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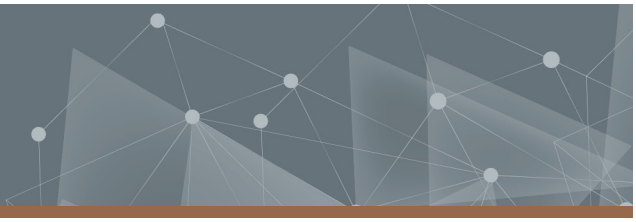

Understanding the Innovation Process in the Automotive Industry

Identifying the Direct and Indirect Impacts of Innovation Elements

Master's thesis in Management and Economics of Innovation

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Abstract

As the automotive industry is undergoing a great technological shift due to automation and electrification, many firms are changing their way of working with innovation. Radical technological developments and a greater focus on software compel industry giants into operating in a more agile way. Because of the ongoing organizational restructuring, discussions regarding appropriate innovation processes within the automotive industry are central for most firms. This study uses Volvo Cars as a case example, to understand how well the current innovation capacity and project management practices work. The data collection has been done through qualitative interviews, which have been transcribed, coded and categorized based on theme and negative or positive annotation. The results show that most innovation barriers occur when trying to diffuse an idea through the organization using facilitators such as sponsors, product champions and networks. Resource allocation for explorative projects are poor while team creation and idea presentations are some of the more successful enablers of the innovation process. Four key elements in Volvo Cars' innovative work that are in need of improvement and are highlighted in this study are (1) leveraging networks, (2) ability to explore, (3) common goals and (4) experience and knowledge.

Keywords: Innovation, innovation process, innovation barriers, innovation diffusion, project management, innovation capacity, project success.

Acknowledgments

Our last 6 months have been spent at one of Sweden's most well-known and globally recognized companies. Their brand has always been associated with safety and is a cornerstone in the preconception of the typical Swedish lifestyle. Of course, we are talking about Volvo Cars. Our Master's thesis at Volvo Cars marks the end of our 5 years as students at Chalmers University of Technology.

We would like to thank our supervisors at Volvo Cars, Jonas Fenn, Danilo Neves, and Konstantin Lindström, for the support and help throughout the process. Even though a pandemic has hindered face-to-face meetings they have helped us through several online-meetings and email chains, reaching Volvo Cars' employees world-wide, and ultimately helping us reaching the end of our Master of Science degrees.

We would also like to thank the participating interviewees, all of who joined in on our conversations and answered our question with great enthusiasm and insight.

Last, but not least, we would like to thank our supervisor Professor Hans Löfsten for his help with the academic writing and ability to provide valuable feedback with lightning speed.

Gothenburg, May 2021

Niklas Kullerstrand

Fabian Steen

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1. Introduction

This chapter guides the reader through the development of the automotive industry in relation to what has previously been considered best-practice management tools. The aim of the study and research questions are presented.

1.1 Industry Background

Throughout history, many inventions have been introduced that have led to a better driving experience. The three-point seatbelt, power steering and ABS are just a few examples of small changes that make driving a car safer and more comfortable. Although many improvements have been made, the car has not changed fundamentally since the rollout of the T-Ford in 1908 (Britannica, 2020). Majority of cars still consist of four tires, a steering wheel and a combustion engine and the driver must be sufficiently skilled to control the vehicle. The same goes for the process of automotive production. Henry Ford introduced the assembly line style of production, which is used by most commercial automotive manufacturers around the world. Toyota innovated on the assembly line process and improved efficiencies by reducing waste, not keeping inventory, and receiving necessary parts just-in-time, which has come to be known as the cornerstones of lean production (see eg. Liker, 2004). Lean production has been celebrated in the automotive industry as a breakthrough process innovation and has been adopted by several large manufacturing firms with high volume and low product varieties (cf. Monden, 1983). However, it still does not fundamentally change the process of building a car.

With technology accelerating industry development and demand, the automotive industry is on the verge of fundamentally changing. Both products and processes are being radically innovated upon. Automation might disrupt the classic manufacturing process, leaving human assembly lines obsolete while robots and artificial intelligence manufactures and assembles (Autor & Salomons, 2018). The classic automotive products are also at risk of being displaced. The combustion engine is at risk of becoming obsolete because of electrification and classic manual driving features might be disrupted by autonomous technologies (Witteman, 2017). These disruptive innovations could cause destruction of current knowledge, capabilities and resources

in the industry, which has happened to many other industries in the past (see eg. Tripsas, 1997).

These fundamental changes in industries due to disruptive innovation is almost always a result of technology development. Bower and Christensen (1995) explain that as technology evolves, disruption of industries becomes more common and large incumbent firms struggle to innovate properly to stay on top during technological change. Technology increases the uncertainty on the market because technological advances are quicker than the R&D process of firms after the realization of a shift in demand (Bower & Christensen, 1995). Here, startups have an advantage, because incumbent firms focus on current high revenue and certain demand, while new companies must differentiate themselves by focusing on innovations that have future potential (Schumpeter, 1942). Many industries have been disrupted in the past and some of the biggest firms of their time have gone bankrupt due to the development of disruptive technologies. Some of the more prominent industry examples are the disk drive industry and the analog photo industry (Christensen, McDonald, Altman, & Palmer, 2018).

Because of the apparent influence of new technology, new ways of managing businesses and projects are favored over traditional methods. Classic top-down decision making, hierarchical organizational structures, and sequential project management methodologies are left for autonomous teams, decentralized decision making, and agile project management (Maskell, 2001). Being able to swiftly change goals and plans in an increasingly changing environment is important to stay competitive. Further, in industries where technology is starting to encompass the core of businesses, the focus on innovation increases. To stay competitive and increase chances of the development of successful and sustainable innovations, a firm must develop a sustainable innovation capacity i.e. resources and capabilities required for successful innovation (Szeto, 2000).

As the automotive industry stands in front of one of the most impactful technological shifts ever, caused by electrification and autonomous driving, incumbent firms must adapt to survive. Firms that do not develop successful innovation capacities, are stuck in old and diminishing demand and do not develop new practices for managing projects are bound to perform poorly. However, properly constructing these new

practices and resources might be a hard task because of the great uncertainty of the future. To understand what changes to make there is a need for extensive research of the industry, current practices, and the implications of transforming a firm's business model.

1.2 Problem Identification and Pre-Study

Automotive firms are starting to change their project management and innovation practices to keep up with the fast development of automotive technologies. Volvo Cars has recently undergone many changes within the organization to better prepare for the electrified and automated future. The Volvo Cars headquarters in Torslanda initiated a shift from traditional waterfall processes of innovation and project management to a more agile way of working with innovation and within projects in 2019. Additionally, a tech center in Sunnyvale, CA, opened in 2016 (Volvo Cars, 2018), to increase innovativeness and technological development insights by being located in one of the most innovative areas in the world.

It is evident that Volvo Cars is changing their practices to deal with the ongoing and forthcoming transformation in their industry. Demand is changing and new technologies are becoming more readily available. However, as mentioned above, properly developing new practices and switching business models is in many ways challenging and might not always result in higher competitive advantage. Understanding how successful this shift in innovation processes have been is crucial for the firm's future competitiveness and survival. Volvo Cars must evaluate their current and historical practices to identify weaknesses and strengths in relation to the changing industry. By understanding what innovation elements are affecting Volvo Cars' innovation process, the firm can better prepare for the disruptive changes ahead.

An interpretation of Volvo Cars' innovation work has been made together with supervisors at Volvo Cars (Figure 1). The interpretation was done as part of a pre-study during the first week where Volvo Cars' current innovation work structure was discussed.

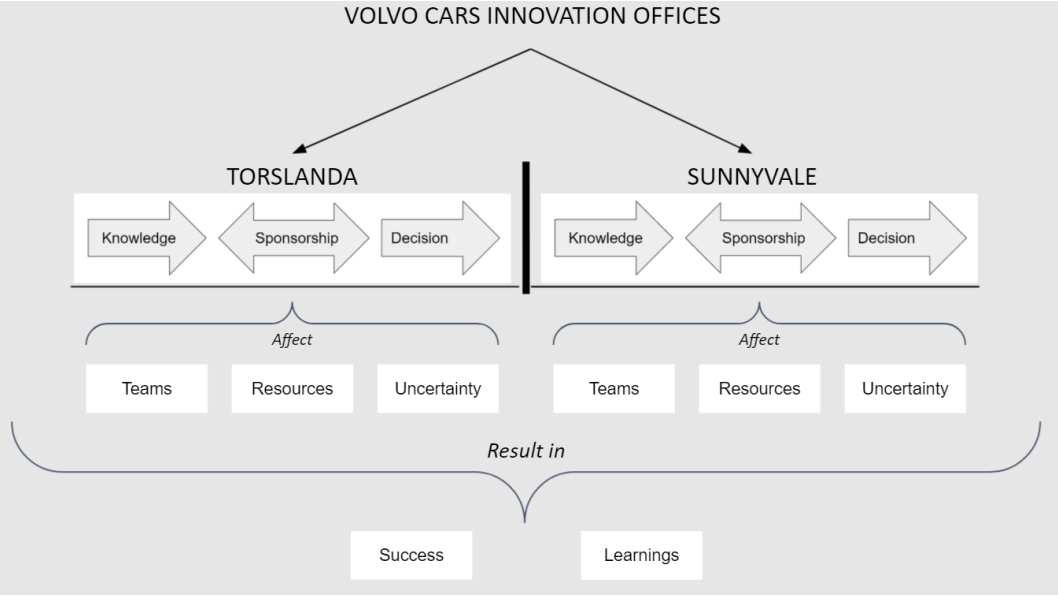

Figure 1. Visualization of the innovation process, what themes affect it and what the outcomes might be at Volvo Cars (Source: private).

From the pre-study, it became clear that the innovation work, after the agile shift, at Volvo Cars includes three main themes - knowledge, sponsorship, and decision. These three themes are from now on called the innovation process. Further, the pre-study revealed another set of themes; teams, resources, and uncertainties, from now on called process conditions, that has an effect on the innovation process. At the start all six themes, three from the innovation process and three from the process conditions, were believed to all have an equal effect on the overall innovation work. However, through the pre-study it became clear that the elements from process conditions had an indirect effect on the innovation process. As a third step, the innovation process and process conditions have an impact on the project outcomes, where this study looks at two themes - success and learnings. See Table 1 for a list of all themes investigated.

Table 1. Lists of themes covered in study.

Innovation process	**Process conditions**	**Project outcomes**
Knowledge	Teams	Success
Sponsorship	Resources	Learnings
Decision	Uncertainties	

All themes in the study have elements connected to them. With an element this study refers to a specific detail related to the theme. Passion and trust are examples of elements in the theme of sponsorship. The notions of themes and elements will be central moving forward in the study.

Volvo Cars' will in the study be examined through two different offices - Torslanda and Sunnyvale. According to many Volvo Cars employees, the Sunnyvale office works with innovation in a more agile and individually autonomous way. Torslanda previously had a structure for innovative work in which project management was performed with rigid goals, top-down decision making and control. But with the agile shift in 2019, Volvo Cars in Torsland underwent a restructure to manage projects in a more agile manner. At Torslanda there is a department called Open Innovation Arena that works with innovation and R&D in a similar manner to the Sunnyvale office. The innovative projects that stem from Sunnyvale and the Open Innovation Arena in Torslanda will be the focal point for this report.

1.3 Aim

With the current technological change in the automotive industry, there is a need to access industry data in order to gain an understanding of how to stay competitive and develop innovation capacity and project management methodologies. By investigating practices after the agile shift and different elements in the innovation process, recognizing and understanding trends within innovation capacity and project management structures is possible.

The aim of the study is to understand and identify direct and indirect barriers and enablers affecting the innovation process at Volvo Cars. This aim is achieved by consolidating projects to investigate common and recurring elements.

1.4 Research Questions

The aim can be divided into three separate research questions. The first research question will be used to understand elements of innovation capacity and project management at Volvo Cars through academic research and practical examples. The second research question helps in identifying certain elements that hinder or enable innovative work at Volvo Cars. The third research question will conclude the thesis

by analyzing elements of innovation projects to understand what core elements are included in the most successful projects at Volvo Cars and how success is perceived.

RQ1: How do existing elements directly impact the innovation process i.e., the three themes of knowledge, sponsorship and decision?

RQ2: How do existing elements indirectly impact the innovation process through the process conditions i.e., three themes of teams, resources and uncertainty?

RQ3: How are different project outcomes i.e., success and learnings, perceived in innovation projects at Volvo Cars?

1.5 Limitations

This project will have certain limitations due to time restrictions and comprehensiveness. In order to narrow the scope, Schilling and Hill's (1998) explanation of three different types of innovation projects; derivative projects, platform projects and breakthrough projects will help in establishing an appropriate scope. Derivative projects focus on incremental innovations that merely improve current products or processes while platform and derivative projects develop new products or processes within the scope of the firm and outside of it respectively (Schilling & Hill, 1998). Because of the more radically innovative nature of the Open Innovation Arena in Torslanda and the Sunnyvale office, a decision to limit the thesis to exclude derivative projects has been made. Thus, focus will be on breakthrough projects and platform projects when conducting interviews and data collection.

Evidently, the innovation process at Volvo Cars is continuous throughout the entire process cycle, from ideation and R&D, to manufacturing and marketing. In this project, a limitation has been made to focus on the early stages of the innovation process i.e. up until an innovation moves into implementation and full scale production. This limitation has been made because of the scope of the thesis. Focus is on breakthrough and platform projects, which more often than not occur in the early innovation stages and not after handover to implementation (Schilling & Hill, 1998).

1.6 Disposition

The study sets out to discover elements that prove to be barriers or enablers for innovative work at Volvo Cars. From the initial *Chapter 1.* the reader is given a background to the industry context and the company under investigation, Volvo Cars. Through a pre-study, the problem at hand at Volvo Cars and its current innovation work were understood. In relation to the industry context and problem description, the aim and the research questions are presented.

From the research questions and problem description, *Chapter 2.* covers relevant literature to get a deeper knowledge about the topics related to the study. *Chapter 3.* explains the research methods and the research design used when conducting the study at Volvo Cars and how data was collected to be able to answer the research questions.

Chapter 4. gives the reader all the data collected and presented under each theme of innovative work. *Chapter 5.* builds upon the empirical findings and relates them to the literature review from *Chapter 2.* Further, the analysis digs deeper into the reasons why some elements are more important than others and supports the claims made with data and academic literature.

The study ends with *Chapter 6*. and gives the reader a brief summary and highlights the most important findings and contributions that were made. Also, suggestions for further research are given since the study can be used as a foundation when solving and enhancing the innovation work done at Volvo Cars and in the automotive industry.

2. Literature Review

The following chapter aims to help distinguish existing research in relation to innovation management and innovation capacity to later identify positive and negative innovation elements to improve innovation projects in the automotive industry. A foundation of theory was built before commencing data gathering. When more knowledge about certain topics were needed, the literature review was reworked iteratively.

To better understand the intention of each theoretical topic covered in the literature review Figure 2 connects each research question to its related subchapter.

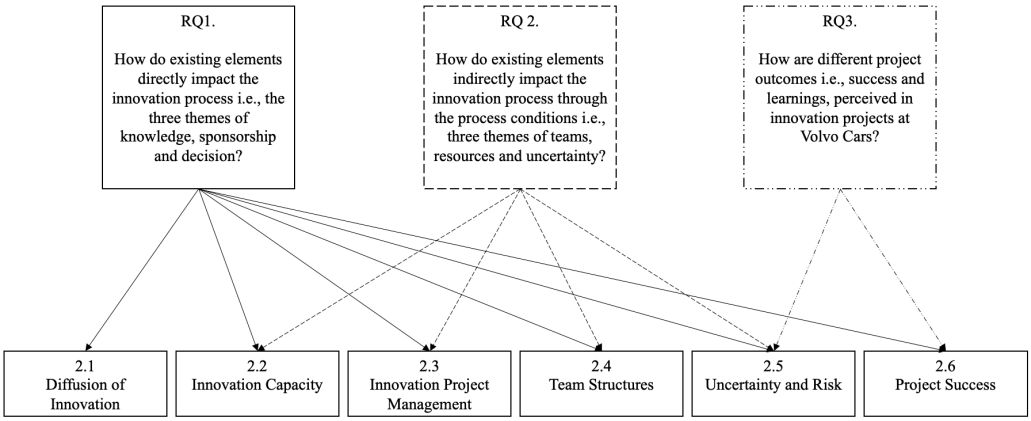

Figure 2. The research questions' connection to the literature review.

2.1 Diffusion of Innovation

To better understand diffusion of innovation, the literature review distinguishes between external and internal diffusion. The key difference lies in the scope of the diffusion, internal diffusion is more focused on personal influence rather than advertisement and the final goal of internal diffusion is often acceptance of an idea rather than a pure adoption and revenue as in external (see eg. Burgelman, 1983; Robertson, 1967).

When looking at a diffusion process, there are a number of variables present that affect how the process folds out (Robertson, 1967). Some of the variables are advertisements roll, identification of early adopters, and the predictability of the diffusion. Robertson (1967) describes an adoption model developed by Everett

Rogers with innovators, early adopters, early majority, late majority, and laggards. This is only a theoretical model that simulates adoption rates over time, i.e. the diffusion, and if this model would be the truth, less time would be spent on advertisement and identification of key stakeholders in the diffusion process (Robertson, 1967).

2.1.1 External Diffusion of Innovation

Central to the innovation capacity and innovation project management literature is the diffusion of innovation i.e. how innovations spread. Everett Rogers developed a widely used model for innovation diffusion in 1962 (Sahin, 2006). This model includes five stages of which innovations go through while being adopted on the market. Sahin (2006) explains the five stages of external innovation diffusion, described in Table 2. The model can be used in many instances by applying the understanding of the stages to specific cases.

Table 2. Rogers' external diffusion of innovation theory (Sahin, 2006).

Knowledge stage	People on the market figure out there is an innovation available. This stage consists of three types of understanding: 1. Awareness knowledge: knowing the innovation exists 2. How-to knowledge: understanding how to use the innovation 3. Principles knowledge: understanding how and why the innovation works
Persuasion stage	A stage where reinforcement or discouragement from colleagues affect how customers perceive the innovation
Decision stage	The stage where a customer decides to reject or adopt the innovation.
Implementation stage	Customers start using the innovation, both in the way the innovation was designed and in new ways i.e., reinvention.
Confirmation stage	A stage where adopters seek to confirm their decision to adopt the innovation.

2.1.2 Internal Diffusion of Innovation

When looking at internal diffusion of innovation, focus is put on the knowledge and information diffusion, similar to Rogers' initial stages (Sahin, 2006). A driver for internal corporate changes are autonomous initiatives by individuals in the organization (Burgelman, 1983). Individuals risk their reputation when pursuing opportunities outside the current strategic context of the organization (Burgelman, 1983). Ardichvili, Cardozo, and Ray (2003) describes the development and identification of opportunities within existing organizations and startups as similar. This is because the diffusion process of knowledge is similar when it revolves around a new business or technology. Personal traits, social networks, prior knowledge, and entrepreneurial alertness are factors that affect the process of discovering and developing opportunities (Ardichvili et.al, 2003). Prior knowledge functions as a trigger for new opportunities. According to von Hippel (1994) people notice information that is tied to prior knowledge. Opportunities and knowledge will not be obvious for all since they might not have the prior knowledge needed to absorb (Ardichvili et.al, 2003; cf. Cohen and Levinthal, 1990).

It is argued that productive organizations more often are capable of efficient knowledge transfer internally (Inkpen & Tsang, 2005). Knowledge transfer means that a member of the network is affected by the knowledge of another member (Inkpen & Tsang, 2005). Further, social capital is said to be the ability of gaining benefits from a membership in a social network or from network relationships (Portes, 1998).

All autonomous internal initiatives will encounter proponents due to resources allocation and managerial dilemmas (Burgelman, 1983). But there are mitigating factors and alternatives that can overcome the managerial dilemmas and critique from proponents. One way is for top management to modify structural context and allow for the initiative to prosper, which they have the ability to do according to Burgelman (1983).

2.2 Innovation Capacity

When examining the innovation capacity literature, a good way to start is to get an overview of what factors play a role in facilitating or hindering internal innovation

diffusion. Assink (2006) explains five barriers to innovation. These five barriers make up the backbone of a firm's inability to successfully stay innovative.

Adoption barrier

The first barrier to innovation is the adoption barrier. This barrier suggests that technology is path dependent, meaning new technology advancements in firms normally resemble previous technologies. Further, conflicts with the primary business model are not accepted and employees who upset the status quo are not appreciated. Firms with excessive bureaucracy inhibit quick reactions and often get stuck in their historical ways. (Assink, 2006).

The way Assink (2006) describes the adoption barrier relates to the concept of willingness to cannibalize. A willingness to cannibalize means investing in secondary business models at the expense of the primary one, upsetting the status quo and focusing on brand new technologies (Chandy & Tellis, 1998). Thus, combatting the adoption barrier is done through a high willingness to cannibalize. Chandy & Tellis (1998) prove that a firm's willingness to cannibalize is dependent on four factors. A high amount of specialized investments would increase the adoption barrier, as managers fall for external justification – persisting in action to "save face", sunk cost fallacy, cognitive dissonance and self-justification (Chandy & Tellis, 1998). If a firm has a strong internal market, many different business units make their own decisions, resulting in spread investments and high cannibalization (Chandy & Tellis, 1998). Chandy and Tellis (1998) further explain that the amount and influence of product champions will increase the willingness to cannibalize. Finally, future market focus will increase willingness to cannibalize (Chandy & Tellis, 1998).

Mindset barrier

An unwillingness to cannibalize tends to occur in firms that are stuck in old ways, resisting new developments and with a great dedication to business as usual. Assink's (2006) second barrier is the mindset barrier, firms stuck in their old ways because of obsolete knowledge and an inability to unlearn and relearn. This mindset barrier is fueled by a resistance to change, which is a concept explaining that change brings worry, irritation and resentment because of a need to relearn (Coch & French, 1948). Thus, the ability to relearn is important to not resist change and overcome the mindset

barrier. Argyris (1991) explains that barriers to learning are: (1) To remain in unilateral control, (2) to maximize winning and minimize losing, (3) to suppress negative feelings and (4) to be as rational as possible. This resistance to change can also arise based on firm politics and power. Buchanan and Badhan (1999) explain that managers are likely to resist change if this means loss of influence. On the other hand, organizational politics is also needed to implement change but it should occur transparently (Buchanan and Badhan, 1999). A product champion with influence to change, as discussed above, is an example of organizational politics for change.

Risk barrier

The third barrier to a firm's innovativeness is the risk barrier (Assink, 2006). A common way of resisting change and fuelling the mindset barrier is being extremely risk averse. This inhibits innovation diffusion as innovation is in nature uncertain. Staying risk averse or deeming risky investments unsuccessful because of unrealistic return expectations decrease the innovativeness of a firm (Assink, 2006).

Nascent barrier

Assink (2006) describes the fourth and fifth barriers to a firm's innovation capacity as the nascent barrier and the infrastructural barrier. The nascent barrier is enhanced by lack of acceptance for creativity, focusing on historical not future demand and innovation mismanagement (Assink, 2006).

Infrastructural barrier

The infrastructural barrier focuses on society's ability to allow radical innovation. Described as a factor which affects a firm's willingness to cannibalize, future market focus is important to foster innovation. When firms are too close to their customers, they cannot anticipate future demand and managers tend to focus on what brings in revenue at that time (Bower & Christensen, 1995). To understand future demand there needs to be procedures in place to absorb external information. Cohen and Levinthal (1990) explain that a firm's absorptive capacity is crucial for innovation success. Through strong relationships with market customers, high individual absorptive abilities and successful knowledge transfer, a firm can establish a high absorptive capacity (Cohen and Levinthal, 1990). Individual absorptive abilities and knowledge transfers relate to the concept of gatekeepers, employees of the firm who are exposed

to new information and manage to transfer relevant information to appropriate business units (Reid and Brentani, 2004).

2.2.1 Ambidexterity

To successfully work with both incremental and radical innovation, both short term and long term thinking is required to succeed at the moment and in the future. The notion of thinking both long term and short term can be seen as a loose definition of ambidexterity. O'Reilly and Tushman (2013, p.324) defines organizational ambidexterity as

> "The ability of an organization to both explore and exploit – to compete in mature technologies and markets where efficiency, control, and incremental improvement are prized and to also compete in new technologies and markets where flexibility, autonomy, and experimentation are needed." (p.324).

Chen (2017) explains three main types of ambidexterity - contextual, sequential, and structural.

Contextual ambidexterity allows members of an organization to explore and exploit in unintended ways by not having set time periods for exploration and exploitation (Adner & Levinthal, 2008). Contextual ambidexterity works well if the explorative project lies within, or in proximity, with the organization's core business (Chen, 2017). New initiatives that lie within the core business and competence of the organization have contexts to develop in (Chen, 2017).

Sequential ambidexterity builds on the idea that the organization can decide and focus on either exploration or exploitation at different points in time (Boumgarden, Nickerson, & Zenger, 2012). This form of ambidexterity can be successful at project levels since it allows for different managerial practises at different situations, however is hard to manage and allow at organizational levels (Chen, 2017).

Structural ambidexterity creates entities within the organization that works solely with exploration or exploitation (O'Reilly & Tushman, 2004). This separates the explorative initiatives completely from the core's exploitative work. For structural ambidexterity to function well, top management needs to be extremely involved in all decisions and coordination becomes crucial to reduce redundancy (Chen, 2017).

Creating innovation projects can be seen as a type of organizational ambidexterity (O'Reilly & Tushman, 2004).

Chen (2017) proposes a fourth form of ambidexterity called dynamic ambidexterity that builds upon the structural, sequential, and contextual ambidexterity. A dynamic approach can utilize structural ambidexterity at top management level, using different organizational entities for exploration and exploitation to facilitate management and coordination. Further, at business unit level a contextual ambidexterity is beneficial as this allows the employee to freely pursue exploration and exploitation in the unit's own context (Chen, 2017. Lastly, at project level sequential ambidexterity can be used as flexibility at this level allows for faster switches between explorative and exploitative initiatives (Chen, 2017).

2.3 Innovation Project Management

This section of the literature review has been structured to examine general project management practices, i.e. ways of organizing projects. The following chapters will continue to examine project operations, i.e. ways of working.

2.3.1 Stage-gate

Maylor (2010) explains that stage-gate project management is a project management methodology and is used to review progress throughout a project. Before starting, criteria must be identified for different stages of the project (Maylor, 2010). Maylor (2010) further explains that if the criteria have not been fulfilled when reaching a stage-gate, the project will be terminated, which can save considerable amounts of time and money. The stage-gate model often follows a sequential work method i.e. the next step in the process does not start before the previous one has finished (Maylor, 2010). This is often called the waterfall method. However, the stage-gate can sometimes include concurrent work, where the different steps in the process overlap (Maylor, 2010).

The stage-gate model is relatively rigid and planned and does not allow for much deviation. Clear and concise goals are central to this type of project management. Engwall (2002) explains that poorly formulated goals are the biggest reason for failed

projects. The goals of each stage-gate must consider performance, time and cost to understand whether the project is on the right track. Setting strict goals in the beginning of a project and not deviating from the plan is cheaper than changing your goals late in the project because of already committed resources. However, having too strict goals is problematic as knowledge regarding the desirable outcome becomes more apparent later in the project (Engwall, 2002).

2.3.2 Agile

A rather opposite project management practice to the stage-gate model is agile. Maylor (2010) explains that agile management is characterized by focusing on the skills of the project members, heavy customer collaboration and adapting to change rather than following a strict plan. The most common project management methodology used in the agile practice is scrum (Maylor, 2010). Scrum sets out to create short and intense projects, with daily meetings, autonomous teams and a manager who oversees rather than controls (Maylor, 2010).

2.3.3 Lean Management

Lean management is a project management practice which focuses on the elimination of waste (Monden, 1983). To reduce and eliminate waste, lean management focuses on making potential waste visible, so that it can be identified and dealt with (Monden, 1983). Waste includes waiting times, non-value adding information, inventory (get everything just-in-time instead) and mistakes. The simplification and combination of different tasks is central to lean management (Liker, 2004).

2.3.4 Design Thinking

Design thinking is described by Brown (2008) as a methodology that covers all aspects of the innovation process with a human-centered focus. Design has for long been seen as an add on, used downstream in the internal processes covering innovation and development, but it has the potential to be used more resourcefully and add value upstream (Brown, 2008). Using design thinking can counteract biases from innovators and change the way we look upon innovative work (Liedtka, 2018). The methodology flows through three separate stages; inspiration, ideation, and

implementation (Brown, 2008). The process is not linear, meaning that using design thinking can be harder than traditional stage-gate models to schedule and predict. Design thinking works because it helps the innovator to immerse themself in the intended end-user, make sense of vast amounts of qualitative data, and use feedback and prototypes as a way to create a process that lowers risk and cost (Liedtka, 2018).

2.4 Team Structures

The above practices described in *Chapter 2.3.* explain how to think regarding project management and how to work within projects. A second part to project management is how the teams are structured and organized. Pushing for a team to be cross-functional is important to be able to consider different options and potential perspectives of customers (Schilling & Hill, 1998). There are different types of team structures as well (Wheelwright & Clark, 1992). Functional teams include people from different functions, located together to work on temporary projects (Schilling & Hill, 1998). Functional teams do not have project managers, coordination and communication is therefore often lacking (Barczak & Wilamon, 1989). This results in a high risk of overdue deadlines and results that are not in line with the customer's specifications (Schilling & Hill, 1998).

Lightweight teams have both a project manager and a dedicated facilitator of coordination and communication between functions (Schilling & Hill, 1998). However, team members do not spend much time on the project and the functional managers are in charge of functional resources. This makes coordination and communication difficult, even though there is a dedicated facilitator (Schilling & Hill, 1998). This team structure could be used for incremental innovation projects.

Heavyweight teams resemble lightweight teams but with two distinctions. The project manager of heavyweight teams is of senior status and holds most of the power (Barczak & Wilamon, 1989). Also, team members are dedicated full time to the project (Schilling & Hill, 1998). The influential role of the project manager as a leader makes coordination and communication easier (Barczak & Wilamon, 1989). This team structure is therefore better suited for more radical innovation projects within the realm of the firm. Heavyweight teams are characterized by contextual

ambidexterity, when the team is looking for innovations that both explore new markets and exploit current demand (Grant, 2020).

An autonomous team is very similar to the heavyweight team, except the team members are fully removed from their separate functions and are no longer evaluated by functional managers (Schilling & Hill, 1998). Instead, the project manager becomes their full-time boss and evaluator (Damanpour, 1991). Autonomous teams also create their own procedures and rewards. This type of team can often drift away from the core business model because of its autonomy and should therefore be used for more breakthrough radical innovations (Schilling & Hill, 1998). Autonomous teams are characterized by structural ambidexterity, when the units are separate from the company and explore new markets (Grant, 2020).

2.5 Uncertainty and Risk

In all projects there is uncertainty. By definition uncertainty is considered as the lack of knowledge in a certain area or topic (Tushman & Nadler, 1978; Asllani & Ettkin, 2007). However, high uncertainty does not correlate to high risk. Project risk factors are factors that have an impact on project outcome (Asllani & Ettkin, 2007). Meaning that a risk factor can simultaneously be an uncertainty if no knowledge is available but will stop being an uncertainty when knowledge is acquired. Uncertainty regarding risk factors will lead to an inability to predict the outcome of the project (Asllani & Ettkin, 2007). Figure 3 presents a weighted list of uncertainty and risk factors.

Table1. Information Systems project Uncertainty Factors			
Uncertainty Factors	Jiang & Klein (2001)	Lederer at al.(1990)	Alter & Ginzberg (1978)
Information system project size	9		6
Application complexity	8		
Technology acquisition	7		1
Insufficient resources	6	5	3
Lack/presence of methodology and expertise	5	7	2
Lack/presence of user support	4	2	7
Lack/presence of user experience/historical data	3	3	5
Lack/presence of role definition and coordination	2	6	
Lack/presence of user/analyst conflicts	1	8	
Ability/inability to anticipate designer's expertise		9	
Lack/presence of IS project purpose			4
Lack/presence of review standards		4	
Changes in IS development personnel		1	
Numbers indicate the significance of each factor (1=less significant and 9=very significant). Empty cells indicate absence of the respective factors in the respective study.			

Figure 3. List of uncertainty factors that pose a risk for projects (Asllani & Ettkin, 2007).

2.6 Project Success

Cooke-Davies (2002) puts forward 8 critical success factors (CSFs) for project management success, but only 1 for project success. "*Existence of an effective benefits delivery and management process that involves the mutual cooperation of project management and line-management functions*" (Cooke-Davies, 2002, p.188), i.e incentives for helping each other is the only CSF for project success brought forward. While CSFs for project management success can be relatively generalized across industries, CSFs for project success cannot unless they are purposely vague and broad.

Project success is defined by two factors: performance and learning (Arthur, DeFillippi & Jones, 2001). The more quantitative measure of success is performance and is therefore more often used to deem projects successful or not. In the past, project performance success was only measured through quality, costs and time (De Wit, 1988) . However, as technology develops and projects become more intricate, more measures are introduced to quantify project success. Todorović, Petrović, Mihić, Obradović, and Bushuyev (2015) explain that key performance indicators (KPI's) can be examined to understand how successful a project has been. By investigating the amount of KPI's, goals or objectives that have been achieved, the project success can be determined (De Wit, 1988).

The current research within project success is not very developed. Methods to identify crucial elements for project success have not been developed enough because of the ambiguity of the definition of success (Todorović et al., 2015). If the success is to be measured by the amount learnt, which rarely is quantifiable, defining success is difficult (Arthur, DeFillippi & Jones, 2001). Therefore, learning is not often used as a measurement of success.

Making a general framework for CSFs is near impossible because of the vast difference between projects (Todorovićet al., 2015). However, Todorović et al. (2015) proclaim to have developed a framework to increase the success rate of projects. By identifying and analyzing CSFs and KPIs, the project manager knows what factors to focus on to best reach the goals of the project (Todorović et al., 2015). This framework is very general and requires heavy research in itself to use. No two projects are alike and a framework for elements to include for a project to be successful will not be generally applicable.

CSFs differ from success criteria in the way that CSFs are elements of project success while success criteria are measurements of success, often in the form of KPIs. These KPIs must be defined by the project manager to account for all stakeholders (Cooke-Davies, 2002). Thus, CSF's do not describe how successful a project is, rather what elements might play a role in the final success of a project.

2.6.1 Learnings

As described above, learning can be an indicator for how successful different projects are. However, learning could also be defined as an element of innovation because applying previously learned knowledge to new ideas is a common way of developing projects and businesses (Reid and Brentani, 2004). Kuhn (1962) explain that knowledge, ideas and innovation often follow specific trajectories, meaning that they are based on previous knowledge. Because of this characteristic, learning plays a great role in successful projects. However, many high achieving organizations might struggle with learning as successful managers and employees often face learning barriers, as described in *Chapter 2.2.* by Argyris (1991). Thus, the ability to both learn and use knowledge from previous projects will affect the outcome of the project.

2.7 Summary

Diffusion of innovation externally is done to create traction and increase awareness of the innovation. The process goes through a number of stages; knowledge, persuasion, decision, implementation, confirmation. When diffusion happens internally more focus is put on the earlier stages of knowledge and persuasion leading to a decision. Another dimension is also added to the internal diffusion where relationships, networks, and reputation plays a key role in the diffusion.

The innovation capacity of a firm can be described by looking at what facilitators of innovation that are present, but also by looking at barriers that might be hindering. Examples of barriers of innovation are adoption, mindset, risk, nascent, and infrastructural barriers. However, unless there are appropriate project management practises, a great innovation capacity will merely make the firm aware of opportunities without capitalizing on them. Project management practises that focus on the diffusion and future implementation of innovations must be in place for a firm to be innovative.

Different forms of project management, i.e. ways of organizing projects and ways of working, are affecting the innovation capacity and also the efficiency and outcomes of innovative initiatives. More classical methods such as waterfall and stage-gate can be used for efficiency and control, but can hinder exploration and flexibility. The same goes for Lean Management practises in relation to agile. Further, design thinking is a method used to increase the user's perspectives and focus on data-driven decision making in all the stages of an innovative project.

The ways of structuring teams will have an effect on the outcome of innovation. The role of a manager or members with seniority can in different ways pivot the team's ways of working. Stage-gate and Lean practises have a more pre-determined team structure, whereas agile and design thinking can use more free roles and change accordingly when the project or team demands different competences.

Project success is often defined by performance and learnings. If applicable, KPIs can be used to measure performance and give a numerical value to each project. When dealing with innovative and explorative projects, KPIs are most often not available or

measurable. In those cases, learning becomes the measurement of success. To be able to predict success, CSFs can be analyzed.

Uncertainty is defined as the lack of knowledge, and risk is a factor that will have an impact on the project outcome. There is not always a correlation between uncertainty and risk. Using different methods of working, uncertainty can be reduced. However, a risk might not always be feasible to remove. When working with innovation, uncertainties and risk will always be present. The important thing is to decide on a reasonable level of uncertainty and risk to keep working.

3. Methodology

The design of this study is a case study. Data that is collected is analyzed to make general conclusions based on specific events (Denscombe, 2018). According to Easterby-Smith, Thorpe, and Jackson (2015) this study can be seen as having a relativistic ontology with constructionism as the epistemology. Ontology and epistemology represent the fundamental assumptions of the researcher about the environment and context (Easterby-Smith, et al., 2015). Having a clear ontology and epistemology helps in choosing the methodology and design of a research study. Constructionist epistemology suggests that a case study is used as the research design and the data type is most often qualitative (Easterby-Smith, et al., 2015). Relativism sees facts as dependent on the viewpoint of the observer. In this study, relativism becomes noticeable in the viewpoint of stakeholders in different innovation projects. Wallen (1996) suggests that a case study design does not include the stakeholder in the research process. In this study, Volvo Cars' supervisors have been included in the initiating phases, but not in later phases of data gathering and analysis.

One concern of using a case design is the handling of large amounts of data (Easterby-Smith, et al., 2015). In relation to this, it is suggested that case studies benefit from having the design determined before data collection begins in order to cope with this struggle. In this study the method for taking notes and analyzing data was determined before the first interview was conducted. See *Chapter 3.3.* for more details. Further, the study used a model for innovation diffusion that all interviews were structured around. The model is described below.

3.1 Adapted Model for Internal Innovation Diffusion

Internal innovation diffusion often describes the spread of an innovation within an organization. In this study, innovation diffusion is considered to be a central part in the entire internal innovation process. Figure 4 depicts the case study's model for internal diffusion, shaped and created during a pre-study. All themes, introduced in *Chapter 1.2.* are present in Figure 4.

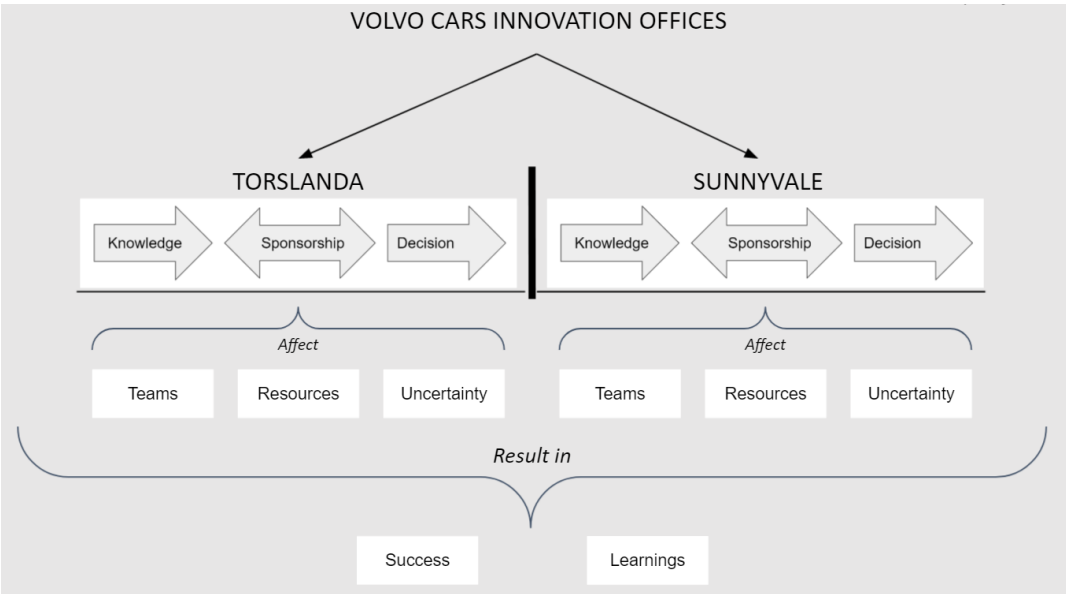

Figure 4. Visualization of the innovation process, what themes affect it and what the outcomes might be at Volvo Cars (Source: private).

In the innovation process, the three themes of knowledge, sponsorship, and decision are the focal points under investigation. The themes in the innovation process are based on Everett Rogers' model (Sahin, 2006) described in *Chapter 2.1.1.*, but adapted by the study's authors and Volvo Cars' supervisors in order to better suit the conditions at Volvo Cars. One key difference between Rogers' and the study's model is the addition of themes indirectly affecting the innovation process themes, which are called process conditions in the study. Also, as seen in Figure 4, the model is not linear. Rogers' model explains external innovation diffusion on the market (Sahin, 2006), while the study analyzes how innovation is spread internally. Rogers' innovation diffusion model is one of the most recognized models of diffusion and covers many aspects of it. However, it is targeted at external innovation diffusion. By adapting it and adding process conditions in this study it is better suited for an internal context. Further, an organization of Volvo Cars' size can be argued to have similarities to an external context even when looking internally. With global presence, multiple offices and departments, internal innovation diffusion shares similarities with external diffusion.

3.1.1 Description of Themes

As mentioned, the three themes in the innovation process, knowledge, sponsorship, and decision stems from the literature review. All eight themes were discussed with

Volvo supervisor to ensure complete coverage of the innovative work and to be able to find elements and answer the research questions. Below is a short description of the eight themes and the intended scope of each.

Knowledge - Innovation process

Employees of the firm understand that there is a new idea that might be developed into an innovation. Necessary knowledge is gathered and spread internally in order to develop initial ideas. New ideas can stem from different places, both internal, external, and personal. Focus is on spreading awareness of a potential innovation with as little resources as possible.

Sponsorship - Innovation process

The employee with the idea looks for reinforcements from colleagues that the idea is promising. By finding supporting colleagues that are willing to push the idea i.e. sponsors, the idea can move forward. Discussions and explanations help in formulating the idea into a viable innovation. Pivots back to the knowledge theme happens, as more sponsors are included, and new understandings and knowledge is created.

Decision - Innovation process

The theme where the idea is presented to managers, and it is decided on whether to start the innovation project or not. A final decision to move to implementation is taken at a specific point in time. However, the theme of decision investigates the process behind the decision taken. The decision theme occurs after or simultaneously as the knowledge and sponsorship. Similar to the sponsorship theme, the theme of decision is also about finding the right support that can help reach a decision. Sponsorship and decision can in some aspects be similar, the differentiation lies in the size of the decision. For sponsorship the decision is smaller i.e., to support, whereas the final decision is more in the sense of go or kill.

Teams - Process conditions

The creation and composition of teams can either be pre-determined or happen more organically. Also, the theme of teams will include how team members interact, cooperates, and deals with external parts. Teams and its creation and composition will affect the knowledge and sponsorship with its relations and networks tied to individuals in the team.

Resources - Process conditions

Resources are often in high demand. How the allocation of resources and the usage of it is covered in the resource theme. For some innovation project resources are more critical than for others. Resources can be allocated more or less easily depending on the members in the team and the decision and support tied to the project.

Uncertainties - Process conditions

Uncertainties will have an impact on the methodology used in the project and also the lack of prior knowledge will affect the sponsors and decision makers. The level of uncertainty and risk the team and project is ready to accept differs depending on the prior knowledge and experience of team members.

Success - Project outcomes

Success can be measured with metrics if the project is mature, and metrics are applicable. For some less mature projects metrics are not available and success is not as tangible. Sponsors and decisions are more easily attracted when a potential success or positive return is likely. Success can be constituted by different values in terms of money, knowledge, learning, etc.

Learnings - Project outcomes

At the pre-study it was determined that for new technology and innovation projects learnings are considered to be one the major measures of success. A project that fails in terms of market readiness or monetary value can still be successful by accumulating knowledge and learnings for future initiatives.

3.2 Data Collection

In order to define and find innovation elements at Volvo Cars primary and secondary data were collected. Easterby-Smith, et al. (2015) suggests that ensuring access to individuals and organizations as well as ensuring a sample that gives enough perspectives are important research design questions when using constructionist epistemology. All data gathered were qualitative and the collection phase proceeded until redundancy in the data regarding elements and themes of importance was reached.

3.2.1 Primary Data - Interviews

In most of the projects examined, primary data from interviews served as the only source of information. Available databases on project-specific details regarding the eight themes we needed were not updated with the most recent information. Interviewees were selected based on position and involvement in projects fitting to this study's aim. The supervisors from Volvo Cars initiated the interviews by quickly briefing potential interviewees and providing a list of names. Once an interview had been done, a snowball sequence commenced, the interviewee suggested additional leads on whom to interview.

All interviews were semi-structured to allow for the interviewee to answer more freely and give details needed for finding elements of innovation. Each interview was scheduled for one hour and the semi-structured questions aimed at covering all of the stages in the model for internal innovation diffusion created specifically for this study. Semi-structured interviews allow for more open communication which often results in broader perspectives and answers to questions that may be relevant but not asked (Leech, 2002). As this study moved forward, there were discussions about project managers and other sensitive topics. By avoiding recordings in those scenarios, the study aimed to create a more neutral environment for the interviewee. All interviews were conducted with both authors present, one leading the interview and one taking notes.

The majority of interviews were performed using online tools due to the special circumstances caused by Covid-19 at the time of this study. However, this enabled the researchers to have conversations and interviews just as easily with the stakeholders in the Sunnyvale office of Volvo Cars as with the Torslanda personnel. In total 37 interviews and conversations were conducted focusing on 25 different innovation projects, as summarized in Table 3.

Table 3. Total amount of interviews conducted, and projects analyzed.

Source of data	**Amount**
Interviews	37
Projects	25

3.2.2 Secondary Data

Apart from scheduled interviews with project specific interviewees generating primary data, this study used other methods for qualitative data collection. Weekly supervisor meetings generated leads on projects and additional sources for information helping the study progress.

Secondary data from internal company databases was further used as a source of more project specific historical data. Secondary data of this nature was only used for better understanding and context of the projects and interviewees, thus not used or presented in the empirical findings.

3.2.3 Workshop

The purpose of arranging a workshop was as a final step of verification of the findings, held together with higher management. This workshop was conducted after all interviews were performed and the empirical findings summarized. At the workshop, the empirical findings were presented and discussed. Three higher level managers participated together with the three Volvo supervisors and authors, lasting one and a half hours. Questions raised and discussed supports the discussion held in *Chapter 6.* and adds a long-term perspective to the findings. A secondary purpose of the workshop was to initiate a discussion about solutions to some of the negative aspects presented in the findings. The workshop worked as a reality check and validation both for the study and for high management at Volvo Cars.

3.3 Analysis of Data

This study has used an analysis method similar to what Alänge (2009) describes as Affinity-Interrelationship Method, AIM. Affinity - and interrelationship methodologies are commonly seen as management and control tools (see eg. Shoji, Graham, & Walden, 1993) and in AIM they are utilized for complex problem analysis. Alänge (2009) describes AIM as having four key parts; identifying the issue to analyze and collection of data, securing quality of data and first level grouping, higher levels of abstraction, and evaluation with conclusion.

Easterby-Smith et al. (2015) describes grounded analysis as a similar way of analyzing qualitative data. Using grounded analysis, the researcher performs seven steps in order to understand, link, and draw conclusions from data. The qualitative data that is analyzed is assumed to have categories and relationships "grounded" inside it and therefore the analysis aims at finding these grounded theories and not elaborating on existing ones (Charmaz, 2014). Since no previous study has conducted an analysis at Volvo Cars in a similar way, there are no preconceived theories to start from. This study needed a grounded approach in order to analyze the data collected. For the version of AIM used in this study digital tools were used instead of post-it notes as a collector of data. After each conducted interview the data collected and written down during interviews were reviewed by the authors and transcribed. This was to ensure consensus about what was discussed in the interview. From the transcribed notes, grouping and coding began, first notes were divided by topics and questions they intended to answer. Each group of notes was first divided individually in order to reduce biases. The notes that were placed in different groups were further discussed in order to ensure clarification of the meaning and then the correct placement in subcategories. Transcription of notes occurred at the end of each day of interviews, coding and categorization occurred weekly.

3.3.1 Coding and Narrative Analysis

Of the 37 interviews a majority were discussed with a specific project in mind that was chosen by the interviewee, covering all stages of the innovation diffusion model. The interviewee was asked to choose a project fitting our limitations, i.e., avoid derivative projects and focus on platform and breakthrough as described by Schilling

and Hill (1998). and Data from these interviews were coded to show that they had a specific project to support the claim. When interviewees had no project as focus for the interview, data was coded using a general prefix.

The study used methods described as part of a narrative analysis (Easterby-Smith, et al, 2015). In accordance with Riessman (2003), emphasis was put on certain parts of the narrative analysis methodology that suited the aims and needs in the study. Using a narrative approach can be time consuming, therefore putting emphasis on some stages is often the case when narrative methods are conducted (Riessman, 2003). In this study emphasis was put on re-contextualization of the data gathered from interviews with special projects as the focal point. The re-contextualization allowed for finding elements and better coding to facilitate the analysis.

3.4 Reliability, Validity, and Generalizability

Since the nature of the data in this study is qualitative, there was more emphasis on reaching a high validity rather than reliability. Reliability refers to the consistency in the data gathered (Eriksson & Wiedersheim-Paul, 2008). A high reliability yields similar results if the same study is performed by others (Easterby-Smith, Thorpe, & Jackson, 2015). There are methods to ensure a high reliability in a qualitative study. Being aware of personal biases and presenting clear and consistent data management, where interviewees are encouraged to comment on data to verify the reliability (Noble & Smith, 2015). Personal biases regarding innovation and the process involved were mitigated by using the adapted model described in *Chapter 3.1*., and a consistent data management was kept throughout the study.

Validity refers to accuracy and validity of the data gathered. In order to ensure validity Yauch and Steudel (2003) suggest using multiple sources of data, both quantitative and qualitative. This is supported by Easterby-Smith et al. (2015) that points to the importance of including sufficient amounts of perspectives to reach validity in a study. This study includes both secondary historical data of innovation projects as well as primary data from interviews of multiple stakeholders. After data analysis, a workshop was conducted with higher management that gave another level of perspectives to ensure validity.

Bryman and Bell (2005) point out that there are struggles in making a qualitative study generalizable and useful for others. Further, case studies can sometimes result in conclusions that are firm specific because of too little generalizability (Ejvergård, 2003). In this study, the model used for assessment is built upon academic findings and literature on innovation, project management, and innovation capacity. Some adjustments are done due to organizational characteristics. Some themes and elements of importance, found in Volvo Cars, could be generalizable for other organizations within the industry.

4. Empirical Findings

Data collected from interviews were categorized into three major groups; innovation process, process conditions, and project outcomes. These three groups contain themes that focus on one part of the overall innovation work that takes place at Volvo Cars, see Table 4. Elements found in the themes all stem from the re-contextualization work done in the data analysis.

Table 4. Themes that have been under investigation.

Innovation process	**Process conditions**	**Project outcomes**
Knowledge	Teams	Success
Sponsorship	Resources	Learnings
Decision	Uncertainties	

In the empirical findings, data is summarized, and four levels of metrics were taken and are presented in the data-tables. First, the summary of mentions of a specific theme (Σ in tables) depicts the overall importance of the element in the organization. More mentions of a specific element represents a higher importance. The summary of mentions is the total of all mentions which include neutral, positive and negative ones. Second, positive mentions as a percentage of total mentions is recorded (%+ in tables). This shows how many of the interview discussions regarding a specific element are mentioned in a positive manner i.e. how many in the organization who believe that the specific element is currently working well.
Third, the annotation %- presents the percentage of discussions of a specific element that has been negatively loaded i.e. an element that is working poorly. Fourth and last, a metric for the quotient between positive and negative mentions is presented (÷ in tables).

Since the neutrally loaded mentions are included in Σ but not in %+ or %-, the summation of percentages between %+ and %- will not add up to 100%. The decision to not include a column for neutral mentions has been made as neutral mentions on its

own do not contribute to the analysis, but instead helps to understand the overall importance of elements embodied in the total mentions.

4.1 Innovation Process

The innovation process at Volvo Cars has been divided up into three distinct themes; knowledge, sponsorship, and decision. Below, the results from the data collection of the different themes are presented.

4.1.1 Knowledge

Table 5 shows the results from the interviews regarding how knowledge and ideas are created at Volvo Cars. The origin of the idea is the most discussed element group, where internal company opportunities generate the majority of new ideas. The element group of foundation, i.e. the ways of working to create and expand ideas was discussed throughout the interviews and half of new ideas seem to be developed top-down and half seem to be developed bottom-up. Enablers of idea generation were thoroughly discussed, while barriers was a group often avoided.

Table 5. Presentation of the different elements discussed regarding creating knowledge.

Knowledge	**∑**
Enablers	*30*
Internal Discussions	8
Technology Partners	8
Research Partners	7
Supply Chain Partner	2
Start-up Partner	1
Government Partner	1
Freedom	1
Innovation Mindset	1
Seeding of Ideas	1
Barriers	*3*
Resistance to Change	1
Exploitation	1
Regulations	1
Foundation	*50*
Top-down	15
Bottom-up	14
Spare time	10
Cross-functional	7
Management Decision	2
Open Innovation	1
Cheap Proof of Concept	1
Idea Origin	*63*
Company Opportunities	42
Market Opportunities	12
Macro Opportunities	9

4.1.2 Sponsorship

The findings in the theme of sponsorship helped in understanding whether getting help diffusing and developing an idea in the organization is easy or difficult. As can be seen in Table 6 the amount of positive elements, 73, are just slightly higher than the amount of negative elements, 63. Presenting new ideas and increasing the status or reputation of the innovation seem to be mostly successful. However, the difficulties in finding sponsors and product champions generally slow down the diffusion of new ideas.

Table 6. Presentation of the elements which were discussed in the theme of sponsorship

Sponsorship	∑	% +	% -	÷
Succesful Enablers	**73**			
Idea Presentations	*47*			
Demo	15	73%	7%	10%
Value Description	10	50%	0%	0%
Business Case	8	63%	0%	0%
User Data	8	63%	13%	21%
Persuasion	6	50%	0%	0%
Increasing Idea Status	*26*			
Internal Interest	6	50%	0%	0%
Passion	5	40%	0%	0%
Trust	5	60%	0%	0%
Transparency	4	50%	0%	0%
Seniority	3	67%	0%	0%
Low External Interest	3	67%	33%	49%
Poor Enablers	**63**			
Human Factors	*47*			
Finding Sponsors	23	43%	30%	70%
Finding Product Champions	9	33%	44%	133%
Finding Stakeholders	8	25%	38%	152%
Creating a Network	7	43%	29%	67%
Other	*4*			
Lack of Common Goals	4	25%	50%	200%
Barriers	*12*			
Timing	7	N/A	N/A	N/A
Backlog	4	N/A	N/A	N/A
Sponsor Hesitation	1	N/A	N/A	N/A

4.1.3 Decision

The theme of decision is the final stage in the early innovation process. Similar to sponsorship, negative elements appear often in the decision theme, as can be seen in Table 7. The positive elements summarize to 68, while negative elements are only trailing behind with a few mentions at 53. Here, presenting the innovation is generally successful and innovations that leverage stakeholders and have clear needs and benefits are more likely to get the go-ahead from decision makers. However, the lack of resources and the difficulty in leveraging strong networks, along with bad timing can stop innovation projects in their tracks.

Table 7. Presentation of the different elements that were brought up during discussions regarding decision.

Decision	**∑**	**% +**	**% -**	**÷**
Succesful Enablers	**68**			
Idea Presentations	*20*			
Clear Business Case	11	27%	0%	0%
Clear Value Proposition	6	67%	0%	0%
User Data	3	67%	0%	0%
Project Specifications	*16*			
Existing Clear Needs	10	50%	10%	20%
Clear Benefit	6	67%	0%	0%
Human Factors	*32*			
Involving Stakeholders	22	50%	14%	28%
Top-down Projects	5	60%	0%	0%
Passion	3	33%	0%	0%
Transparency	2	50%	0%	0%
Poor Enablers	**53**			
Availability of Resources	10	50%	30%	60%
Leveraging Networks	10	30%	10%	33%
Innovation Understanding	5	40%	60%	150%
Leveraging Seniority	4	50%	25%	50%
Unclear Common Goals	3	0%	67%	N/A
Barriers	*21*			
Bad timing	8	N/A	N/A	N/A
Dependencies	3	N/A	N/A	N/A
Resistance to Change	2	N/A	N/A	N/A
Missing Diffusion Process	2	N/A	N/A	N/A
Costly Project	2	N/A	N/A	N/A
Organizational Politics	1	N/A	N/A	N/A
Regulations	1	N/A	N/A	N/A
Backlog	1	N/A	N/A	N/A
High Overheads	1	N/A	N/A	N/A

4.2 Process Conditions

While the greatest focus has been on the innovation process, indirect factors often play a great role in innovation success. Team creation and structures, availability and allocation of resources and uncertainties are the three most present indirect themes that affect the innovation process at Volvo Cars. Below, these three themes are presented to understand the positive and negative elements within each of these indirect process conditions.

4.2.1 Teams

The interviews regarding teams are overall positive, as can be seen in Table 8 with 69 positive mentions and 19 negative mentions. Generally, creating a team is easy and teams often possess many positive characteristics. However, some negative aspects are discussed and barriers to team creation and working in teams are present. The data collection identified one ambivalent element where the perception and opinion of the overall benefit might differ. According to some, dependencies are beneficial for teams to succeed, while some want to decrease dependencies as much as possible.

Table 8. Presentation of the elements brought up during discussions of team creation and working in teams.

Teams	**∑**	**% +**	**% -**	**÷**
Positives	**69**			
Team Creation	*44*			
Organic Creation	18	67%	0%	0%
Start Small	13	0%	0%	N/A
Network Utilization	7	71%	0%	0%
Expanded When Needed	6	0%	0%	N/A
Positive Characteristics	*25*			
Cross-functional	13	62%	0%	0%
External Teams	5	80%	0%	0%
Passion	4	75%	0%	0%
Stakeholder Involvment	2	100%	0%	0%
Personal Relationships	1	0%	0%	N/A
Negatives	**19**			
Negative Characteristics	*12*			
Managers	5	0%	60%	N/A
Lack of Experience	4	0%	100%	N/A
Lack of Common Goals	1	0%	100%	N/A
Lack of Accountability	1	0%	100%	N/A
Predetermined Role	1	N/A	N/A	N/A
Barriers	*7*			
Redundancy	4	0%	50%	N/A
Backlog	3	0%	33%	N/A
Ambivalent Elements	**5**			
Dependencies	5	20%	40%	200%

4.2.2 Resources

The availability of resources will almost always affect innovation and project success. Based on the data collection, it is evident that availability of resources and resource allocation often can be a great problem for furthering innovation projects, as shown in Table 9. Clear and continuous communication is the enabler that seems to be positively affecting resource allocation. Many projects do not receive enough time or money to be successful or explore new ideas.

Table 9. Presentation of the positive and negative elements regarding resource allocation.

Resources	∑	% +	% -	÷
Positives	**3**			
Enablers	*3*			
Communication	3	67%	0%	0%
Negatives	**56**			
Enablers	*40*			
Time	21	19%	43%	226%
Cash	14	29%	64%	221%
Way Forward	2	0%	100%	N/A
Cross-collaboration	1	0%	100%	N/A
Organizational Understanding	1	0%	100%	N/A
Internal Interest	1	0%	0%	N/A
Barriers	*16*			
Lack of Ability to Explore	11	0%	100%	N/A
Wrong Timing	4	25%	75%	300%
Backlog	1	0%	100%	N/A
Ambivalent Elements	**7**			
Spare Time Innovation	7	29%	57%	197%

4.2.3 Uncertainty

External and internal uncertainties is the third indirect process condition theme that affects the innovation process at Volvo Cars. Positive and negative elements are present relatively equally in the data and are presented in Table 10. The structural working method of reducing uncertainty is generally working well, while competences and external factors often create the greatest barriers to innovation success.

Table 10. Presentation of the elements discussed when uncertainty is mentioned.

Uncertainty	**∑**	**% +**	**% -**	**÷**
Positives	**40**			
Working Method	*40*			
Sufficient Testing	16	56%	13%	23%
Methodological Working	10	60%	0%	0%
Sufficient Data	10	60%	10%	17%
Availability of Options	2	50%	0%	0%
Transparency	2	0%	0%	N/A
Negatives	**54**			
Working Method	*5*			
Lack of Feedback	5	40%	20%	50%
Competence	*38*			
Insufficient Overall Knowledge	25	28%	32%	114%
Insufficient Technological Competence	13	23%	77%	335%
External Uncertainty Reduction	*11*			
Knowledge from Mature Markets	7	0%	71%	N/A
Knowledge from Competitors	3	33%	33%	100%
Regulations	1	0%	100%	N/A

4.3 Project Outcomes

The themes of success and learning were throughout the interviews discussed in relation to early innovation. Most discussions revolved around the perception of what constitutes success and how that could be measured for early innovation.

4.3.1 Success

The data showed the employees' perception of project and innovation success. Five different element groups have been identified within the success data; types of success, successful CSFs, poor performing CSFs and different outcomes of innovation projects, all presented in Table 11.

Table 11. Presentation of the elements discussed when success is mentioned.

Success	∑	% +	% -	÷
Types of Success	50			
Learning Success	20	85%	0%	0%
Technical Success	15	87%	13%	15%
Commercial Success	11	73%	0%	0%
PR Success	4	100%	0%	0%
Succesful CSFs	26			
Sufficient General Knowledge	11	64%	0%	0%
Outside-the-box Thinking	3	33%	0%	0%
Methodological Working	3	33%	0%	0%
Teamwork	2	100%	0%	0%
Trust	2	50%	0%	0%
Transparency	2	50%	0%	0%
Eager Consumer Adopters	1	N/A	N/A	N/A
Motivation	1	N/A	N/A	N/A
Communication	1	N/A	N/A	N/A
Poor CSFs	20			
Ability to Measure Success	11	18%	45%	250%
Wrong Timing	7	57%	29%	51%
Organizational Politics	1	0%	100%	N/A
Costly Projects	1	0%	100%	N/A
Outcomes of Success	6			
Platform for Future Innovation	4	25%	0%	0%
Failing to Learn	2	100%	0%	0%
Ambivalent Elements	5			
Working Towards KPIs	5	60%	20%	33%

4.3.2 Learning

Learning success is one of the most prominent forms of success i.e. developing new knowledge through the different stages of the innovation process that can be used in new projects. Because of the prevalent concept of learning, discussions regarding type of learning were initiated as well, presented in Table 12. Here, general knowledge creation, the improvement of processes and enabling future innovation are the most prominent forms of learning.

Table 12. Presentation of the elements discussed when learning is mentioned

Type of Learning	∑	%
Increasing Knowledge	17	38%
Improve Processes	11	24%
Enable Future Innovation	9	20%
Pivotting the Project	7	16%
Enable Open Innovation	1	2%

4.4 Summary

The findings in this study highlighted several major elements that are present in Volvo Cars' innovation process. Many are positively mentioned, meaning that these elements benefit and enable innovation diffusion and success. However, some are more negatively mentioned, which will hinder the innovation diffusion and success and will create barriers within the innovation process.

In the following chapter, all of these elements will be analyzed and described in further detail, to give the reader a deeper understanding of their origin and effect on the innovation process. The negatively mentioned elements will need more focus at Volvo Cars in the future, as these are the ones which may hinder the firm's competitive advantage in a changing industry environment. In the analysis, the most common and recurring negatively mentioned elements have been identified and explained and are mentioned to be: (1) Inability to leverage networks, (2) lack of ability to explore, (3) lack of common goals and (4) lack of experience and knowledge, all visualized in Figure 5 below. Although all elements will be analyzed in more depth below, these four negatively charged and recurring elements will be the basis of discussion and further research.

Figure 5. Visualization of the most recurring and negatively mentioned elements throughout the interviews.

5. Analysis

The following analysis is based on interview data from employees at Volvo Cars presented under *Chapter 4*. To more easily compare and analyze the positive and negative mentions of a specific element, the negative mentions are taken as a proportion to positive mentions (÷ in Tables) and if the quotient is above 50 percent, the element is considered to need improvement. The quotient is not a predetermined rule of thumb, it was decided on by the authors for highlighting the most important negatives. A quick sensitivity analysis shows that lowering or increasing the quotient 10 percent will not change the outcome. Setting a reaction threshold for a measurement like the quotient is comparable to setting thresholds for KPIs. Literature suggest that measurement should be done over time to account for fluctuations and variations in the data and utilize statistical methods (see eg. Maleyeff, 2003). This study uses data collected from one point in time and is not trying to set up a measurement reaction threshold. 50 percent is set as the threshold in this study. Drastically lowering the threshold will change the outcome, however then some interviews will be wrongfully represented. For that reason, the quotient is set to 50 percent.

To connect to the research questions that were developed in the beginning of this study, the analysis has been divided into distinct chapters to present the answers to each of the research questions. *Chapter 5.1*. aims to answer the first research question and present the conclusions made regarding elements that directly impact Volvo Cars' innovation process i.e. the themes of knowledge, sponsorship and decision. In *Chapter 5.2*., the second research question is answered, by analyzing the elements within process conditions i.e. teams, resources and uncertainties. The elements within process conditions will indirectly affect the innovation process at Volvo Cars. Finally, *Chapter 5.3*. aims to answer the third research question, regarding project outcomes, i.e. success and learnings, and how these are perceived in innovation projects at Volvo Cars.

5.1 Innovation Process

This section focuses on answering research question 1: *How do existing elements directly impact the innovation process i.e., the three themes of knowledge, sponsorship and decision?* The section presents the analysis of the innovation process themes at Volvo Cars. The following three sections will describe the direct enablers and barriers within the three themes of the innovation process; knowledge, sponsorship, and decision.

5.1.1 Knowledge

The data that has been collected in regard to the theme of knowledge of the innovation process can be divided up into four distinct element groups, which can be seen in Table 5. First, the idea origins were unveiled and quantified, i.e. understanding where most of the ideas in the organization come from. Second, the foundation upon which an idea is developed can be identified e.g. if the idea occurs top-down, bottom-up, cross-functionally or during employee spare time. Finally, the last two element groups are enablers and barriers of idea creation, which will be used to understand what is currently working well and what needs improvement to support the creation and diffusion of knowledge.

The *Idea Origin* element group is consolidated to understand what spurred the idea. Evidently, the majority of idea generation comes from internal discoveries and opportunities. These company opportunities include the spillover of knowledge from previous projects, identifying internal needs and improvement opportunities, finding capabilities that can be better deployed, better understanding how customers use products and by exploring different avenues of the vision of the organization. The external seeding of ideas come mostly from market opportunities i.e. identifying new needs of the market and better understanding market trends and data. Macro opportunities are similar to the market opportunities but occur mostly outside of the current industry boundaries with the exception of the discovery of competitor innovations. Other examples of macro-opportunities are new discoveries in academic research, industrial trends and forecasts. Macro opportunities can be seen as opportunities discovered through various macro analyses, such as PEST. As shown by Table 5, macro-opportunities are least likely to result in idea creation at Volvo Cars.

This could be a result of a combination of a lack of external awareness by the organization and a high infrastructural barrier (Assink, 2006), as mentioned in the literature review. If a high infrastructural barrier exists externally, society is less likely to accept and adopt radical innovations, which decreases the profitability of exploring future focused innovations.

The element group *Foundation* has consolidated the different ways of working to generate and explore different ideas. Around half of the ideas that are generated seem to be of top-down nature, that is higher management setting exploration scopes i.e. electrification or autonomous driving. The other half of the idea generation occurs bottom-up, where innovative discoveries are made by employees of the company. Much of the creation of knowledge seems to be created during employee spare time, often because of the great backlog of everyday work focusing on existing products and processes. A cross-functional approach to idea generation is often mentioned, where the discovery of innovations occurs because of collaboration between departments and the identification of overlapping opportunities. The "other" elements here include less mentioned methods of creating knowledge such as open innovation.

Enablers of knowledge are here defined as elements that help in the creation and expansion of an idea. Internal discussions regarding the project help in spreading awareness as well as improve and develop additional knowledge of the original idea. Partners play a great role in developing an idea further, by providing external tools and knowledge. Specifically, technology partners such as Big Tech firms and research partners such as universities and research centers aid in the creation and development of knowledge surrounding the idea. Other partners were also mentioned e.g. startups, governmental bodies, suppliers and buyers, but do not enable the expansion of the idea to the same extent. Freedom to explore, an innovation mindset and continuous seeding ideas were also mentioned to enable the creation and expansion of new ideas. If these last elements exist in an organization, the likelihood of having a low nascent barrier is high, something that would be beneficial for a firm's innovation capacity (Assink, 2006).

While there were a lot of discussions regarding enablers to idea generations, a smaller percentage of interviewees mentioned obvious *Barriers* to idea generation and knowledge creation. Although few discussions were had regarding these elements,

their implications to innovation are often great. Resistance to change was mentioned in the form of employees and managers not supporting ideas that were of more radical nature. Connected to resistance to change is the mentioning of exploitation, this in the context of too much focus on developing and improving current products at the expense of future opportunities and markets. These discussions can be related to the constant pressure of innovating within the current scope of the organization's products, a theme that was present throughout the interviews. Topics of this nature fuel the mindset barrier, described by Assink (2006) - enhanced by resistance to change (Coch & French, 1948) and an unwillingness to cannibalize. Regulations were also mentioned to be a barrier for idea creation, as many new ideas might need the acceptance of governmental bodies.

5.1.2 Sponsorship

The sponsorship theme highlights the positive and negative elements of internal innovation diffusion at Volvo Cars. Here, employee characteristics and project characteristics are analyzed in order to find the most effective and least effective aspects of developing and spreading ideas within the organization. The findings are presented in Table 6 and an analysis is conducted below.

In the theme of sponsorship, both negative and positive elements have been identified. Presenting an idea or an innovation increases the chances of receiving sponsorship to help develop knowledge and diffuse the idea throughout the organization. Building business cases, showing the true value of the idea, basing the ideas and descriptions on data and being persuasive are all elements that are easy to pursue in the organisation and help in attaining sponsorship.

Being persuasive is also connected to increasing the idea status - ensuring that people in the organization deem the innovation important and worth pursuing. Increasing the idea status helps in diffusing the innovation by creating internal interest, passion and trust for the project and innovator. Being transparent and leveraging your seniority will help in increasing the idea status. If these elements are present in the sponsorship theme, the innovator is likely to be able to develop more knowledge surrounding the idea and diffuse the innovation easily throughout the organization. This analysis is in line with Ardichvili et.al, (2003), who explain that positive personal traits e.g.

persuasiveness, passion and trust will increase the success of internal innovation diffusion.

Although presenting the idea and being passionate seems to help in spreading innovation, finding sponsors, product champions, stakeholders and building a supportive network is difficult. These human factors create a barrier for sponsorship at Volvo Cars, as finding support through sponsors most often occurs through an already established network and relationships. These established networks are often a result of a long employment and relationship building (i.e seniority) or a result of great expertise and being well-known in the organization (i.e trust). Senior and trustworthy employees can leverage their existing relationships to find sponsorship, even though barriers such as backlog and sponsor hesitation exists. As a result, novel employees who have not had the time to develop seniority or a prominent status find it more difficult to develop relationships and networks and in turn to find sponsorship. Potential sponsors have limited time and resources and choose to focus on their own work and backlog. This is evidently a problem, as Ardichvili et.al (2003) present networks as an important factor for successful innovation diffusion. Further, this can be connected to what is described by Assink (2006) as the adoption barrier in the literature review. Employees focus on their own backlog and dismiss new ideas that might not fit the primary business model.

This high adoption barrier not only increases the resistance to sponsor new projects from different business units because of limited resources, but also increases the lack of common goals. Common goals could break the adoption barrier because of the increased similarity in work between business units. This increases the chances of finding stakeholders and product champions and spreading the innovation. As mentioned by Engwall, 2002), not having clear and well formulated goals is one of the biggest reasons for failed projects. In the sponsorship theme, this factor plays a big role in the innovation project being cancelled because of poor sponsorship.

The great backlog which increases the adoption barrier is one of the often-mentioned elements which negatively affects innovations in the sponsorship theme. However, the barrier that is mentioned the most when discussing sponsorship is having the wrong timing. Innovations are usually too early for the market and the organization does not have the capacity to focus on more explorative innovations. This element is

brought up in the theme of knowledge as well, as a barrier to idea creation because of too much of an exploitative scope. As already mentioned, this unwillingness to focus on explorative innovations fuels the mindset barrier. The high mentions of having the wrong timing could point to a need for greater focus on both structural ambidexterity and contextual ambidexterity, as described by Chen (2017). The firm could also explore a sequential ambidextrous approach, which would allow Volvo Cars to focus on either exploration or exploitation based on whatever is needed at the moment (Boumgarden, Nickerson, & Zenger, 2012).

5.1.3 Decision

While sponsorship focuses on a lower level of pursuit of an innovation, by finding stakeholders and product champions, the decision focuses on whether or not an idea is worth pursuing on a higher level. Rather than employees and team leaders being involved and making decisions whether to help sponsor an idea or not, higher level executives and managers are the decision makers in this stage. In the decision theme, projects are either accepted to move to further research or implementation or rejected to pivot or start from scratch. Important to note is that the decision that is discussed is not a singular point in time. Rather, decisions to move forward or cancel projects occur continuously. Therefore, the decision theme is considered a process, occurring at many stages of the innovation's life cycle. The findings within this theme of decision will highlight what project elements improve a project's chances of being accepted by decision makers. This section also presents the elements that are more likely to result in a rejection. The findings of which the analysis is based on can be seen in Table 7.

Just like the sponsorship theme, a relatively equal amount of positive and negative elements have been identified. Presenting the idea is associated with positive elements and developing clear business cases, value propositions and leveraging user data is easy and helps in getting a positive response from decision makers. Further, if clear needs and benefits are specified, the idea is more likely to be accepted. If stakeholders have been involved throughout the project, decision makers are more easily persuaded because support from different departments clarifies the need and benefit of the innovation. However, as mentioned in the theme of sponsorship, initially involving stakeholders in the project is difficult for employees of low seniority and status. Top-

down projects are more likely to be accepted by decision makers as such projects are in line with the organization scope and specifications are developed by top management. Additionally, having passion and being transparent throughout the innovation process increases the chances of decision maker acceptance.

An element that is most mentioned to negatively affect decision makers accepting an innovation is the availability of resources. All businesses must try to utilize resources as efficiently as possible, thus the negative mentions of this element comes as no surprise. Burgelman (1983) explains that all innovative initiatives of more radical nature will encounter barriers due to resource allocation. The positive mentions within this element are often collected from interviewees with innovation projects that require few resources, most of which are software projects. Most of the negative mentions are from interviewees that work on hardware projects, which require more resources. The second element that is often negatively mentioned is the ability to leverage networks. This element is brought up in the sponsorship theme as well, and it has become obvious that less senior employees have a more difficult time in developing networks to help them support the innovation project in the decision. As Ardichvili et.al, (2003) explain, these networks are vital for innovation diffusion.

A new element that is mentioned in the decision making is innovation understanding i.e. having the decision maker fully understand the technological aspects and value of the innovation. This has to do with the topic of gatekeepers. Gatekeepers help knowledge diffuse to the right people in the organization (Reid and Brentani, 2004). In the innovation process at Volvo Cars, gatekeepers often come in the form of sponsors and stakeholders. Without diffusion enabling gatekeepers, it is possible that the innovation is not brought to an appropriate decision maker in the right department with the right knowledge to understand how to utilize it. Thus, once again, non-senior people get punished for the lack of relationships with sponsors to bring the innovation to an appropriate decision maker. This element correlates with the barrier of a missing diffusion process - newer employees lack a way forward from idea creation. However, the often enabling elements of network exploitation and stakeholder involvement create dependencies in the project. These dependencies are seen as negative elements in the decision-making theme as they decrease the speed of diffusion and decision making. The more dependencies a project has, the more people

the specific innovation must go through and be accepted by before a decision can be made.

The common barrier of bad timing, connected to the lack of exploration is present in the decision making as well. This correlates with the element resistance to change, described by Coch and French (1948), and the heavy focus on exploitation fuels the mindset barrier (Assink, 2006) which once again hinders the development of certain innovations. The lack of an ambidextrous approach and mindset (O'Reilly and Tushman, 2013) reduces the likelihood of explorative innovations to succeed in the decision-making stage. Further, pursuing innovations outside of the current firm scope can risk reputation (Burgelman, 1983). Thus, employees of lower status and seniority face obstacles in diffusion of innovation because of the network barrier as well as risking their reputation for pursuing more radical innovations.

5.2 Process Conditions

The section focuses on answering research question 2: *How do existing elements indirectly impact the innovation process through the process conditions i.e., three themes of teams, resources and uncertainty?* By analyzing process condition elements another dimension of analysis is added that describes the indirect enablers and barriers of the innovation process.

5.2.1 Teams

Team structure and creation can affect the efficiency of which innovations are developed and diffused. The analysis will provide insights in how efficient and successful teams are built and work, and what elements might slow innovation teams down, as shown in Table 8.

Working in and creating teams is a theme which mostly consists of positive mentions. Thus, the teams at Volvo Cars are working well in the innovation process. The creation of a team is easy and often occurs organically - once specific expertise is required, team members from different departments are added, creating cross-functional teams. The team structures at Volvo Cars are often functional. Functional teams consist of people from different functions that work temporarily on a specific project (Schilling & Hill, 1998). In the beginning of the innovation process, teams

start small to develop an idea and team members are often added based on employee relations and networks. A likely reason for network utilization being positively mentioned in team creation, compared to the negative mentions in the different innovation process themes is that team members receive resources to complete the tasks within that team. The team specific work is included in their current work, compared to being a sponsor and needing to help develop knowledge and diffuse the innovation with a great backlog. Sponsors are external to the team and might therefore not be as passionate about the idea, something that is needed for an efficient innovation process. However, backlog is still mentioned to be a barrier in some teams. A reason for this could be different team structures. Functional teams and heavyweight teams work full time on specific projects (Schilling & Hill, 1998), thus not having any other backlog commitments. Lightweight teams, however, only spend some time on specific projects (Schilling & Hill, 1998), having to deal with a backlog of other work in the organization. Thus, lightweight teams might still suffer from the backlog barrier, while functional and heavyweight teams do not.

Further, external teams to the organization are mentioned to positively affect the innovation process. External teams can be different partners, as mentioned in the theme of knowledge, which help in developing the knowledge of an innovation. External involvement can help in reducing the infrastructural barrier, as it increases awareness of potential radical innovations in society (Assink, 2006). This increases the chances of acceptance and adoption once the innovation is fully developed and commercialized.

The negative elements within the theme of teams has mostly to do with working in teams. Many mentions suggest that managers are not needed and decrease the speed of innovation as the team members must continuously explain and provide updates of the developments. This suggests that some teams within the organization are not, but wish to be functional, as such teams lack a team manager (Schilling & Hill, 1998). Another negative element of the teams at Volvo Cars is a lack of experience and understanding of the innovation that is being developed. Previous experience and expertise is vital for teams to succeed because prior knowledge is needed to understand opportunities and threats (Ardichvili et.al, 2003; cf. Cohen and Levinthal, 1990).

Again, the negative element of lack of common goals is mentioned in the theme of teams. This fuels redundancies, another barrier that is mentioned. Many interviewees mention that different teams throughout the organization might be working on the same or similar projects, which likely is due to the lack of common goals, communication and too little cross-collaboration.

Just like in the theme of decision, dependencies are mentioned in relation to teams. The element of dependencies within teams have been mentioned as both positive and negative. As described in the theme of decision, dependencies are positive because they are needed to involve sponsors and stakeholders, to increase the chances of diffusing the innovation throughout the innovation process. But, as mentioned before, dependencies slow down the innovation process.

5.2.2 Resources

Allocating resources and prioritizing projects are daunting but important tasks. The analysis of Volvo Cars' handling of resources will provide insights into what kind of projects are currently receiving the most resources as well as what areas are lacking resources.

As mentioned in the theme of decision, availability of resources and efficient resource allocation are important topics in every firm. There will always be dissatisfaction from some teams and business units not receiving resources because of the fact that resources most often are scarce, specifically for autonomous employees working on radical innovations (Burgelman, 1983). Therefore, the theme of resources has a lot of negative mentions and many believe that they are not receiving enough resources, as depicted in Table 9 through the time and cash elements. However, communication is the one enabler that works well to increase resource allocation. Communicating with stakeholders and with decision makers is connected to involving stakeholders early and building a network to diffuse the innovation in the sponsorship and decision themes. Continuous communication is also correlated with transparency, as mentioned is the sponsorship and decision themes as well.

A negatively mentioned element that is recurring is the lack of an organized structure to diffuse and spread innovation in the organization. Once an idea is created there is no clear way to move forward towards implementation, as most of the diffusion

happens through already established networks and relationships. This is why networks and stakeholder involvement are so effective for senior employees in the theme of sponsorship. Another recurring element is the lack of ability to explore, and the reason has been explained to be the heavy focus on current markets. The current market focus leads to the constant perception of wrong timing - innovations occur before the market is ready. Without a clear benefit for the firm in the moment, these ideas are unlikely to be accepted in the organization. Once again, this hard focus on exploitation rather than exploration could be a result of a lack of ambidextrous approach and too little focus on the future market (O'Reilly and Tushman, 2013).

Because of a great backlog and lack of resources, most innovations occur without company resources and on employee spare time. Most of the data points to the fact that forcing spare time innovation creates barriers, as employee's willingness to work outside of company time is low. However, some explain that innovation occurs because of personal interests and passion, which more often than not flourish outside of working hours.

5.2.3 Uncertainty

Dealing with unknowns and risks requires a lot of attention. When working with innovation, uncertainties are a central aspect. The following analysis shows where attention lies to reduce risks, as well as what areas of uncertainty management might need more attention. The analysis is based on the data that is presented in Table 10.

Uncertainty reduction at Volvo Cars has quite a few areas of improvement. However, there are many positive mentions as well, specifically regarding the actual working method of reducing uncertainties. Testing plays a big role in reducing risks, where software testing, business model testing and project trials are used to reduce both technological risks and market risks. Methodological working is also a very efficient risk reduction method. Taking care of the most prevalent uncertainties first and moving up the ladder ensures that no risks are overseen. Reducing current risks can also unveil future uncertainties that would not have been prevalent before. Having an existing methodology to reduce risks is important (Asllani & Ettkin, 2007). While innovation might flourish in more agile environments, uncertainties must be dealt with sequentially, in a waterfall or stage-gate manner, concepts described by Maylor

(2010). Methodological working being positively mentioned in the organization suggests that this way of dealing with uncertainties is successful at Volvo Cars. Testing and methodological working is all backed up with both market and user data. Using data to reduce uncertainties is mentioned to be an efficient and accurate way to ensure risks are mitigated properly at Volvo Cars, and is also supported by Asllani and Ettkin (2007).

While testing and user data is commonly used to reduce uncertainties, an element that is missing from many projects is feedback loops. Once testing and data provide insights in certain risks and uncertainties, there needs to be redesigned testing in continuous feedback loops to reduce the uncertainties to a minimum. This is something that is often overlooked in the organization. Further, lack of competence is often one of the biggest uncertainty elements, as many people working with innovation lack experience in adjacent fields. Not only is this one of the bigger problems regarding uncertainty at Volvo Cars, but lack of expertise and experience is an element which increases uncertainties and reduces opportunity identification (Asllani & Ettkin, 2007; Burgelman, 1983). Finally, external elements affect uncertainty incredibly. There seems to be a lack of understanding in market and competitor information, which could reduce the uncertainties in innovation projects.

5.3 Project Outcomes

This section focuses on answering research question 3: *How are different project outcomes i.e., success and learnings, perceived in innovation projects at Volvo Cars?* The final chapter of the analysis will discuss success and learnings as a part of the project outcomes.

5.3.1 Success

The data collection showed great insights in what innovation success is at Volvo Cars and what is currently beneficial to successful projects, the data of which is shown in Table 11.

First, the different types of success that have been discussed is presented in Table 11. Learning is the most mentioned type of success and is something that the entirety of interviewees believe is present in all projects. Learning is mentioned as one of two

factors of success, alongside performance (Arthur, DeFillippi & Jones, 2001). Because of the great presence of learning success in the data, this element has been analyzed in more depth. Table 12 presents the different types of learning that is present in the organization. Technical success refers to the innovation being technologically feasible and occurs in most projects. In many of the projects where technical success was not reached, the idea was too advanced for the existing technologies. Commercial success refers to the innovation being implemented on the market and making money. Fewer projects reach this stage but for many interviewees, commercial success is not as important as learning success as learning can enable future innovations. Some projects have not been commercially or technically successful but have still improved the Volvo Cars brand. Some projects have focused on specific trending topics to increase brand recognition. Technical success, commercial success and PR success are all part of the second factor of success, performance as mentioned by Arthur, DeFillippi and Jones (2001). These factors increase the performance of the organization through technical advancements and increased sales.

Second, successful CSFs are presented, which is evident from the 0% mention rate in the %- column. Sufficient general knowledge is one of the most important elements in reducing uncertainties, as seen in the previous chapter. Obviously, a project with reduced uncertainties is likely to be more successful. It is therefore not surprising that the most critical success factor is possessing sufficient knowledge regarding the project. Outside the box thinking enables innovative mindsets and often leads to radical new ideas. Many mention this to be a success factor for innovation projects. Once again, connected to reducing uncertainties, methodological working plays a great part in both uncertainty reduction and success as the two elements are intertwined and correlated. Teamwork, trust and transparency are also mentioned to be critical to success and are elements that are currently working well within the organization.

Following successful CSFs, Table 11 presents CSFs that are in need of improvement. Many interviewees proclaim that measuring success is difficult and sometimes impossible and therefore understanding whether or not a project is successful can be hard, supported by Todorović et al. (2015). There is great difficulty in quantifying success of projects specifically dealing with innovation, because they are intricate and

based on new knowledge and discoveries. A CSF that is often mentioned as lacking is correct timing, something brought up throughout the different themes. Wrong timing can be detrimental, especially if the organization is heavily focused on exploiting current markets and lacks ambidextrous approaches, as previously stated by several authors from the literature review (such as Chen (2017)) and in the analysis. Politics are mentioned to play a big role in whether a project is successful or not, and often costly projects are denied, which comes as no surprise based on the amount of negative mentions regarding resources earlier in the analysis.

Finally, Table 11 presents two different outcomes of success. One of which is that successful projects often lead to future success by creating platforms for new knowledge to be developed from. This phenomenon is mentioned in the literature review as well, technology is path dependent (Assink, 2006). The second outcome of success regards failed projects, which are also mentioned to lead to future success because as mentioned before, all projects result in learning.

5.3.2 Learning

Since learning success was mentioned by the majority of interviewees, data was also collected on what constituted learning success. Interviewees mentioned the form of learning, but never the degree of learning. This falls in line with Arthur, DeFillippi and Jones (2001), that explains that quantifying the amount learnt is near impossible. The different kinds of learning within the organization is presented in Table 12. This shows that the majority of learning results in an increase in knowledge, followed by improving processes and enabling future innovation. Often, learning results in a project pivoting or a restructure of the scope to result in something better. As mentioned in *Chapter 5.3.1*., learnings are considered a success. Even though a project might get cancelled, if learnings are acquired it was considered a success by the interviewees. Keeping this rationale is important to allow for future learnings. If one starts to only strive for other means of success, i.e monetary value, or by suppressing negative inputs and feelings, it could become a barrier for future learnings (Argyris, 1991).

5.4 Discussion

When analyzing the negatively mentioned innovation elements, the most mentioned and the most recurring elements are: (1) Inability to leverage networks, (2) lack of ability to explore, (3) lack of common goals and (4) lack of experience and knowledge. Because these elements are the most negative and the most recurring ones, identifying solutions to these would be a great first step of further research. Ahead, there will be a discussion regarding these four main elements that have been uncovered in the analysis as well as initial thoughts on how the identified problems might be mitigated.

The analysis of this thesis could be used as a foundation for further research. The groundwork of identifying innovation elements has been done but future projects must focus on solutions to the negative impacts some elements have on the innovation process. The analysis unveiled a vast amount of elements that affect the innovation process at Volvo Cars. Many elements are positively affecting the innovation process by i.e. enabling knowledge creation, sponsorship and beneficial decision making. However, many elements which negatively affect the innovation process were discovered as well. The scope of this thesis focuses on identifying elements but does not include researched and developed solutions. Therefore, there is a need for further research on the subject, to understand how to mitigate the problems that certain elements create within the innovation process at Volvo Cars.

Together with higher management at Volvo Cars, these four recurring elements have been discussed and potential areas for solutions were pinpointed. Leveraging networks is an organic and beneficial way of spreading ideas and knowledge and the COVID-19 pandemic has proven that long distance relationships and networks can be built online. Networks should be the main tool of diffusing innovation, but they should be available to all employees, not only senior ones. Thus, there must be an increased focus on facilitating network creation. Senior employees should become assets for all employees to help creation of networks and relationships through introductions and referrals. Meetings and presentations should also decrease focus on debriefings and increase focus on discussions and networking. Although networks organically spread innovation, there is a need to increase focus on the quality of the

innovation, rather than the status and strength of a person's relationships when in the decision-making stage.

As for the lack of ability to explore, there is a great balance between exploration and exploitation. Obviously, firms must exploit to be competitive in current markets but explore to be competitive in future markets. To increase successful exploration, utilizing networks and increasing relationships between global offices is crucial. Innovation facilitators such as the Sunnyvale office and the Open Innovation Arena are steps in the right direction to increase exploration. However, moving from being in traditional manufacturing to innovation takes time and this disruptive transformation in the automotive industry is still premature. Increasing exploration, hiring innovative people and instilling an innovative culture in a previously traditional firm takes time.

As previously mentioned, increasing the common goals within the firm will help avoid redundancies and enable better cross-functionality. The discussions with higher management showed that common goals will increase by improving the network element. Increasing and enabling stronger networks will lead to more transparency and communication and in turn to increased common goals. Also mentioned was the importance of increasing availability and ease of access to forums, demos and general dialogues.

Lack of experience is a big innovation barrier at Volvo Cars, which according to higher management can be solved by exploring uncertainties methodologically and to build innovation on data. However, not all projects can afford to explore uncertainties and be data-based, because of the scarcity of resources. It was discussed that there is a need to understand prioritization, to focus on building experience and knowledge and reducing uncertainties in the most promising projects. Less promising projects cannot receive the same amount of resources to increase knowledge and experience, but should be allowed to transform and pivot as best as possible.

6. Conclusion

Because of the great changes that the automotive industry is currently undergoing, the future is very uncertain. With disruptive changes in the industry, driven to a large extent by automation and electrification, new technologies and processes are developed on a regular basis. Which of these new and radical factors will be the basis for competitiveness on the automotive market is hard to predict. However, it is evident that innovativeness is crucial in such transforming times. Therefore, automotive firms are moving away from traditional manufacturing and project management practices to focus on innovation and agility. Ensuring that the processes for innovation are efficient is important for the future survival of all automotive firms.

Within the last couple of years, Volvo Cars focused on increasing and enabling innovation through new departments and management styles. While the contributions this study has made to research within the automotive industry are focused on Volvo Car's organization, some findings and analyses can be generalized. However, such generalizable findings are relatively limited. The study has explored current practices by consolidating both positive and negative common elements that directly and indirectly affect innovation processes in the industry, with Volvo Cars as a case example. The elements of which are most recurring and negatively affect the innovation process at Volvo Cars both directly and indirectly are: (1) the inability to leverage networks to find innovation sponsorship, supportive decision making and sufficient resource allocation (2) the lack of ability to explore which hinders idea creation and creates barriers within sponsorship, decision making and resource allocation (3) the lack of common goals, which hinders sponsorship, decision making and team creation and finally (4) the lack of experience and knowledge which hinders team creation and uncertainty reduction. While our analysis has provided insights to more radical innovation projects during the initial stages of the innovation process, the study was limited to exclude more derivative innovations that often occur later in the innovation process and during industrialization and commercialization.

In addition to the recurring negative elements that have been identified, this project has also contributed to the understanding of how project outcomes i.e. success and learnings, are perceived within Volvo Cars. There are four types of success at Volvo Cars: (1) learning success, (2) technical success (3) commercial success and (4) PR

success. Employees of Volvo Cars believe that working methodologically and thinking outside the box, along with having sufficient general knowledge are currently the most efficient factors to reach success. Less efficient factors have been mentioned to be a lack of ability to measure success and the inability to work exploratively. Since learning success is the most present in the organization, what kind of learnings that are present in the organization have been explored as well. Most learnings result in increase in knowledge and improvement of processes but there are also mentions of enabling future innovation and pivoting projects.

In conclusion, Volvo Cars has been working towards becoming a more innovative organization. Their shift away from traditional departments, management, and processes are steps in the right direction, as shown by the positive elements in the analysis, but because of the great industrial uncertainty, automotive firm's innovation processes must be as efficient and optimized as possible. This project has identified what elements are currently efficient and what elements need improvement. The elements that have been identified as in need of improvement provide Volvo Cars with insights in their innovation process and how to optimize it for future competitiveness and success.

Further Research

Although this study provides great insights specifically to Volvo Cars, it is important to note that the conclusions made cannot be fully generalized to the industry as a whole. It is possible that the conclusions may hold true in other situations as well, however, more research needs to be done before such parallels can be drawn. Therefore, further research is needed within this area. More studies on other large firms in the automotive industry is needed to generalize the conclusion, but this study could be a great starting point for further research.

Further research must not only focus on more generalized studies, but also on Volvo Cars specific ones. Since the scope of this study was limited to the early innovation process and more radical innovations, there is a need for further research on derivative and incremental projects that might occur in the later stages of the innovation process at Volvo Cars, such as industrialization and commercialization.

The study that has been performed has focused on identifying and exploring negatively mentioned elements in Volvo Car's innovation process. However, the scope is limited to only identification. Further research is needed to expand on the specific findings of identified barriers within the innovation process. Here, the study can work as a great base as many problems have been identified. The next step is to look into potential solutions and try to come up with improvements. As the discussion in this study has mentioned, some improvements have been put forward and developed together with higher management. Further research can therefore explore these potential suggestions for improvements to see if they are feasible and beneficial to the company.

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Appendix

A. Interview Questions

Success

1. What goals, objectives or KPIs were set for this project?
2. Was there a specific timeline for specific parts of the project or objectives?
    a. More often push (no timeline) or pull (timeline). SAFe and epics are designed to not be limited by timelines
3. Which of the objectives were achieved? Did you stick to the timeline?

Uncertainty / risk

1. How much knowledge existed about the topic before the epic was created?
2. Can a project be started without any previous knowledge?
3. How do you feel that your current way of working (agile SAFe) agile methodology deals with uncertainty?

Innovation capacity

1. Willingness to cannibalize
    a. Was there a lot of capital and resources available for this new project? If not, where is the capital or resources deployed?
    b. Are there a lot of different business units that fight for the same resources? What does the decision making structure look like in the different business units?
    c. Who came up with the idea and what has this person done to realize it? Are there other people that try to push the idea or project forward? Let the interviewee elaborate regarding how people push ideas.
    d. Have there been similar projects like this in the past? What does the current market for the potential innovation look like? How do you think this market might grow?
2. Resistance to change
    a. Have you ever been pushed onto a project that you did not quite understand or believe in? Can you explain what happened?

    b. Explain how you keep control of the project and the idea. Are there times where things are very uncertain and the outcome of the project does not depend on you?
    c. What is your view on failed projects or ideas? What is your department's view? Volvo Cars as a whole?
    d. Can you voice your opinions even if they might not be positive?
3. Risk perspective
    a. Take up in the uncertainty questions - was this project risky? Is it ok to take risks? Do you take a lot of risks with new ideas?
4. Absorption of new information
    a. Where did you get this idea? How did you come into contact with this information?
    b. What did the process look like from the time you got information to the project actually starting?

Innovation project management

1. Can you explain the project process? A quick overview of how the project went from being started to finished.
2. How was the team built?
    a. How long was the project? Was it temporary or permanent?
    b. How much time do the team members allocate to the project?
    c. Are team members removed from their specific departments?
    d. Was there a manager of the project? Do team members report only to this manager or to department managers as well?
    e. How does the cross-functional communication work?
3. Ambidextrous approach
    a. What market was this project focusing on? (See innovation capacity 1d.)
4. Learning and applying previous knowledge
    a. Have there been similar projects in the past? (Already asked probably)
    b. What methods did you use and how did you come up with the idea? Where did you learn these methods?

B. Findings - Innovation Process

Knowledge	Σ
Enablers	30
Internal Discussions	8
Technology Partners	8
Research Partners	7
Supply Chain Partner	2
Start-up Partner	1
Government Partner	1
Freedom	1
Innovation Mindset	1
Seeding of Ideas	1
Barriers	3
Resistance to Change	1
Exploitation	1
Regulations	1
Foundation	50
Top-down	15
Bottom-up	14
Spare time	10
Cross-functional	7
Management Decision	2
Open Innovation	1
Cheap Proof of Concept	1
Idea Origin	63
Company Opportunities	42
Market Opporunities	12
Macro Opportunities	9

Sponsorship	Σ	% +	% -	÷
Succesful Enablers	73			
Idea Presentations	47			
Demo	15	73%	7%	10%
Value Description	10	50%	0%	0%
Business Case	8	63%	0%	0%
User Data	8	63%	13%	21%
Persuasion	6	50%	0%	0%
Increasing Idea Status	26			
Internal Interest	6	50%	0%	0%
Passion	5	40%	0%	0%
Trust	5	60%	0%	0%
Transparency	4	50%	0%	0%
Seniority	3	67%	0%	0%
Low External Interest	3	67%	33%	49%
Poor Enablers	51			
Human Factors	47			
Finding Sponsors	23	43%	30%	70%
Finding Product Champions	9	33%	44%	133%
Finding Stakeholders	8	25%	38%	152%
Creating a Network	7	43%	29%	67%
Other	4			
Lack of Common Goals	4	25%	50%	200%
Barriers	12			
Timing	7	N/A	N/A	N/A
Backlog	4	N/A	N/A	N/A
Sponsor Hesitation	1	N/A	N/A	N/A

Decision	Σ	% +	% -	÷
Succesful Enablers	68			
Idea Presentations	20			
Clear Business Case	11	27%	0%	0%
Clear Value Proposition	6	67%	0%	0%
User Data	3	67%	0%	0%
Project Specifications	16			
Existing Clear Needs	10	50%	10%	20%
Clear Benefit	6	67%	0%	0%
Human Factors	32			
Involving Stakeholders	22	50%	14%	28%
Top-down Projects	5	60%	0%	0%
Passion	3	33%	0%	0%
Transparency	2	50%	0%	0%
Poor Enablers	32			
Availability of Resources	10	50%	30%	60%
Leveraging Networks	10	30%	10%	33%
Innovation Understanding	5	40%	60%	150%
Leveraging Seniority	4	50%	25%	50%
Unclear Common Goals	3	0%	67%	N/A
Barriers	21			
Bad timing	8	N/A	N/A	N/A
Dependencies	3	N/A	N/A	N/A
Resistance to Change	2	N/A	N/A	N/A
Missing Diffusion Process	2	N/A	N/A	N/A
Costly Project	2	N/A	N/A	N/A
Organizational Politics	1	N/A	N/A	N/A
Regulations	1	N/A	N/A	N/A
Backlog	1	N/A	N/A	N/A
High Overheads	1	N/A	N/A	N/A

C. Findings - Process Conditions

Teams	Σ	% +	% -	÷
Positives	69			
Team Creation	44			
Organic Creation	18	67%	0%	0%
Start Small	13	0%	0%	N/A
Network Utilization	7	71%	0%	0%
Expanded When Needed	6	0%	0%	N/A
Positive Characteristics	25			
Cross-functional	13	62%	0%	0%
External Teams	5	80%	0%	0%
Passion	4	75%	0%	0%
Stakeholder Involvment	2	100%	0%	0%
Personal Relationships	1	0%	0%	N/A
Negatives	19			
Negative Characteristics	12			
Managers	5	0%	60%	N/A
Lack of Experience	4	0%	100%	N/A
Lack of Common Goals	1	0%	100%	N/A
Lack of Accountability	1	0%	100%	N/A
Predetermined Role	1	N/A	N/A	N/A
Barriers	7			
Redundancy	4	0%	50%	N/A
Backlog	3	0%	33%	N/A
Ambivalent Elements	5			
Dependencies	5	20%	40%	200%

Resources	Σ	% +	% -	÷
Positives	3			
Enablers	3			
Communication	3	67%	0%	0%
Negatives	56			
Enablers	40			
Time	21	19%	43%	226%
Cash	14	29%	64%	221%
Way Forward	2	0%	100%	N/A
Cross-collaboration	1	0%	100%	N/A
Organizational Understanding	1	0%	100%	N/A
Inernal Interest	1	0%	0%	N/A
Barriers	16			
Lack of Ability to Explore	11	0%	100%	N/A
Wrong Timing	4	25%	75%	300%
Backlog	1	0%	100%	N/A
Ambivalent Elements	7			
Spare Time Innovation	7	29%	57%	197%

Uncertainty	Σ	% +	% -	÷
Positives	40			
Working Method	40			
Sufficient Testing	16	56%	13%	23%
Methodological Working	10	60%	0%	0%
Sufficient Data	10	60%	10%	17%
Availability of Options	2	50%	0%	0%
Transparency	2	0%	0%	N/A
Negatives	54			
Working Method	5			
Lack of Feedback	5	40%	20%	50%
Competence	38			
Insufficient Overall Knowledge	25	28%	32%	114%
Insufficient Technological Competence	13	23%	77%	335%
External Uncertainty Reduction	11			
Knowledge from Mature Markets	7	0%	71%	N/A
Knowledge from Competitors	3	33%	33%	100%
Regulations	1	0%	100%	N/A

D. Findings - Project Outcomes

Success	Σ	% +	% -	÷
Types of Success	50			
Learning Success	20	85%	0%	0%
Technical Success	15	87%	13%	15%
Commercial Success	11	73%	0%	0%
PR Success	4	100%	0%	0%
Succesful CSFs	26			
Sufficient General Knowledge	11	64%	0%	0%
Outside-the-box Thinking	3	33%	0%	0%
Methodological Working	3	33%	0%	0%
Teamwork	2	100%	0%	0%
Trust	2	50%	0%	0%
Transparency	2	50%	0%	0%
Eager Consumer Adopters	1	N/A	N/A	N/A
Motivation	1	N/A	N/A	N/A
Communication	1	N/A	N/A	N/A
Poor CSFs	20			
Ability to Measure Success	11	18%	45%	250%
Wrong Timing	7	57%	29%	51%
Organizational Politics	1	0%	100%	N/A
Costly Projects	1	0%	100%	N/A
Outcomes of Success	6			
Platform for Future Innovation	4	25%	0%	0%
Failing to Learn	2	100%	0%	0%
Ambivalent Elements	5			
Working Towards KPIs	5	60%	20%	33%

Type of Learning	Σ	%
Increasing Knowledge	17	38%
Improve Processes	11	24%
Enable Future Innovation	9	20%
Pivotting the Project	7	16%
Enable Open Innovation	1	2%

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