lastly, the third research question, "*How can commercial value be captured from innovation processes through intellectual property management?"* was answered by the findings of the case study which was constructed from several theories found in the literature, where the IAM framework was the main theory used to answer research question three. In particular, the Capture component of the framework as focuses on identifying, describing, and transforming assets into intellectual property rights. Finally, by answering the three research questions, the main research question could be answered. Figure 11 below visualizes the theoretical framework, set up to create a structure for the empirical study of the report.

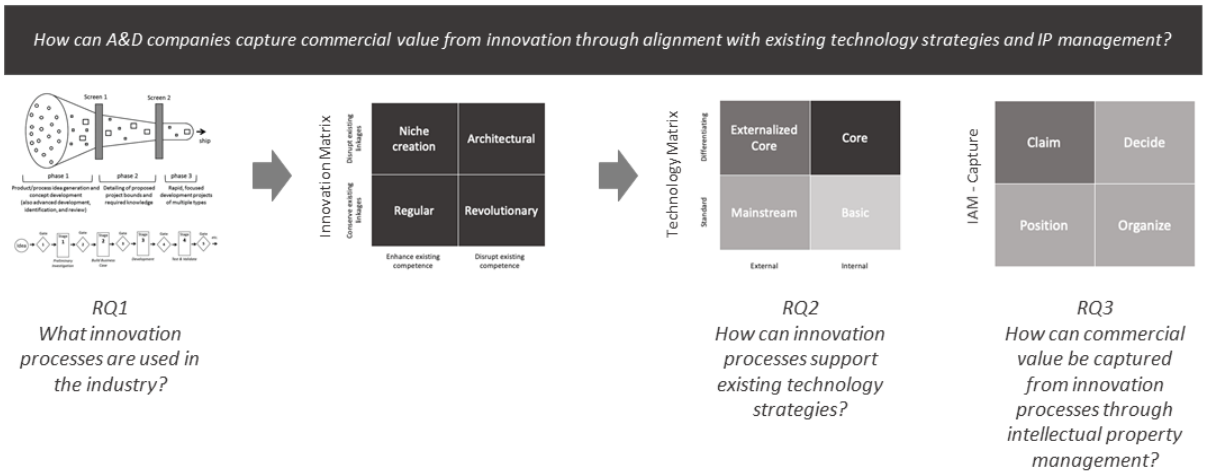


Figure 11. Theoretical framework for case study.

Chapter Five

5. Case Study

In this chapter, the case study is introduced. The individual cases are not individually presented, but were studied by the structure of the theoretical framework, presented in section 4.6. The five studied cases are named Case A-E. However, the corporate innovation initiative is not a case in itself in this study.

5.1. Introduction to Saab

Saab was founded in 1937 as a result of the Swedish government's need for quality military aircraft at the beginning of the Second World War. Saab is a Swedish technology-driven industrial company within the A&D industry, civil security, and aerospace. The company is divided into six business areas; Aeronautics, Dynamics, Industrial Products and Services, Kockums, Support and Services, and Surveillance.

At Saab, there are currently several initiatives to strengthen the innovative power. Five of these were studied in the case study. At a corporate level, work has been conducted to form a cohesive best practice of how Saab, as a company, should work with innovation. The corporate innovation process is not case in itself in this study.

Chapter Six

6. Analysis

This chapter aims to first analyze the cases by comparison, based on the results of the case study. Second, to answer the three sub-questions that will lead up to the answer to the main research question that will be presented in Chapter 8, Conclusion. The findings from the case study, together with the literature, and the documentary analysis form the basis of the answers.

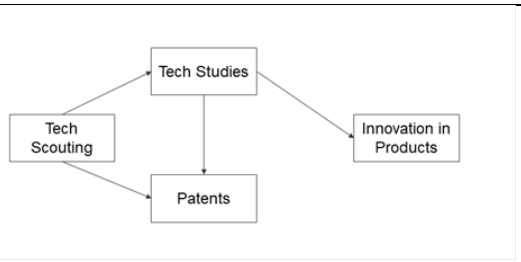
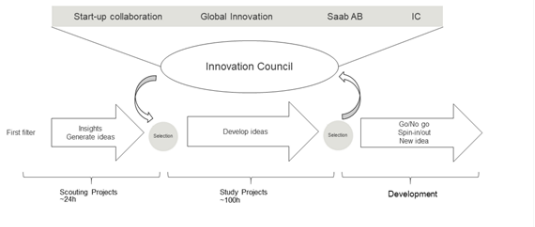
6.1. Comparative Analysis

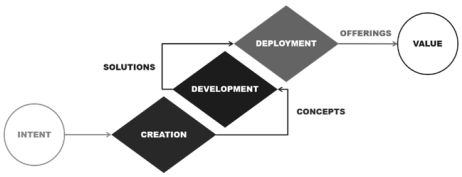
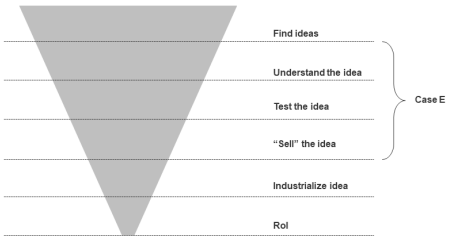
In the section below, a comparison between the cases has been made. The structure of the comparison follows the main themes of the theoretical framework; innovation process, innovation strategy, technology strategy, and the IAM framework. The analysis takes the abstraction level of the cases into consideration, meaning that some of the discrepancies between the cases are due to the nature of the cases. Hence, the analysis is made on several layers to cover all abstraction levels to achieve an exhaustive analysis.

6.1.1. Innovation Process

None of the five cases studied claim to have a formal innovation process. However, as shown in Table 3, several graphical representations are in place.

Table 3. Graphical representation of the cases' innovation processes

Case	Innovation process
Case A	No graphical representation exists.
Case B	
Case C	

Case D	
Case E	

Both Case C as well as Case D look towards the work at the corporate level for inspiration on how to set up the structure around innovation and to create a formal process. One reason for this is the value of an alignment of how innovation work is conducted at Saab, but with adaptions to the particular part of the organization at hand. Case B, on the other hand, has taken more of a practical approach, by testing different ways to go about innovation and have let practice steer the progress of the work.

Case B has a well-functioning structure, Case C has taken inspiration from Case B on how to create an innovation process in practice. Both Case B and C have taken on the structure, however using different wording, of Tech Study/Study Project, Tech Scouting/Scouting Projects, and The Challenge. The Tech Study/Study Project enables the innovator to work with an idea for 24h to explore its potential. If considered interesting, a Tech Scouting/Scouting Project, a longer project in hours, can be conducted in order to dig into the topic further. The Challenge is also used in the same manner, where a particular problem is raised and solutions can be suggested.

The two cases B and C, as well as Case D have a deciding council, also using different naming but more or less have the same tasks. However, there is a difference in the competence and scope of the teams. Case C has a combination of IP, business and technology competence, which is similar to Case B. Case D on the other hand, has a broader scope of the council where responsibilities for portfolio management, Product Life Cycle Management (PLCM) process are mixed together with IP and innovation. The persons within the cases view a potential risk of a skewed focus on the maturity of the ideas.

All cases, to different extents, present focus on the alignment between innovation and the technology strategy, particularly in how ideas are prioritized. Case D has an additional focus on Ten Types of Innovation and therefore seeks to have a broader spread of the ideas that are collected. Case D also emphasizes the necessity of an innovative culture slightly more than the rest of the cases, even if the culture is mentioned by all.

The nature of Case E differs from other cases. Case E particularly differs from the rest of the cases as the innovator does not realize the idea on its own. Therefore, time, resources, and competence are provided whereas in, for example, Case C and Case D the innovator receives different amounts of time depending on the type of project is it. There is no deciding council, most decisions are made by the responsible person. Here the competence of the innovator to perform the idea is not limited, however, the team working in Case E has a specific competence within software development. Therefore, the ideas that can be realized are limited. This stands in contrast to the philosophy of Case D on Ten Types of Innovation. Case A has expressed that no formal processes exist but minor guidelines and innovation initiatives, such as Dragon's Den.

The innovation processes of Case C and B are similar since both start with different project types that can be pursued by anyone with an idea. The maturity of the idea defines the type of project. Further, as mentioned before, a council that evaluates ideas and decides on how to proceed is used in both cases. Both of the processes end with development and demo projects. Case D, on the other hand, takes a less practical approach as it describes the process on a high aggregation level. It starts with intent, and the second step is creation. However, it does not state in which context the creation is executed, as it does in Case B and C's process charts. As the settings in Case E are different, there is also a difference in the process used. It starts with finding ideas, understands, develop, and test it. Finally, the innovation is transferred back to the business unit in question, as Case E is not interested in the ownership themselves. Therefore, the innovation process also ends outside Case E's scope. This is unlike all other cases. A similarity between Case D and E is that the processes start with the finding of ideas or with the intention. On the contrary, Case B and C, start with the different streams of collecting and projecting an already existing idea.

6.1.2. Innovation Strategy

Within the topic of innovation strategy, a clear similarity is seen between the cases as none has presented any established innovation strategy. In some of the cases, an initiative towards an alignment of technology strategy and innovation strategy has been mentioned, but only one case has put it into practice, so far. Case C and Case D consider innovation strategy as a part of their technology strategy since the innovation is used as one way of covering the identified gaps in the technology strategy. Overall, the five cases have the spirit of aiming to increase the innovation power and amount of ideas in common.

One case that differs from the others regarding innovation strategy is Case D who has considered to create a stand-alone innovation strategy to align the work between technology and innovation. The main aim of the innovation strategy is to broaden the focus of innovation from products to Ten Types of Innovation in order to increase process- and business model innovation. Case A and E are using other initiatives, than an innovation strategy, to increase innovation. For example, challenges or investment in ideas outside the regular business area. In the future, Case B is aiming to develop a stand-alone innovation strategy.

Innovation through Niche Creation where existing technology and competences are used to innovate on new markets are mostly done through the market department in collaboration with product units in the cases. In addition, awareness around existing products or techniques are gained through a lot of different initiatives among the cases, for example, branch fairs, innovation awards, or Tech Scouting. However, Case C's nature of the products does not allow for Niche Creation and Case E does not focus on this kind of innovation either.

Revolutionary Innovation, new technology for existing markets, is seen as incremental development in Case A. This is different from Case E as the overall idea is to develop innovation within this area by creating an environment where "crazy" ideas are welcome. Case B also sees this as an opportunity to use the Innovation Lab or Tech Studies. Moreover, Case C and Case D do research in collaborations with partners such as Vinnova or EU sponsored projects to develop new competences for its existing markets.

The previously mentioned type of collaborations are also conducted by Case A when it comes to Architectural Innovation, where new technologies are developed for new markets. Tech Scouting, trend spotting, and market insights are other tools used to increase architectural innovation in Case B, C, and D. In Case E, digitalization is used as an enabler to find new techniques for new markets.

Regular Innovation, existing technology for existing customers, is considered a part of the day-to-day development in Case A, B and D. But, in Case C, Regular Innovation is used as an important factor in order to gain an understanding of customer needs to be able to deliver the right product. Case E uses Regular Innovation to improve the infrastructure in the organization.

6.1.3. Technology Strategy

In most cases, innovation is closely steered by the technology strategy. The aim of the technology strategy is to pinpoint strategically important technology areas to ensure resources and competence. Most use gap analysis or Technology Mapping as helpful tools in defining where there is a gap between present and the set goals. Case B notes that innovation and technology are interdependent and that innovation is a vehicle to achieve the goals of the technology strategy.

This is in line with Case C that is looking to more clearly define what technology areas that need an innovation push to reach its goals, and also to be able to clearly communicate it to the organization to reach a common understanding on what is more important to focus on. Case C also emphasizes the need for a technology strategy as it is used to ensure competence and resources. Due to the nature of the product in Case C, the technology strategy is effected by external regulations. In similarity to Case B, Case C sees innovation as a complement to traditional ways of finding solutions to technical problems.

Case E is steered by the department's technology strategy, the nature of the work, and its competence. Further, Case E strives to increase the innovative culture at the department and increase the collaboration between the engineers. Case D and Case B also discuss increasing innovative culture.

All cases declare core technology to be where innovation will bring the most value to Saab. Case B notes the importance of innovation work within core technologies to be aligned with the technology strategy. Case C also empathize that resources and innovative power should be focused on core technology. In addition, other ways to gain competence within core are to collaborate or acquire start-ups. Case D comments that innovation is always within the differentiating row and that focusing on innovation within core technology brings the most value to Saab. Lastly, Case A also centers its resources on core technology. However, the risk of only focusing on core technology might be limiting. In addition to technology innovation, it has to be a combination with process innovation and ways to discover new business opportunities.

Case E has a slightly more focus on externalized core as the goal is to increase the efficiency, by using external competence and standardized solutions. The other cases focus on partnerships and collaborations within this type of technology. For example, Case C mentions the importance of supporting and collaborating with a partner as well as choosing a partner that is innovative and ahead in technology development and has a competitive advantage against its competitors. Case A empathizes the need to understand this type of technology. Even though it is externally sourced, it is important to require specific abilities and understand the quality and performance of the technology being sources. Case D acknowledges the importance of also being innovative within externalized core.

Case B does not have a focus on basic technology. Similarly, Case D states that basic technology innovation is included in the continuous day-to-day development. Case E neither has innovation within this technology area, however, it points out the importance of this type of technology. Case C takes the same view as Case E, as it enables core technology. Basic technology is not mentioned by Case A.

Mainstream technology is considered an enabler to create products, which is a responsibility of the procurement department at Case B. Case C, on the other hand, does not acknowledge mainstream technology as innovation as it does not have a differentiating effect on the product. However, Case C finds it important to spot new applications of technology. Innovation tends not to be developed within mainstream technology within Case D and is strategically bought by Case A. Case E has another view of mainstream technology as it is used to find more efficient ways of working, which is, as mentioned above, the aim of Case E.

6.1.4. IAM Framework

The management of intellectual assets is differently handled within the different cases. In some cases, there is a person appointed responsible for IP, but in other cases, this becomes the

responsibility of the individual innovators. All cases have a webpage or intranet page where an invention disclosure can be filled out when an innovation is considered patentable. These disclosures are later handled differently within each case, some are handled by an IPR responsible, some by the Patent Council, and some are sent directly to an external patent attorney.

Case B has a combination of the above-described differences, a person is appointed responsible for IPR issues, who is also a member of the deciding council. The involvement of the IP department creates, according to Case B, a greater understanding of IP protection in the organization and increases the protectability of innovations when discovered in early stages.

In comparison, Case C and Case D has a structured way of working by using a form to discover patentability. The decisions on further investment is often based on the results in the form. Case A sees the intellectual assets management as an activity where the aim is to collect ideas and identify potential valuable assets, where the responsibility lies on the innovator to recognize the potential. In Case E the Value Modelling is used to identify value and potential stakeholders. Afterward, the responsibility lies on the innovator to take the question of IPRs further.

The process of identifying knowledge assets differ among the cases, Case A considers this as a responsibility of the Patent Council and Case B as a task for the IPR responsible. Several of the cases have mentioned the invention disclosure or their webpage for collecting ideas as common ways of identifying valuable knowledge assets. In Case D, the importance of personal networks of the IP manager is emphasized since most knowledge assets are discovered that way. Nevertheless, none of the cases present any structured way of categorizing identified assets.

Documentation routines to understand the technical solution of the assets vary among the cases. There are several tools suggested for this kind of documentation, such as a form, a matrix or Value Mapping. In addition, intranet pages are used to store this information.

Case C has established a process on the intranet for identifying potential stakeholders for new innovations, while Case A, B, and D mean that a larger context and packaging of the asset are needed before any stakeholder can be identified. To claim control of the assets, most of the cases use an external patent attorney to evaluate patentability, write claims, and to handle the patent process with the registration office. But, usually, innovations are protected by trade secrets due to branch trends in patentability and the nature of the innovation. Case B points at the importance of awareness of IPRs since a great responsibility is put on every innovator to express a need for protection.

6.2. Research Question One

What innovation processes are used in the industry?

The innovation processes used in the industry can be summarized into three different types of models. The first is a linear process that begins with the collection of ideas. The process takes a practical approach as it includes different project structures that can be used for different types of ideas and in some structures. For example, The Challenge can spur innovation within certain technical areas. In the process, a council with members from the division jointly make decisions on whether different ideas should be proceeded with or not, is used. This decision-making council is similar to a gate in the Stage-gate process since the function is to make the go or kill decisions. However, the processes found in the case study do not have as many decision points.

When considering the Innovation Funnel, where many ideas reaches the wide front, but only a few make it through the full process (Schilling, 2017), the logic of taking in many ideas is also applied in the process found in the case study. However, only in the first step where the Tech Scouting/Scouting Project allows many ideas further sponsorship. Progressing with the idea from the first step to the second, into the Tech Study/Study Project, requires feasibility and potential of the idea in order to receive a further budget for it. Only ideas with enough potential, regarding technical feasibility, budget, and potential profitability reach this phase. Later on, in the next phase of the process, the idea is turned into a demo or a development project in order to realize and commercialize the innovation. In Figure 12, this process is presented in a graphic, made by the authors, in accordance with the perception of how it is practically executed within the industry.

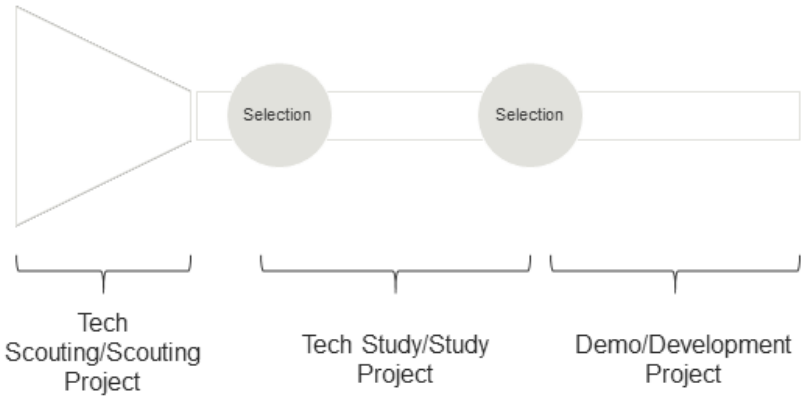


Figure 12. Illustration of the authors' perception the first innovation process.

Another type of innovation process used in the industry was found where a graphical presentation of the general steps of innovation is shown through a sequential flow (see Figure 13). The definition of innovation is demonstrated by the process's start and end. Innovation starts with an idea and ends with value. However, the process lacks information on how it should be performed in practice. It does not state where to make a decision or by whom. Neither does it state how ideas can be collected or handled. The graphical representation of the process does not present the use of a deciding council, even if it exists. Therefore, the process is only

helpful in understanding the principles of innovation, but not on how to perform or structure it in the divisions where the innovation is supposed to be executed.

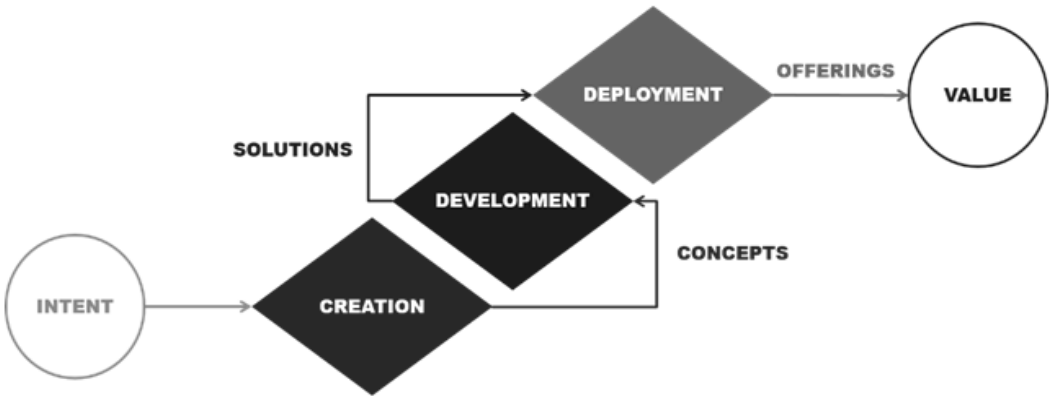


Figure 13. The second innovation process (Saab 2020b).

The third process found in the study looks graphically more like the Innovation Funnel than the other processes (see Figure 14). A funnel shape for the process is deliberate as it signals the logic, coherent with the Innovation Funnel where many ideas are accepted at the beginning of the process and a few get through. The process ends with transferring the idea back to the original department from which the idea came. Hence, in comparison to the second innovation process, this innovation process ends much earlier as well as the responsibility. The process does not have any similarity to the Stage-gate process as there are no defined decision points, nor a defined responsible person for making those decisions.

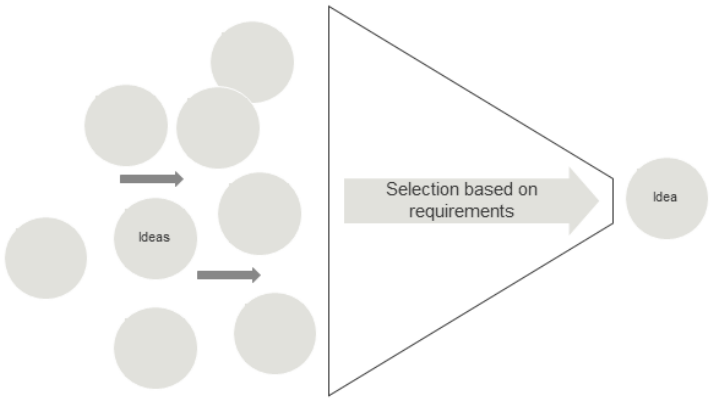


Figure 14. Modified from the third innovation process Saab.

In summary, the most used innovation processes within the industry use a linear structure even if iterations are done in reality. Most of the processes seen in the industry use the logic of an

Innovation Funnel, where many ideas enter the process, but few make it through. The case study shows that an innovation process needs to be defined with natural steps for IP management, clear decision points with involvement from a cross-functional decision-making council.

6.3. Research Question Two

How can innovation processes support existing technology strategies?

Technology strategies steer the focus of the technical development within each case, which is why the connection between such strategies and innovation processes can be seen as an enabler for more aligned development work. In one of the cases, a clearer definition of innovation is thought to enable more concrete guidelines on how to drive and finance innovation. The case study shows that there exist different perceptions and definitions of what innovation is and how innovation differs from the already occurring development work, which is well established through existing work structures. A difference in definition was also seen in another case, which argued that innovation lies within the differentiating row of the Technology Strategy Matrix. However, all cases had the common view that innovation brings the most value when it is focused on Core technology. Hence, in order for the innovation process to support the technology strategy, it must be clear what innovation is and perhaps also where it should be focused. Based on the definition and aim of innovation, an innovation process can be formed. Defining the difference between innovation and continuous development is also needed as it could assist in identifying whether different technology issues should be solved by development or innovation.

Establishing an innovation strategy is a crucial step for the innovation process to support the technology strategy. Clearly stating the aim of innovation and what value it should create can be directly linked to the technology strategy. Further, when stating the aim of innovation, a decision on how the department should work with the different types of innovation needs to be made. The necessity for a company to set up an innovation strategy is also argued by Pisano (2015) and Bowonder et al. (2010) since it can assist the company in providing, for example, new customer offerings, build competitive advantage, and penetrating new markets. The choice of strategy is, according to Gilbert (1994) defined by the industry in which the company is operating, the firm's history and present strategy as well as human and material resources. In the case study, no innovation strategies were presented. Defining what type of value the innovation should create is crucial when setting up an innovation strategy as the different types require different capabilities (Pisano, 2015; Henderson and Clark, 1990; Abernathy and Clark, 1985).

The management of innovation is, according to Durand (2004), focusing on the facilitation of idea generation, selecting relevant innovations, and managing the portfolio of innovation opportunities that have commercial and technical feasibility. The focal point of innovation management is also ensuring access to the resources and knowledge needed for innovation.

Together with the management of social and organizational implications of innovation, there might exist tension and resistance in the organization for the new structures needed to facilitate innovation. The management of the portfolio of innovation opportunities and the selection of relevant innovations can be assisted and steered by the technology strategy, where the innovation strategy describes how the goals can be reached. As innovation can be the vehicle of the technical objectives, technology strategy is the driver and innovation of the tool.

In most of the cases, a council is making decisions on innovation projects and incoming innovative ideas, which is similar to a Stage-gate structure. Depending on the competence chosen to be incorporated in the council, the focus of the innovation ideas differed. When having a member with responsibility or involvement in the technology strategy at the particular department, a greater focus on the ideas to be aligned with the technology strategy could be seen in the cases. Therefore, using this type of set up could be beneficial when striving for the innovation process to support the technology strategy. The same logic is also applicable to IP competence and the capturing of commercial value, which is elaborated on in the analysis of research question three.

In research, it has been well established that technical innovation is a source of competitive advantage and financial business performance (Dasgupta et al., 2009). For the innovation process to support the technology strategy, a clearly defined technology strategy is needed. Dasgupta et al. (2009) further argues that the technology strategy can reflect a company's attitude towards innovation, and the role it plays for the company's development will affect the claimed position on the market. When the aim of the technology strategy is set, a gap analysis can be a helpful and important tool to understand where there are gaps in competence, resources, or technical solutions. Based on this gap analysis, an innovation strategy can be formed. The strategy can include what type of innovation is needed to fill the gaps in the technology strategy. In addition, bearing in mind that there are several types of innovation, not only product innovation, but also business model and process innovation, as an example.

The technology strategy also needs to be revised as innovation projects are performed and implemented (Dasgupta et al., 2009). Hence, creating a feedback loop between the innovation and the technology strategy is needed. In cases where the technology strategy was more closely connected to the innovation process, innovation was inherently, to a larger extent, steered by the technology strategy.

The innovation strategy could greatly benefit from defining what type of idea generation methods that can be efficiently used to create the innovation needed for each type of technology. For example, within core technology, the use of The Challenge and Tech Studies could be identified as useful and efficient methods, whereas methods for gaining customer insight would be more important for other technology types.

In conclusion, innovation needs to be more clearly defined, complemented by a clear aim with innovation in order for innovation to be able to support the technology strategy. Therefore,

there is a need to set up an innovation strategy, including a definition and the aim of innovation. Hence, to set up an innovation strategy is one way to align innovation and technology strategy where the Innovation Matrix can be used as a helping tool. Management of innovation should focus on idea generation, selection of ideas, and innovation portfolio management. A deciding council and its chosen competence have a great impact on the connection between innovation processes and technology strategy. Yet, innovation processes can support technology strategies when an innovation strategy is established by a cross-functional decision-making council.

6.4. Research Question Three

How can commercial value be captured from innovation processes through intellectual property management?

For knowledge companies profiting from commercialization of inventions, the innovativeness and the business creation are crucial (Sullivan, 1998). Intellectual property management is a process where knowledge-based businesses can transform knowledge, in the shape of innovations, into valuable assets, property, and capital (Petrusson and Pamp, 2009). This connection of innovation and intellectual property is also made clear in the case study since the overall business of the host company is to develop differentiating sophisticated technology for a unique industry.

The innovations of technology, developed for the A&D industry meet certain attributes for the protection of potentially valuable assets. To be able to succeed and to be competitive within the branch, a collaborative environment between suppliers, customers, producers, and competitors is required (Elkington, 2012a). The IP currency in the A&D industry is the proprietary information (Elkington, 2012b), which is why the effort on establishing protection for such information becomes vital.

In the case study, it was confirmed that when an IP responsible person is appointed member in the deciding council, the chances of discovering potential assets the in early phase increase. If the cases lacked a cross-functional composition of the council, this can be considered a risk as a team with business, technology, and IP competence would be able to identify valuable innovations from a broader perspective. For example, depending on the competences of the members of the team, various business scenarios can be considered in order to avoid IP protection for innovations that lack a business- and technology strategy fit. This is in line with Elkington's (2012b) and Fisher and Oberholzer-Gee's (2013) elaborations on the importance of having legal, technical, and business resources involved in the IP management to make decisions with various perspectives of the functions involved. Germeraad (2010) also acknowledges the importance of aligning IP strategy within the company in order to avoid misunderstanding between different functions. Therefore, Germeraad (2010) states that the supply of resources needs to be supported by all functions. The knowledge regarding the importance of identifying potential assets also needs to be more widely spread among innovators to have a pro-active approach for IP management. This can be executed in various

ways, intranet, networks, workshops, and presentations have been suggested within the case study as some possible methods.

The underlying issue for lack of alignment is experienced by employees in the case study, to be due to time constraints, which limits the possibility to align important functions. Several departments were unsure of the responsibility for IP management, especially in the early phases of innovation. How to educate the organization within the IP management area is a usual challenge, experienced by IP professionals in the A&D industry. This is thought to occur due to large, geographically spread organizations, which limits the communication of the importance (Elkington, 2012b).

Another finding was the importance that the IP perspective is included in the innovation process. To further elaborate on the potential of IP management's involvement in the innovation process, the various alternative for IP protection needs to be addressed. Trends within the industry are directed towards decreased patent applications and more focus is put on know-how, trade secrets, and copyright. To maintain strong IP protection, such IPRs also need to be emphasized.

Even if there are internal differences in how IP management is handled, the importance of IP protection stays essential. Elkington (2012b) states that IP rights are crucial for a company to be able to protect the essential parts of innovations in order to maintain a technology edge. Today, the competitive landscape is growing due to globalization, which demands an increased IPR focus (Petrusson, 2004). The emerging importance of IP is also identified as a result of the global trading trends, which encourage companies in the industry to use IP as a major element in corporate business management (Idris, 2003).

Simultaneously, economic growth, where the majority of investments in technological innovation comes from industrial firms (Schilling, 2017), affects the value chains. The mature product value chain (Porter, 1998 see Schilling, 2017), becomes unusable for knowledge companies. Petrusson and Heiden's (2008) Intellectual Value Chain presents another perspective of how to view value creation of non-physical products. Instead, human capital and value vision are seen as the starting points for such a value offering. By connecting the Intellectual Value Chain to the globalization trend, the importance of establishing IP protection is strengthened. Hence, the capturing of commercial value will benefit from the intellectualized value visions. The previous importance of patents is decreased (Croning and DiGiammarino, 2009) while trade secrets, copyright, and know-how are becoming essential control mechanisms within the industry (Elkington, 2012a). This change can be due to an increased amount of knowledge firms, since the kind of business goes towards a knowledge-based business sphere. Therefore, possibilities for the establishment of new value chains are opened, such as the Intellectual Value Chain.

To improve the IP management, especially in early phases in the creation of IP protection and to capture commercial value, the IAM framework from Petrusson (2015) can be used. The first

part of the framework, Claim, aims to ease the identification, description, assessment of stakeholders, and establishment of control positions. In the identification step, Petrusson's (2015) suggested categorization of assets is one way to ease the next steps of documentation and description. By simplifying the early phases of IP management, the communication of how to execute it can easier be distributed through the organization. Therefore, a well-informed organization can also more easily be educated within the framework when it is commonly known. Fisher and Oberholzer-Gee (2013) point at the importance of early and continuous interactions between the functions making decisions regarding business, legal, and engineering in order to identify crucial opportunities to deploy IP. Another tool, mentioned in the cases, to identify valuable assets and to document its value, is Value Mapping.

In summary, by improving the early identification process of potential knowledge assets, control positions can be claimed to create commercial value. Early stages of innovation are developed through the innovation processes or will be in the future for those departments that have not implemented a process yet. Therefore, the IP management needs to be an expressed and recognized part of the process. When involving several functions of the organization in the IP management, through information and education, new perspectives can be taken into consideration and the IPR management can be improved. The organization's involvement will also enable IP to be an element in the future corporate business management. Following, the commercial value of innovations, identified in the innovation process, can be captured.

Chapter Seven

7. Discussion

This chapter explains the limitations of the study as well as contains a discussion on the thesis' theoretical and practical implications.

7.1. Limitations

Innovation is a broad term that can be viewed from many different angles. This study examines innovation from the perspective of how it can be managed through the formation of an innovation process, how innovation can support a company's technology strategy as well as capture commercial value arising from the process. Hence, there is a limitation to the perspective taken in the thesis, as delimitations are needed in order to scope the research questions. Other perspectives that could have been considered are how innovation could support other functions, such as marketing and customer relations.

This thesis is carried out in the context of the A&D industry, the characteristics of the branch, especially regarding IP matters, limits the generalizability of the findings. However, conducting a comparative study among several companies within the A&D industry would most likely be very difficult as the nature of the industry does not allow for information sharing. Secrecy is strict within the industry, for obvious reasons, and therefore a comparative study on cases within the organization was executed. The multiple embedded studies increase the generalizability in comparison to using a single embedded case study.

The perspective of commercial value is defined by the authors, and might therefore, differ from other established definitions of the term. This definition is stated to take an internal view of the problem statement. Another interesting point of view could have been a competitive advantage. However, to explore whether the competitive advantage is increased through the alignment of innovation with technology strategy and IP management, the external perspective would have been required as competitive advantage looks outside the firm.

7.2. Implications

The findings of the case study show an inconsistency regarding the interpretation of the term innovation. This was found both across the cases at the host company as well as within the literature, where scholars use different definitions of the word. This finding implies that there is a need for streamlining the definition of the term.

The main contribution to research is the comprehensive overarching view of the connection between innovation, technology, and IP which was identified as a gap, presented in section prior research in Chapter 1. The concepts of innovation, technology strategy, and IP management are well researched from a stand-alone perspective. However, how an innovation process can support a firm's technology strategy and IP management has not been researched

before in the context of the A&D industry. Therefore, this trinity of concepts in such a perspective makes the research novel.

A discrepancy between the innovation models found and the level of detail or practical approach was found in this study. This finding is useful as it depicts the necessity to, not only create generalizable and highly aggregated theories but also to derive practical and useful methods for practicing innovation in an efficient manner. Further, the finding of the dissimilar interpretation of the word innovation strengthens this need for a more practical approach taken to innovation. Otherwise, the risk of innovation being neglected because of its inconsistency will lower the chances of it being taken seriously. The need for taking innovation seriously is of great importance as it is necessary for a company's relevance and continuous profitability.

Chapter Eight

8. Conclusion

In this concluding chapter, the main research question is answered. From the findings of the case study, triangulated by an internal documentary analysis and an extensive review of the literature, answers of the three sub-questions were presented in Chapter 6. Here, the learnings from all components are comprised into the final answer to the main research question of this study.

Main research question

How can A&D companies capture commercial value from innovation through alignment with existing technology strategies and IP management?

In order to be able to answer the main research question, three sub-questions were stated. The first research question was answered by both the case study, documentary analysis, and the review of the literature in order to research how innovation can be dealt with and what processes that exist. The second question aimed to investigate how innovation processes can support existing technology strategies, this question was answered based on the case study. Finally, the third research question was phrased to explore how commercial value could be captured from innovation processes through IP management, which was also found in the case study with assistance from the document analysis and the review of the literature.

Within the A&D industry, there are three types of innovation processes used to guide innovation work. The most commonly used innovation process, found in this study, is the Innovation Funnel structure. The importance of having an innovation process in place needs to be stressed. The innovation process should motivate and drive employees' engagement in innovation, to increase the innovativeness. Therefore, regardless of which kind of process that is used, the proceeding of innovation need to involve a natural connection to technology strategy and IP management, to be able to capture commercial value.

All of the innovation processes found in the A&D industry included a decision-making authority, for example, a council. It is of great importance that these groups consist of a variety of competence among the parties since a cross-functional team is proven to identify crucial aspects of potential innovations in a more strategic way. When human resources are allocated to such important go or kill decision, to give further sponsorship to ideas, the chances of identifying potential knowledge assets in an early stage are also increased. When such knowledge assets are discovered early, the commercial value is more likely to be captured.

Commercial value can also be captured from innovation through alignment with the technology strategy by setting up an innovation process, which is supported by the innovation strategy. In the innovation strategy, clear prioritization of how to work with different kinds of innovation

to promote essential technology. This prioritization also needs to be known and adapted to, by the decision-making council to align it with the technology steering. Streamlining the meaning of the term innovation will ease the communication in the feedback loops between innovation and technology strategy. By having a common apprehension of the term, gaps identified in the technology strategy can be more efficiently filled by the use of innovation, steered by innovation strategy through an innovation process. Therefore, the commercial value will be captured when the company, as a whole, becomes an even more innovative actor within high-tech competitive areas.

Incorporation of IP management in the innovation process will enable a natural involvement of the right competence for the establishment of potential IPRs. Although to be able to file for any protection, the knowledge assets need to be identified in an early stage of the development. Increased communication around the importance of IP is needed since educated and well-informed employees can contribute to a pro-active IP management approach. If the knowledge is widely spread among the organization, the chances of identifying such assets early increase. By using identification as a first step to establishing IPRs, the documentation of it and the linkages to potential stakeholders become vital for the claiming of control positions. Hence, the control positions can be used to manage the position on the market, and also enable commercial value.

In conclusion, an alignment of innovation, technology strategy, and intellectual property management is what enables the actual creation and ability to capture commercial value for companies within the A&D industry. The reason for the importance of such trinity is the attributes of the branch with a collaborative environment. Therefore, to enhance the innovativeness, the organization must enable the right decisions to be taken by cross-functional competence groups to eliminate the chance of not seeing all perspectives of innovation. Thus, communication of the importance, as well as engagement of all employees, are deemed to be the most prominent enabler of such trinity.

Chapter Nine

9. Further Research

In this last chapter, further research topics are suggested. The suggestions are based on interesting findings from the study that could form valuable insights into new research areas.

There is a discrepancy in the level of detail and practical approach of the innovation process models found. An interesting and valuable area of study would be finding or designing more practical and directly implementable innovation models. This would provide great benefits for companies who strive to become more innovative and incorporate innovation in their organization. Conducting a similar study on cases spanning across several companies within the industry would be interesting and create more generalizable results, however, the nature of the industry makes this difficult. The topic of how an innovation process can support the technology strategy and IP management can also be studied with beneficial results on other industries where technology is the driving factor.

This study looked at how IP management can capture commercial value from the innovation process, which can be viewed as the first step of the IAM framework. A study area that could be beneficial to study further is the next steps of the framework and how ideas from the innovation process can be positioned on the market and leveraged in business.

Further, the main control mechanisms discussed in this thesis are patents, trade secrets, copyright, and publishing. Studying the possible use of other control mechanisms, such as contractual control or market power. Looking further into how the strict regulations of the industry affect the technology strategy may also be a valuable area of study.

References

Abernathy, W., and Clark, K. (1985). Innovation: Mapping the winds of creative destruction. *Research Policy*, *Volume 14* (1), 3-22. doi: 10.1016/0048-7333(85)90021-6

Bagno, R., Salerno, M., and da Silva, D. (2017). Models with graphical representation for innovation management: a literature review. *R&D Management*, *47*(4), 637-653. https://doi.org/10.1111/radm.12254

Bowen, G. (2009). Document analysis as a qualitative research method. *Qualitative research Journal*, *Volume* 9 (2), 27-40.

Bowonder, B., Dambal, A., Kumar, S., and Shirodkar, A. (2010). Innovation Strategies for Creating Competitive Advantage. *Research-Technology Management*, *Volume 53* (3), 19-32. doi: 10.1080/08956308.2010.11657628

Bryman, A., and Bell, E. (2011). *Business research methods.* (3rd ed.). New York: Oxford University Press Inc.

Christensen, J. F. (2002). Corporate strategy and the management of innovation and technology. *Industrial & Corporate Change*, *Volume* 11(2), 263.

Cipher. (2018). Under attack from innovation. In *Airbus conference,* 2018 December.

Cronin, J., DiGiammarino, P. (2009 January/February). Understanding and unifying diverse IP strategy perspectives*. IAM Magazine.*

Dasgupta, M., Sahay, A., Gupta, R., (2009). Technological Innovation and Role of Technology Strategy: Towards Development of a Model. In *9th Global Conference on Business & Economics*, 2009.

Davenport, S., Campbell-Hunt, C., and Solomon, J. (2003). The dynamics of technology strategy: an exploratory study. *R&D Management*, *Volume* 33 (5), 481. https://doi.org/10.1111/1467-9310.00312

Deloitte. (2020). *2020 global aerospace and defense industry outlook.* Deloitte Touche Tohmatsu Limited.

Durand, T. (2004). The Strategic Management of Technology and Innovation. 10.1057/9780230512771_3

Elkington, B. (2012a March/April). IP management in aerospace and defense. *IAM Magazine*.

Elkington, B. (2012b November/December, 2012). IP management in aerospace and defense. *IAM Magazine*.

Fisher, W. Oberholzer-Gee, F. (2013). Strategic Management of Intellectual Property: an integrated approach. *California Management review, Volume* 55 (4).

Germeraad, P. (2010). Integration of Intellectual Property strategy with innovation strategy. *Research Technology Management*, *Volume,* 53 (3), 10–18.

Gilbert, J. (1994). Choosing an innovation strategy: Theory and practice. *Business Horizons*, *37* (6), 16-22. doi: 10.1016/s0007-6813(05)80240-x

Henderson, R., and Clark, K. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly*, *Volume 35* (1), 9. doi: 10.2307/2393549

Hermansson, C. (2019). *IAM in ventures*. Lecture given at Chalmers school of Entrepreneurship, 2019-11-11. Chalmers, Gothenburg.

Idris, K. (2003). *Intellectual Property- a power tool for economic growth*. Geneva: WIPO Publication

ISP. (2020). *About the ISP*. Retrieved from: https://isp.se/eng/about-the-isp/

Jayani Rajapathirana, R.P. Hui, Y. (2017). Relationship between innovation capability, innovation type, and firm performance. *Journal of Innovation and Knowledge, Volume* 3, 44-55.

Keeley, L., Pikkel, R., Quinn, B., and Walters, H. (2013). *Ten types of innovation*. Hoboken: John Wiley & Sons.

Lengnick-Hall, C. (1992). Innovation and Competitive Advantage: What We Know and What We Need to Learn. *Journal of Management*, *18* (2), 399-429. doi: 10.1177/014920639201800209

Lineberger, R. (2019). *A&D Industry trends*. Deloitte Touche Tohmatsu Limited.

Meyer, D. (2008). Technology strategy and China's technology capacity building. *Journal of Technology Management in China, Volume* 3 (2), 137-153.

Palfrey, J. (2011). *Intellectual Property Strategy*. MIT Press Essential Knowledge Series. MIT Press.

Petrusson, U. (2004). *Intellectual Property & Entrepreneurship Creating Wealth in an Intellectual Value Chain.* Center for Intellectual Property Studies, Chalmers University of Technology. Göteborg, Sweden.

Petrusson, U. (2015). *Research and Utilization*. Tre böcker förlag, Göteborg.

Petrusson, U., Heiden, B. (2008). *Assets, Property, and Capital in a Globalized Intellectual Value Chain*. In: Berman, B. From Assets to Profits: Competing for IP Value and Return. Hoboken, New Jersey: John Wiely & Sons Inc.

Petrusson, U., Pamp, C. (2009). *Intellectual property, innovation, and openness*, chapter 8 in *Intellectual Property Policy Reform Fostering Innovation and Development*. Edward Elgar Pub.

Pinto, J (2016). Project Management- Achieving competitive advantage. Pearson Education Limited. Harlow, England.

Pisano, G. (2015). You Need an Innovation Strategy. *Harward Business Review*. Retrieved from https://hbr.org/2015/06/you-need-an-innovation-strategy

Saab (2020a). *R&T Strategy*. Saab. [Unpublished].

Saab (2020b). *Innovation Portal 2.0*. Saab. [Unpublished].

Saunders, M., Lewis, P., and Thornhill, A. (2012). *Research methods for business students* (6th ed.). Pearson Education Limited.

Schilling, M. (2017). *Strategic Management of Technological Innovation* (5th ed.). New York: McGraw-Hill Education.

Schramm, L. (2017a). *Technological innovation: An introduction.* Berlin/Boston: Walter de Gruyter Inc.

Schramm, L. (2017b). *Technological innovation: A dictionary.* Berlin/Boston: Walter de Gruyter Inc.

Sullivan, P. (1998). *Profiting from Intellectual Capital: Extracting Value from Innovation*. New York: Wiley, cop.

USC Libraries. (2020). Industry Research: Aerospace & Defense. Retrieved from: https://libguides.usc.edu/industries/aerospace

Van de Ven, A.H. and Garud, R.(1989). *A Framework for understanding the emergence of new industries*. In R. S. Rosenbloom and R.A. Burgelman. *Research on Technological Innovation, Management and Policy*, *Volume* 4, 153-193.

Yin, R. (2003). *Case study research* (3rd ed.). California: Sage Publications.

Appendix 1

Guide for questions in the semi-structured interviews.

Innovation process

1. How do you work with innovation?
    a. Is there a defined way of working?
    b. Do you have a graphical representation of it?
    c. Is it inspired by theory/literature or practice? Saab best practices?

Innovation strategy

1. Do you have an innovation strategy? If yes, what does it contain?
2. How do you find new markets and customers for existing products and technologies?
3. How do you develop new competences/products/technologies for existing markets and customers?
4. How do you develop new technologies for new customers?
5. How do you develop existing technology for existing customers?

Technology strategy

1. How do you prioritize among ideas?
2. What is needed to reach the aim of the technology strategy?
    a. How is innovation used in relation to technology strategy?
3. What relations are there between the steering of innovation and technology strategy?
4. Is there any direction of what type of technology (core, basic, etc.) innovation should generate?
5. Do you have a focus on ideas within external technology (mainstream and externalized core)?

IP Management

1. How do you identify knowledge assets in your organization?
    a. Do you use any tool for categorization of different kinds of assets? (data, database, frameworks, software, instructions)
    b. Who is responsible for this?
2. How do you describe/ document these knowledge assets to identify the potential value?
    a. Is there a defined way of working?
    b. Who is responsible?
3. How is the identified value connected to stakeholders to create business value?
    a. Is there a defined way of working?
    b. Who is responsible?
4. How is IPRs established/maintained for identified knowledge assets?
    a. Is there a defined way of working to make decisions regarding IPRs?

    b. Who is responsible?
5. Do you have a strategy to maintain IPRs?
    a. Is there a defined working process between innovation processes and IP management?

DEPARTMENT OF TECHNOLOGY MANAGEMENT AND ECONOMICS
DIVISION OF ENTREPRENEURSHIP AND STRATEGY
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden
www.chalmers.se

CHALMERS
UNIVERSITY OF TECHNOLOGY