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Supplier Involvement in Radical Innovation Projects

Master's thesis in Project Management

Supervisor: Tim Kristian Andreas Torvatn

June 2019

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Preface

This paper is a scientific report documenting the work I have done during my Master's thesis in Project Management. The purpose of the thesis was to investigate if a supplier should be involved in radical innovation projects or not. It builds upon a project thesis undertaken in Autumn 2018, in the course TIØ5230 – Project Management specialization Project.

I would like to take the opportunity to thank the individuals who have helped me in the process of writing this report. Firstly, I would like to thank my supervisor Tim Torvatn at the department of Industrial Economics and Technology Management, for the valuable guidance I have received throughout the semester. In addition to this, I would also like to thank the Ola Edvin Vie and Parinaz Farid for the guidance and feedback related to scientific writing, in the project management specialization course.

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Fedessa Daniel Baissa

Abstract

Most industries today are dynamic and highly competitive. These industries are vulnerable for disruption, making solely focusing on incremental innovations a risky option. This calls for organizational ambidexterity, by simultaneously pursuing both incremental and radical innovations. A big challenge when trying to be ambidextrous is that the evolution of organizations from new to mature favors incremental innovations. It is therefore important for mature organization to also promote radical innovations. This can be done through a culture of curiosity, where the individuals in the organizations wish and are allowed to take risks.

Another consequence of the dynamics and competitiveness of industries is the need for frequent innovations with better quality and lower prices. Research has documented that one way of achieving this is by the involvement of suppliers in NPD. There is a consensus among researchers that this is the case for incremental innovation, while there are opposing views related to the involvement of suppliers in radical innovations. The findings of this study supports the proponents of supplier involvement in radical innovations. Suppliers were found to have a positive impact on the performance radical innovations, by adding new competences, new ideas and flexibility to the projects.

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List of Abbreviations

AI Artificial Intelligence

NPD New Product Development

NTNU Norwegian University of Science and Technology

Chapter 1

Introduction

1.1 Background

Most industries today are dynamic, with rapidly changing competition, technologies and customer preferences (de Wit and Meyer 2014). Companies operating in these industries need to change and adapt to the dynamics in their environment to extend their lives (Gareis 2010). One way of achieving this alignment is through radical innovations. Radical innovations are highly uncertain innovations, leading to alignment with the environment through significant changes with an unsteady pace (de Wit and Meyer 2014, Eisenhardt and Tabrizi 1995). The dramatic changes caused by these innovations has the potential of forming the future of industries. At the same time, these changes might also lead to previous investments in resources ending up being useless, often making them undesirable for incumbents (Torvatn et al. 2016).

In addition to being dynamic, most industries today are also highly competitive, with customers demanding frequent innovations with better quality and lower costs

(Wasti and Liker 1997, Ragatz et al. 2002). This has led to many companies turning to their suppliers to improve the performance of their innovations. Suppliers are often involved in the design and development processes of new products, due to their direct impact on costs, quality, technology, speed and responsiveness (Monczka and Trent 1997).

The first research into suppliers involvement in new product development (NPD) has strong roots in Japanese automotive research and can be traced back to the mid-1980s (Johnsen 2009, Imai et al. 1984, Takeuchi and Nonaka 1986). It was used to establish the connection between supplier involvement and the superior performance of Japanese automotive manufacturers, compared to their western counterparts. The research has since then expanded greatly, with more and more companies choosing to outsource parts of their NPD activities to their suppliers (Johnsen 2009).

The earlier studies into supplier involvement in NPD were mainly related to incremental innovations (Johnsen 2009). These studies have provided overwhelming evidence for the positive effects of supplier involvement on the performance of incremental innovations. As the field has expanded, more researchers have started focusing on supplier involvement under conditions of technological uncertainty, i.e. radical innovations (Eisenhardt and Tabrizi 1995, Song and Parry 1999, Primo and Amundson 2002, Ragatz et al. 2002, Petersen et al. 2003, Song and Di Benedetto 2008). Contrary to the consistent results related to the benefits of supplier involvement in incremental innovations, there are opposing views related to the benefits of supplier involvement in radical innovations. Some researchers have concluded that suppliers should be involved (Ragatz et al. 2002, Petersen et al. 2003, Song and Di Benedetto 2008), while others question the importance of supplier involvement in these projects (Eisenhardt and Tabrizi 1995, Primo and Amundson

2002).

Although radical innovations might seem undesirable to incumbents due to the dramatic changes they cause, simply ignoring them or trying to fight them has led to the downfall of many great companies (Christensen 2003). This coupled together with the documented benefits of supplier involvement in incremental innovations, strengthens the need for better understanding of the effects of supplier involvement in radical innovations.

1.2 Problem Statement

The aim of this study is therefore to investigate the effects of supplier involvement on radical innovations, to determine whether suppliers should be involved in these projects or not. This understanding is important for the success of these projects and will benefit companies conducting them. This is especially important today, where a lot of companies operate in a dynamic environment, making solely aligning with their environments through incremental innovations insufficient.

Suppliers have a lot of direct impact on the performance of products. This is due to the fact that most of the costs of products are locked in during the concept and design phases of NPDs (Berliner and Brimson 1988). This makes involving suppliers in these phases a tempting option. At the same time, the decision to involve suppliers should be based on a thorough understanding of radical innovations and the potential effects of suppliers involvement on radical innovations.

To be able to get this understanding, this study will have one main research question and four sub-questions. The sub-questions will facilitate the necessary understanding to be able to answer the main research questions. The research questions of this paper are:

1. *Should suppliers be involved radical innovation projects?*

- 1.1. *Are radical innovations necessary in mature organizations?*
- 1.2. *What are the necessary organizational conditions to promote radical innovations?*
- 1.3. *What are the benefits of involving suppliers in NPD?*
- 1.4. *What is the source of opposing views regarding the involvement of suppliers in radical innovation projects?*

1.3 Limitations

The first limitation of this study is that it considers radical innovations to be a way of achieving strategic innovation as a change process. In addition to being a change process, strategic innovation can also be a strategizing, entrepreneuring and investing process. These other processes are challenging on their own and have not been taken under consideration in this study. One major consequence of this is that the people contacted to potentially participate in this study were people who had worked in mature organizations. This made finding participants for this study difficult. Getting participants from start-ups would probably have been easier, but strategic innovation in start-ups is an entrepreneuring process.

In terms of the benefits of supplier involvement and the different strategies and processes buyers use to integrate their suppliers into NPDs, some of the common ones have been described briefly without an in-depth elaboration. The reason for this is that these topics are big enough to be a Master's thesis on their own and would not fit with the time constraints of a Master's thesis.

Time constraints had also some consequences for the methodology used in this

study. Some of the methodology practices that are usually used in research were not suitable for this study due to time constraints. This will be further elaborated in chapter 3.

1.4 Outline

The rest of the paper is divided into five chapters. The next chapter is the theoretical background chapter. This Master's thesis is a continuation of a project thesis conducted the previous semester. During the project thesis, a literature study was conducted to find out what is already known about the area of interest. The theoretical background chapter will summarize the relevant concepts and theories identified during the project thesis. It ends with a theoretical framework consisting of six proposition.

Chapter 3 is the methodology chapter. This chapter describes the research approach used in this study. It provided an overview of the different methodology practices that can be used in a research, in addition to justifications for the methodology choices made in this study. The chapter is concluded with a section where the research in this study is evaluated.

The next chapter will be the empirical data chapter. After collecting data for this study, the data will be coded. Coding is the process of grouping the data into categories, and will be used to build this chapters. The chapter will start with a background information about the participant in this study, followed by presentation of the findings.

The empirical data chapter is followed by an analysis chapter. In this chapters, the theoretical framework developed in the theoretical background chapter will be used to analyze and discuss the empirical data. The purpose of this chapter is to analyze the empirical data, to see if it supports the propositions made in the

theoretical background chapter.

The last chapter of the paper will be the conclusion chapter. The research question and the sub-questions will be answered in this chapters. This is then followed by the description of potential departure points for future research.

Chapter 2

Theoretical Background

This chapter gives an overview of the literature and theory used in this study. It is divided into two sections, where the first one is related to innovation, while the second one is about supplier involvement in NPD. Both of these sections start out wide before narrowing down to the focus of the study; radical innovations and supplier involvement in radical innovations.

2.1 Innovation

Most organizations today operate in dynamic environments where technologies, customer preferences and competition are constantly changing (de Wit and Meyer 2014). To be able to survive and extend their lives, these organizations must move from their current state to a desired future state (Gareis 2010, de Wit and Meyer 2014, Hill et al. 2014). This ongoing process of adaptation and alignment can be achieved through three generic types of innovation; incremental, semi-radical and radical innovations (Davila et al. 2012, de Wit and Meyer 2014).

There are different models in literature, used to understand the differences between

these types of innovations (de Wit and Meyer 2014, Davila et al. 2012). One of these models is a model by Davila et al. (2012) used to differentiate between different types of innovations in business context (Torvatn et al. 2016). The model is illustrated in Figure 2.1 and consists of two main dimensions, business model innovation and technology innovation. The main dimensions in the model consist of three elements each, called the levers on innovation. The model considers these levers of innovation to be the roots of all innovation, implying that innovation is changing one or more of these elements (Davila et al. 2012).

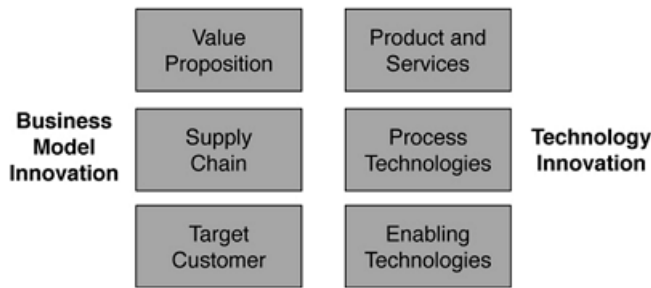


Figure 2.1: The six levers of innovation (Davila et al. 2012) (p. 31)

The first dimension in the model is business model innovation. A business model describes how an organization creates, sells and delivers value to their customers to achieve competitive advantage (de Wit and Meyer 2014, Davila et al. 2012). Innovation in the business model can be achieved by changes in the value proposition, supply chain and target customers (Davila et al. 2012). Value proposition is what the organization sells and delivers to the market. The target customers in the market are supplied with the value proposition through an integrated set of value creation processes, called the supply chain.

The other dimension in the model is technology innovation. Technology innovation can be achieved by changing product and services, process technologies and enabling technologies (Davila et al. 2012). Most customers associate technology

innovation to changes in products and services. This makes sense as its easier for the customers to observe changes made to the products and services delivered to them. But it is important to remember that technology innovation can also be achieved by changes to two more levers of innovation, that are less visible to the customers. The first one is the process technologies, which are the technologies that help organizations deliver their products or services cheaper, faster or better. The other one is the enabling technologies, which are the technologies organizations use to improve the speed of execution of strategies and delivery of products and services.

Davila et al. (2012) differentiate between the three generic types of innovation based on the understanding of the main dimensions and the six levers of innovation in the model. The main difference between these types of innovation is the magnitude and pace of the changes caused by them (de Wit and Meyer 2014). Incremental innovations are innovations leading to minor and evolutionary changes, with the aim of helping organizations achieve continuous alignment with their environment (de Wit and Meyer 2014). These innovation will not lead to any significant changes to the business model or technology of a company (Davila et al. 2012). Semi-radical innovations on the other hand, will lead to significant changes in some of the levers of innovation under the business model *or* the technology. The last and most interesting type of innovation for this paper is radical innovations. These innovations lead to significant changes to one or more levers of innovation under *both* the business model and technology (Davila et al. 2012).

2.1.1 Radical Innovations

Radical innovations align organizations with their environment through significant changes, with an unsteady pace (de Wit and Meyer 2014). Changes made to one or more of the levers of innovation belonging to both the business model and

technology will lead to deep structural and cultural changes in the organizations. Furthermore, they are high-risk, high rewards investments that might shape the future of industries and change the rules of the game within them (de Wit and Meyer 2014, Torvatn et al. 2016).

Although the potential rewards of radical innovations might make them seem like the desired type of innovation within organizations, it is usually not the case (Davila et al. 2012, de Wit and Meyer 2014, Christensen 2003). This is especially the case for mature organizations, who tend to focus on capturing value instead of creativity and developing new ideas. To be able to understand the reason behind this focus, it is important to consider the pattern all organizations follow when growing and evolving (Tushman and O'Reilly III 1996). Figure 2.2 shows the S-curve describing organizational growth and evolution. At first an organization consists of a small group of people working together to generate new ideas, develop and sell new products. As the product succeeds and the organization keeps growing, more structure and systems will be needed for efficiency and control. This is often accompanied with a change in strategy and the need to realign the organization with the strategy. The competition in this stage of the S-curve is based on differentiation. This is followed by the later stage of the evolution, where the organization is mature and competition shifts to features, efficiency and cost. This is the stage where improvements through incremental innovations offer bigger margins, while having lower risk (de Wit and Meyer 2014, Davila et al. 2012).

To get to the later stages of the S-curve, organizations must invest a lot in resources to help them capture value from their innovations. Radical innovations and the dramatic changes caused by them might make these investments useless, requiring new investments to be able to survive (Torvatn et al. 2016). This is the destructive side of radical innovations often making them undesirable for incum-

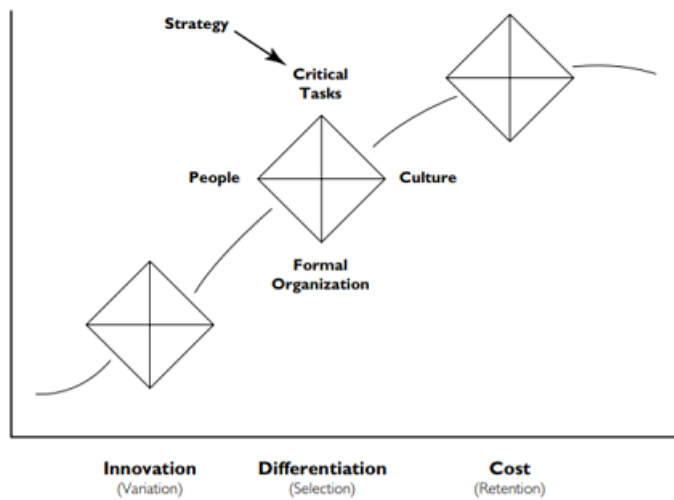


Figure 2.2: Organizational evolution (Tushman and O'Reilly III 1996) (p. 13)

bents. Furthermore, as organizations become older and larger, they often develop structural and cultural inertia (Tushman and O'Reilly III 1996). Structural inertia is the resistance to change caused by size, complexity and interdependence of the structures, systems and processes of the organization. Cultural inertia on the other hand, is inertia caused by the norms, values and lessons that has led to the organization succeeding. Although the culture and structures in an organization might have fostered success, they often tend to be a barrier to change when confronted with discontinuous change (Tushman and O'Reilly III 1996).

Even though the destructive side of radical innovations might make them seem undesirable, ignoring them or choosing to fight them has led to the downfall of many great organizations (Christensen 2003). Most of these organizations focused on exploitation and sustained renewal, leaving them unprepared for the threats of radical innovations and lacking the flexibility needed for the restructuring caused by radical innovations (Torvatn et al. 2016). At the same time, it is important to remember that just focusing on radical innovations is not ideal either. Instead,

organizations should be ambidextrous by simultaneously pursue both radical and incremental innovations to be able to cope with the dynamics in their environment (Tushman and O'Reilly III 1996).

2.1.2 Structuring Organizations for Radical Innovations

The natural evolution of organizations from exploration to exploitation promotes incremental innovations, while often inhibiting radical innovations (Davila et al. 2012, Tushman and O'Reilly III 1996). The consequence of this is that a lot of potentially great ideas never get the chance to be explored in mature organizations. This is the paradox of exploitation and exploration, a paradox where there is no consensus on how to deal with the two opposing views (de Wit and Meyer 2014). At the same time, the dynamic nature of a lot industries requires organizations to balance both types of innovations (Davila et al. 2012, Tushman and O'Reilly III 1996).

Davila et al. (2012) suggest dealing with this paradox through an internal marketplace for innovation. An internal marketplace for innovation allows employees to "sell" their ideas to management. The key here for the management is to use an adequate measurement system and paradoxical thinking to balance the portfolio of project with both incremental and radical innovations. At the same time, simply having an internal marketplace for innovation will not be enough without the right organizational culture. Management should therefore facilitate a culture promoting radical innovations through incentives, patience and slack in employees work schedule to pursue their ideas (Davila et al. 2012).

A culture promoting radical innovations will allow radical innovation projects to be chosen, but that does not mean they will succeed. To be able to understand how organizations can help facilitate the success of radical innovations, it is im-

portant to understand the strategy of radical innovation projects (Artto et al. 2008). Project strategy has for a long time been considered a direct translation of parent organizations strategy in project management literature (Morris and Jamieson 2005, Anderson and Merna 2003). In reality, the parent organization is often just one of multiple stakeholders in the projects stakeholder environment. Furthermore, projects might also be initiated to change the parent organization or its strategy, as it is the case with radical innovation projects (Artto et al. 2008).

Artto et al. (2008) suggest that projects can have one of four positions in their context depending on their strategy. These positions depend on the necessary autonomy and complexity of stakeholder environment required for the projects to be able to achieve their strategy. These contextual positions can be seen in Figure 2.3.

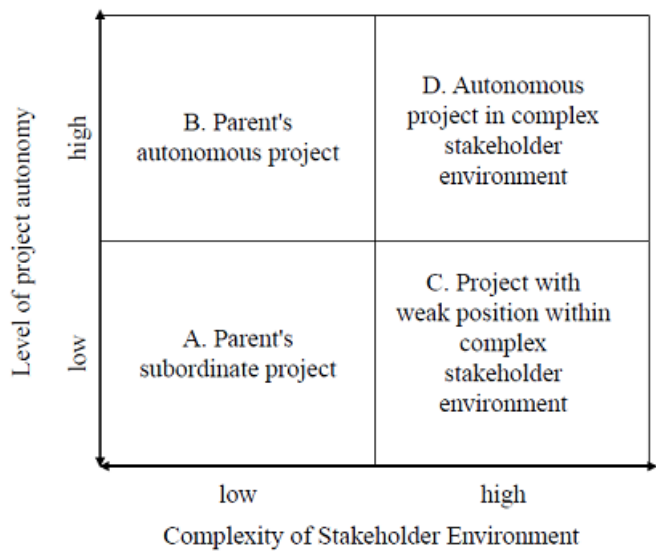


Figure 2.3: Project’s position in their context (Artto et al. 2008) (p. 53)

When deciding what position radical innovation projects should have in their context, it is important to consider their characteristics. Radical innovation projects

aim to achieve revolutionary change, meaning that the direction of their strategy is radical renewal of parent organization or its strategy (de Wit and Meyer 2014, Artto et al. 2008). This is achieved through the generation of radical ideas, challenging the existing organizational culture. To be able to achieve this, the project team should have the possibility to explore ideas that might otherwise be considered "impossible" . Furthermore, cultural inertia will often lead to resistance towards these projects. It is therefore important to protect them from organizational antibodies trying to hinder them (Davila et al. 2012). In addition to this, the high level of uncertainty surrounding them will require the management to be patient and avoid blaming the project team for failed projects (Torvatn et al. 2016).

Based on these characteristics and the necessary organizational conditions to help radical innovation projects succeed, it is evident that the contextual position that suits these projects is position B (Artto et al. 2008). This is a position with high level of autonomy and low complexity of stakeholder environment. The high level of autonomy allows the project team to have the necessary decision-making authority to explore the ideas they want, without having to take constant input and give feedback to top management. The low complexity in the stakeholder environment on the other hand, means that the project team will have a limited number of stakeholders to deal with. This will protect them from organizational antibodies, in addition to protecting them from conflicting stakeholder requirements affecting decision-making time (Davila et al. 2012, Artto et al. 2008).

2.1.3 Summary

The competitive nature of most industries today means that innovation is vital for companies who want to extend their lives (de Wit and Meyer 2014). The literature within the field of innovation distinguishes between three types of innovations; incremental, semi-radical and radical innovations. The most interesting

type of innovation for this study is radical innovations. When using the model by Davila et al. (2012) to understand the differences between the different types of innovation, radical innovation are innovations leading to changes to the levers of innovation under both the business model and technology. These changes are often undesirable among incumbents, as they develop cultural and structural inertia when evolving from being a small organization to a mature organization. Although this is the case, choosing to fight radical innovations or simply ignoring them has led to the fall of many companies (Christensen 2003). It is therefore important for organization to be ambidextrous by simultaneously pursuing both radical and incremental innovations (Tushman and O'Reilly III 1996). Therefore, the first theoretical proposition developed based on the theory introduced in section 2.1 is:

P1: Mature organizations should pursue both incremental and radical innovations to extend their lives.

Being ambidextrous and pursuing both radical and incremental innovations is often easier said than done. Organizations must be structured correctly to be able to achieve this. There is no consensus on how to strike a good balance between these types of innovations. One way of dealing with this paradox is by using the internal marketplace for innovations suggested by Davila et al. (2012). At the same time, having an internal marketplace or using other methods to balance the portfolio of projects is not enough without the right organizational culture. Therefore, it is important that the management facilitates a culture promoting radical innovations through incentives, patience and slack in employees work schedule. Based on this, the second theoretical proposition is:

P2: Organizational culture promoting radical innovations is important to be able to not fall into the trap of just focusing on incremental innovations.

In addition to having an organizational culture promoting radical innovations, radical innovation projects should also have a different position in their context than incremental innovation projects. When using the model by Artto et al. (2008) to determine the contextual position of radical innovations, it is evident that they should have a position with low complexity of stakeholder environment and a high level of autonomy. The low level of complexity in their stakeholder environment is to protect them from organization antibodies and conflicting stakeholder requirements, while a high level of autonomy allows the project team to pursue the ideas they want and challenge organizational culture. The next theoretical proposition is therefore:

P3: Radical innovation projects should have low complexity in their stakeholder environment, while the project team should have a high level of autonomy.

2.2 Supplier Involvement in New Product Development

The first research within the field of supplier involvement in NPD was driven by empirical data from the automotive industry and started in the mid 1980s (Imai et al. 1984, Takeuchi and Nonaka 1986). It was mainly used to understand the superior performance of Japanese auto manufacturers, compared to their western competitors. The past 30 years, more companies have started outsourcing parts of their NPD activities to their suppliers, leading to the expansion of the field through the inclusion of other industries and increased sophistication (Johnsen 2009). Supplier involvement in NPD is widespread in most industries today, delivering great value through involvements ranging from simple consultation to making suppliers fully responsible for some parts of the NPD efforts (Ragatz et al. 2002).

Customers in many industries demand frequent innovations and better quality, while the high level of competition forces companies to keep the costs of these

innovation as low as possible (Ragatz et al. 2002, Wasti and Liker 1997). This had led to many companies turning to their suppliers to achieve these goals, something that is supported by the findings from the first research within the field of supplier involvement in NPD (Imai et al. 1984, Takeuchi and Nonaka 1986, Fujimoto and Clark 1991). These studies found a connection between involvement of suppliers in Japan and the performance gap between Japanese manufacturers and their western counterparts in terms of cycle times, cost and quality.

Involving suppliers in NPD provides the project team with an external source of ideas and solutions, leading to the reduction of internal complexity of projects and addition of extra project personnel (Eisenhardt and Tabrizi 1995). This will reduce the critical path of the projects and shorten the development time (Fujimoto and Clark 1991). In addition to this, having the suppliers present at the buying company's premises will also reduce travel and communication delays, while allowing the suppliers to improve the quality of products by adding information and expertise to new ideas (Ragatz et al. 2002). Furthermore, although the concept and design phases of NPD account for 5-8% of the total costs, 80% of the total costs of products are locked in during these phases (Berliner and Brimson 1988). Involving suppliers in these phases will lead to better decision making, by allowing them to share technology information and ideas (Ragatz et al. 2002). Better decision making in these phases often leads to better cost performance, as it becomes more costly to make changes as the development continues.

Most of the research in the early days of supplier involvement in NPD focused on incremental innovations, providing an overwhelming evidence for the importance of supplier involvement in incremental innovations (Johnsen 2009). In recent years, more researchers have started investigating the effects on supplier involvement in radical innovations (Petersen et al. 2003, Ragatz et al. 2002, Song and

Di Benedetto 2008, Wasti and Liker 1997, Eisenhardt and Tabrizi 1995, Primo and Amundson 2002, Swink 1999). Contrary to the consensus regarding the benefits of supplier involvement in incremental NPDs, there are opposing view regarding supplier involvement in radical NPDs.

2.2.1 Supplier Involvement in Radical Innovations

One of the characteristics of radical innovations is the high level of technological uncertainty associated with these projects (de Wit and Meyer 2014). Radical innovations are often referred to as NPD with high levels of technological uncertainty in literature within the field of supplier involvement in NPD (Johnsen 2009, Ragatz et al. 2002, Song and Di Benedetto 2008). Technological uncertainty is identified as one of the variables affecting the success of NPD projects and the source of the opposing views related to supplier involvement in radical innovations (Johnsen 2009).

Petersen et al. (2003) and Wasti and Liker (1997) are two of the researchers who after conducting studies in Japan, identified a positive relationship between greater involvement of suppliers and higher technological uncertainty. They were supported by Ragatz et al. (2002) and Petersen et al. (2003) who also believe suppliers should be involved under high levels of technological uncertainty. They acknowledged that technological uncertainty has some direct and indirect effect negative effects on NPD projects where suppliers are involved. Although this was the case, they concluded that these effects could be mitigated through the use of effective integrative strategies, team processes and involving the right suppliers. These include the involvement of suppliers with established long-term relationships, sharing cost and technology information and making the suppliers part of the project team.

On the other side of the scale, other researchers have raised questions about the involvement of suppliers under conditions of technological uncertainty, the first once being Eisenhardt and Tabrizi (1995). They conducted a study of 72 NPD projects by distinguishing between predictable and unpredictable projects and raised the issue of generalizing from predictable and unpredictable projects. They concluded that development time could be reduced through supplier involvement in incremental NPDs, which are a series of predictable steps. Radical innovation on the other hand, were unpredictable and required more design iterations, testing and authority to the project manager to reduce development time. They considered time to market to be an important success factor for NPD, something that was supported by Vesey (1991) who concluded that entering the market within budget, but late led to earning 33% less over a five-year period.

Another issue with opposing views in terms of supplier involvement in radical innovations is the which suppliers to involve. Contrary to the views of Ragatz et al. (2002) and Petersen et al. (2003), who believe long-term relationships are beneficial when involving suppliers under conditions of technological uncertainty, Song and Parry (1999) believe technical synergies leads to less technical proficiency. This is something that leads to less product competitiveness, something that was supported by Primo and Amundson (2002) who concluded the involvement of new suppliers might be more beneficial than established relationships.

An important factor to consider when in terms of supplier involvement in radical innovations is the technology used in a product and the level of technological uncertainty related to the technology. Petersen et al. (2003) concluded that technological uncertainty is caused by using new-to-the-world technologies, new application of existing technologies or technologies outside the companies field of expertise in a product. New-to-the-world technologies are the once leading to the

highest levels of technological uncertainty, while new application of existing technologies will lead to least technological uncertainty. New application of existing technologies are not relevant for this study, as they cannot lead to radical innovations when considering the model by Davila et al. (2012).

With the two types of technologies that can be used to get radical innovations, the characteristics of radical innovations and the necessary organizational conditions for them to succeed, the project thesis used as the basis for this master's thesis concluded with a theoretical model for supplier involvement in radical innovation (Baissa 2018). This model can be seen in Figure 2.4 and distinguishes between radical innovations by using technologies that are new to the world and technologies that are new to the company, but not the world.

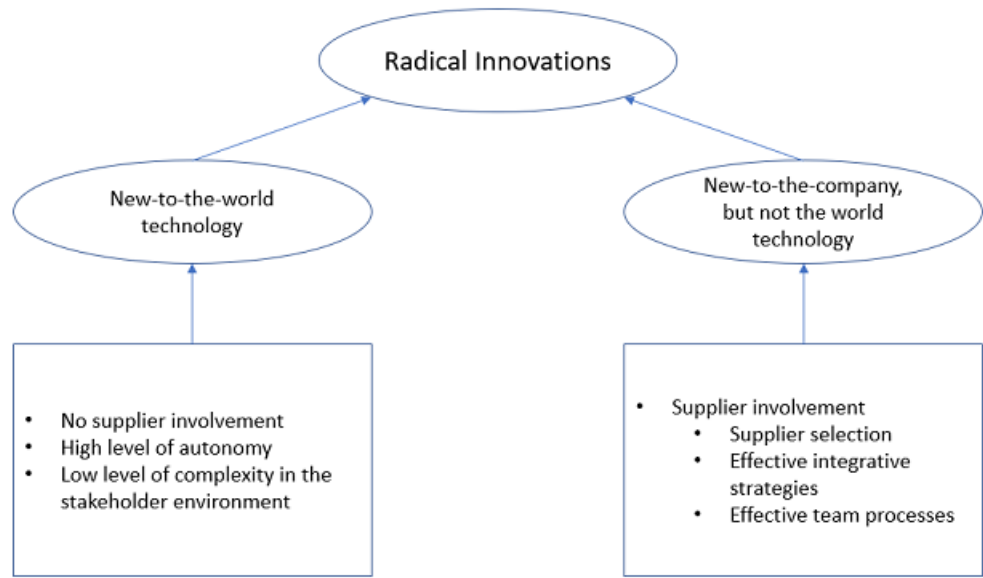


Figure 2.4: Supplier involvement based on the source of technological uncertainty

Developing technologies that are new to the world for the purpose of radical innovations will require the project team to challenge organizational culture and develop

radical ideas (Davila et al. 2012). To be able to do this, the project team should be given a high level of autonomy, while keeping the complexity of the stakeholder environment low, to protect the project from organizational antibodies (Artto et al. 2008). Keeping the complexity of the stakeholder environment low will also mean that suppliers should not be involved (Baissa 2018). This is to protect the project from conflicting stakeholder requirements, that might limit the project teams ability to explore the ideas they want.

When using technologies that are new to the company, but not the world on the other hand, it might be beneficial to involve suppliers with extensive knowledge about the technology (Baissa 2018). This will likely reduce the technological uncertainty, reduce costs, save time and improve quality. In addition to involving suppliers with the necessary knowledge about the technology, effective integrative strategies and team processes must also be employed to facilitate the success of the involvement.

2.2.2 Summary

The competitive nature of many industries, with customers demanding frequent innovations with better quality and lower costs, has led to many organizations turning to their suppliers to stay competitive. At the same time, since the research within the field of supplier involvement in NPD started in the mid 1980s, most researchers have concluded that supplier involvement in incremental NPDs improves the performance of the products. Based on this, the following proposition has been developed:

P4: It is beneficial to involve suppliers in incremental innovation projects?

Unlike the consensus regarding the benefits of supplier involvement in incremental innovations, there are opposing view when it comes to radical innovations. Some

researchers believe that suppliers should be involved in radical innovation projects, while others disagree. After investigating the different views related to the topic, characteristics of radical innovation and the necessary organizational conditions for their success, the project thesis written by me before starting this Master's thesis had the following theoretical propositions:

P5: Suppliers should not be involved in radical innovations using new-to-the-world technologies.

P6: Suppliers with knowledge about the technologies, should be involved in radical innovation projects using technologies that are new to the company, but not the world.

2.3 Theoretical Framework

This section gathers the six theoretical propositions that have been developed in this chapter. The framework will be used to analyze the empirical data in chapter 5 and can be seen in Table 2.1.

Topic	Code	Theoretical proposition
Innovation	P1	Mature organizations should pursue both incremental and radical innovations to extend their lives.
	P2	Organizational culture promoting radical innovations is important to be able to not fall in the trap of just focusing on incremental innovations.
	P3	Radical innovation projects should have low complexity in their stakeholder environment, while the project team should have a high level of autonomy.
Supplier Involvement in New Product Development	P4	It is beneficial to involve suppliers in incremental innovation projects.
	P5	Suppliers should not be involved in radical innovation projects using new-to-the-world technologies in products.
	P6	Suppliers with knowledge about the technologies, should be involved in radical innovation projects using a technologies that are new to the company, but not the world.

Table 2.1: Theoretical Framework

Chapter 3

Methodology

This chapter describes the research approach used in this study. The methodology practices presented by Bryman (2016) have been used as the basis to conduct the research in this paper.

3.1 Research Design

A research design provides a framework that allows the researcher to collect and analyze data (Bryman 2016). When making the choice of research design for this study, the five different research designs examined by Bryman (2016) were considered. These were experimental, longitudinal, cross sectional, case study and competitive design. The first two research designs were quickly ruled out, as they are not compatible for this study. Experimental research design is not suitable for this study, as it would require manipulation of independent variables and a lot of social engineering (Bryman 2016). Longitudinal research design on the other hand, does not fit with the time and resources available for a master's thesis. This leaves us with three potential research designs that could all be applicable for this

study.

The initial choice of research design for this study was a cross-sectional research design. A cross-sectional research design is a design where two or more cases are examined at a single point for time, with the aim of finding quantifiable data that can be used to find patterns of association between two or more variables (Bryman 2016). The aim of choosing this research design was to find patterns of association between variables related to supplier involvement in radical innovation projects and their performance. The comparative research design was also considered as it would make it possible to examine contrasting cases, using more or less identical methods. This research design would for example make it possible to compare cases where suppliers are involved and not involved. This research design is quite similar to cross-sectional research design in terms of reliability, validity, replicability and generalizability, as it is essentially two or more cross-sectional studies carried out more or less simultaneously (Bryman 2016). Therefore, the choice of cross-sectional research design over a comparative research design was due to personal preference instead of criteria for evaluation of social research.

After starting the research and getting to the point where it was time to collect data, it proved to be difficult to find multiple cases to analyze. At the end I was only able to find one person to interview, leading to the research design ending up being a case study. A case study is a detailed and intensive analysis of a single case (Bryman 2016). The subject in this case was a person who has held management positions in companies ranging from start-ups to mature organizations. Although the case study was not my preferred research design, it is still a viable design due to the experiences of the subject. This approach allows me to document the participant's experience, interpretations and understanding on the topic based on experiences throughout the individuals career.

3.2 Research Method

A research method is a technique used to collect data. There are a wide variety of research methods that can be used when conducting a research. What research method to use usually depends on the research strategy and design chosen for the particular study. Bryman (2016) considers qualitative, quantitative and mixed method research strategies to be the three main types of research strategies.

Qualitative and quantitative research strategies have for quite some time been the two dominating strategies when conducting a research. The main difference between them is that quantitative research mainly deals with quantified or quantifiable data, while qualitative research emphasizes words in the collection and analysis of data (Bryman 2016). Mixed research methods on the other hand, is a research strategy that has emerged in recent years and combines qualitative and quantitative methods. The research strategy chosen for this study is a qualitative research strategy.

Using qualitative methods when conducting a research is a good way of understanding the subjective meanings held by actors. It is also an approach that allows for more exploration and will often provide rich and detailed answers than what a quantitative method would do. Furthermore, the flexibility provided by qualitative methods might also lead to emergence of important issues that the researcher might not have thought about (Bryman 2016). There are many types of methods used when conducting qualitative research, the most common once being qualitative interviewing, focus groups, ethnography, conversation analysis and documentary analysis (Bryman 2016). The method chosen for this study is a semi-structured interview, which together with the unstructured interview make up what is considered a qualitative interview.

The semi structured interview is a method where the researcher has an interview guide with a list of question to cover, but where the questions may not follow on exactly as outlines on the schedule (Bryman 2016). Furthermore, this method also allows the interviewer to ask questions that are not on the guide. This often occurs when the interviewer picks up on things said by the interviewees. The reason for choosing the semi-structured interview instead of the unstructured interview is that I have a clear focus on what to investigate and that I knew the specific issues I wanted to address. Unstructured interview would be more beneficial if I just had a general notion of doing research on the chosen topic. Furthermore, this method also provided me with a good structure, while having flexibility.

3.3 Literature Review

A literature review is usually the next step in a research project after identifying the topic of interest. It is a good way of finding out what is already known about the topic of interest and provides an understanding of concept, theories, inconsistencies and unanswered questions related to the topic (Bryman 2016). Literature reviews can be conducted as either a systematic or narrative reviews. Systematic reviews are well planned reviews, with the aim of generating unbiased and comprehensive accounts of literature through a replicable, transparent and scientific process. This is not the case for narrative reviews, who often appear haphazard and aim to give an overview of the field of study through a limited search for the most interesting contributions.

The literature review in this study was conducted as a narrative review. The main reason for this is that time and resource limitations make some of the elements of a systematic review unsuitable for a Master's thesis (Bryman 2016). This is not to say that some elements of the systematic literature review have not been used in this study. One element of the systematic literature review that has been

useful when conducting this study is a meeting with my supervisor in the early stages to define the boundaries of the subject. In addition to this, I did not know what to examine within the field of supplier involvement in NPD when I started this study. This made the broad understanding gained by conducting a narrative literature review very useful, as I used it as a springboard to identify research questions for this study. This led me to chose the topic supplier involvement in radical innovations, due to the inconsistencies identified in the literature.

I started the literature review by finding literature about supplier involvement in NPD. This was not a problem, considering the fact that a lot of research have been conducted within the field the past 30 years. I was able to find a lot of material by using Google Scholar and searching for the keyword "Supplier involvement in new product development". As I read through some of the most interesting literature within this topic, I was able to identify supplier involvement in radical innovations as something I wanted to investigate more. Finding literature became increasingly difficult after narrowing down the topic, as most of the research related to supplier involvement in NPD was related to incremental innovations. Therefore, in addition to searching for the keyword "supplier involvement in radical innovations", I started searching for "supplier involvement under conditions of technological uncertainty". This provided enough material to get a good overview of the topic. In terms of literature regarding radical innovation, materials from different courses I had as a student at NTNU were used.

Although the literature review might not have been as thorough as it would have been if it was a systematic review, it was still comprehensive enough for me to get the necessary understanding to conduct the study.

3.4 Data Collection

The next step after conducting a literature review and identifying the research questions is collecting data. Data collection is the gathering of data from a sample to be able to answer research questions. The sampling of participants in this study was done through purposive sampling. Purposive sampling is a form sampling where the researcher samples participants in a strategic way, rather than on a random basis (Bryman 2016). What this means is that I have contacted participants that I believe are suitable, with my research questions in mind.

3.4.1 Selection Process

The research questions of this study are related to radical innovations, the necessary organizational conditions for their success and benefits of involving suppliers in NPD. These questions were going to be used to answer whether suppliers should be involved in radical innovations or not. What this meant is that the participants must have experience working in an innovative environment. Furthermore, it was important that they did not only work in start-ups focusing solely on radical innovation, but in organization where both radical and incremental innovations were developed. The reason behind the last criteria is that it those participants would be able to give a more comprehensive answers related to the necessary organizational conditions for the success of radical innovations, in an environment where they are competing against incremental innovation, in addition to general answers related to the involvement of suppliers in NPD.

With these criteria in mind, the target participants for this study were business developers/managers, supply chain managers, innovation managers and others in management positions in some of the most innovative companies in Norway. Contacting these people was a very time consuming and challenging process. The

biggest challenge was finding the contact information of these employees, whose contact information was not available due to procedures employed by the companies they work in. Although this was the case, I was able to get the contact information of many potential participants by contacting HR employees, asking representatives of the companies at career fairs and by using contacts I had in the companies. The next challenge after contacting them is the lack of response. Out of the 19 potential participants contacted, only four responded. Although this was disappointing, it was also not surprising as many of them had top management positions with a busy schedule.

One of the four respondents did not have time for an interview. This led me to me having three potential participants, whom I explained the aim of the thesis and the topics the interview would cover. This is where the next challenge occurred. All of them worked in mature organizations producing physical goods, in slowly evolving industries. What this meant is that radical innovations were not something they were concerned about and dealt with. This meant that although they were branded as some of the most innovative companies in Norway, it was due to their incremental innovations. However, they suggested contacting people who worked in telecommunication and bank and finance industries. This was something I had done previously, but I ended up reaching out to more companies without success. In addition to this, I also started contacting people working in other countries. I used LinkedIn premium to search for and contact people who worked with radical innovation. The response rate when using LinkedIn was higher than using e-mail, but their responses was that they were not interested.

At this stage, a lot of time had gone to trying to find participants without success. This led me to turning to my supervisor for help, who managed to find me a participant. Although it was only one participant, this was someone who had held

management positions in four companies ranging from start-ups to mature organizations, operating in different industries. Furthermore, the person had extensive experience working with both incremental and radical innovations. I agreed to present the data in this study anonymously. Therefore, personal information and the companies the participant has worked in have been left out intentionally. According to Yin (2017), this is something that is necessary to achieve anonymity, while it also is undesirable, as it neglects background information. At the same time, I believe it is possible to present the necessary information while making sure the data cannot be traced back to the participant.

3.4.2 Preparation

The preparation for the potential interview was conducted while possible participants were being contacted and the interview guide was finished two month before the interview was conducted. Considering the fact that the chosen method for this interview was a semi-structured interview, it had some questions that covered the issues to be addressed. The issues to be addressed in this case were the research questions for the study.

When formulating the questions for the interview guide, the guidelines presented by Bryman (2016) were used. The steps used can be seen in Figure 3.1 and start by the identification of the general research and the specific research questions. This was something that was done before starting the preparation for the interview. Therefore, the first step when preparing for the interview was the identification of the interview topics. The interview was divided into the topics innovation, supplier involvement in NPD and supplier involvement in radical innovations. The first two topics were introductory topics covering innovation, radical innovations, the necessary condition for their success and the benefits of supplier involvement in NPD. This was then followed by the last topic that would have question seeking

an answer to the main research question, whether suppliers should be involved in radical innovations or not. After the division of the topics, questions were formulated and revised several times before the final guide was completed. The interview guide is attached in the Appendix.

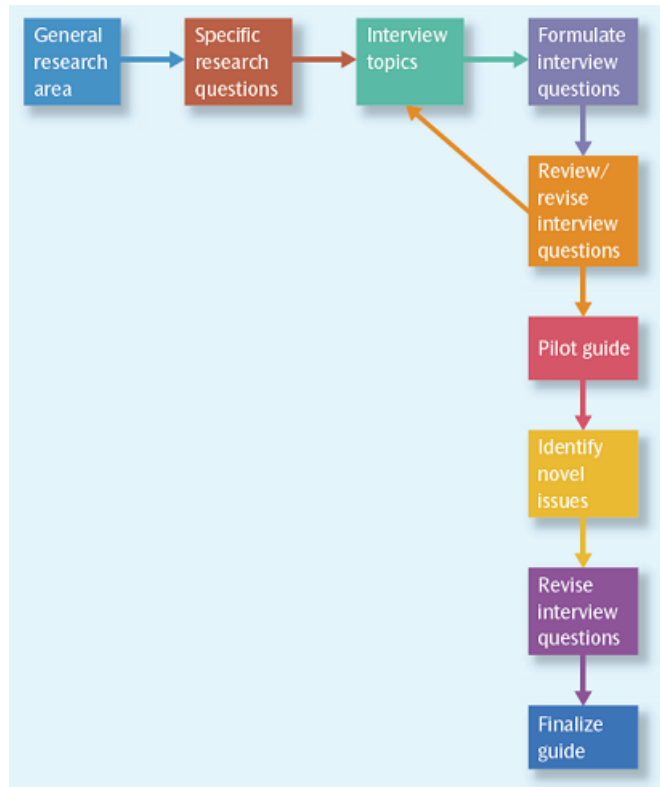


Figure 3.1: Formulating questions for an interview guide (Bryman 2016) (p. 476)

3.4.3 The Interview

The interview with the participant was conducted on Skype. The reason for this was that this was much more convenient for the subject, given a busy schedule. Although face-to-face interview is more common than Skype/telephone interview in qualitative research, there is evidence that there are not many differences in the responses one gets when conducting the interview on Skype rather than in person

(Bryman 2016). At the same time, it is important to be aware of some issues related to the use of Skype in qualitative research. These include the inability to observe body language, technical difficulties and the fact that it is easier for the subject to terminate a telephone interview compared to an interview conducted in person. This was something I was aware of and do not believe it caused any problems during the interview.

The interview lasted an hour and started out with me introducing my self, my topic and the definition of radical innovations and suppliers. This followed by me asking introductory questions followed by questions related to the different topics. Due to the flexibility and "rambling" allowed by a semi-structured interview, most of my questions were answered without me asking them and in a different order than in my interview guide. Furthermore, I was also able to follow up leads and clear up inconsistencies in answers during the interview. In general I would say the interview went very well. The interviewee was talkative and it was very clear that this person had a lot of knowledge about the area of interest.

3.5 Data Analysis

Data analysis is the management, analysis and interpretation of data (Bryman 2016). This sub-chapter will therefore describe what has been done to manage, analyse and interpret the data gathered during this study.

In terms of the management of the data, the interview was conducted without using recording tools. Recording the interview would have had some benefits, but I was not able to record it due to privacy issues. At the same time, I was able to take notes during the interview, while also paying attention to the interviewee. Furthermore, I was also able to revise the notes immediately after the interview to make sure I did not leave something out.

Following the interview, the collected data was grouped into categories. This categorization is what Bryman (2016) describes as coding and is used to build the empirical data chapter. This data was then later interpreted in the analysis and discussion chapter using the theoretical framework developed in the theoretical background chapter. My approach to interpret the data has been linking the empirical data to one and more theoretical propositions to see if the data was confirms the propositions.

3.6 Evaluation of the Research

Reliability and validity are important criteria when evaluating quantitative research (Bryman 2016). Their relevance in qualitative research on the other hand, has been a source of discussions and disagreements. Bryman (2016) presents two different stances researchers have taken in relation to these issues; adapting reliability and validity for qualitative research or alternative criteria for evaluating qualitative research. The research in this study will be evaluated based on the alternative criteria for evaluating qualitative research. This alternative was proposed by Lincoln and Guba (1985) and considers trustworthiness and authenticity to be primary criteria for the assessment of qualitative study. The focus of this evaluation will be the trustworthiness criterion, as authenticity is used to measure the wider political impact of research, something that is difficult for me to assess.

Trustworthiness of a research is assessed by considering four criteria. These four criteria are credibility, transferability, dependability and confirmability. It is these four criteria that will be used to assess the research in this paper.

3.6.1 Credibility

Credibility is the equivalent of internal validity in quantitative research and is concerned with how accurately the account represents the participants' realities of

their social life (Lincoln and Guba 1985). Credibility is something that can be achieved by following good practice when conducting the research and by submitting the findings to the participants to make sure there are no misunderstandings.

Conducting a research project was something I had little experience with prior to starting this study. I have therefore conducted this research using the syllabus in the course TIØ5225 - Project Management, Specialization Course at NTNU and the book *Social Research Methods* by Bryman (2016). I have followed the different steps and practices taught in TIØ5225 and described by Bryman (2016), to make sure the research is conducted by following good practice. I believe this is something I have managed to achieve, leading me to eliminate bad practice as a source of reduced credibility.

In terms of getting feedback from the participant of this research to confirm that there are no misunderstandings in the finding, this is not something that has been done. The main reason behind this is that I did not have time to get the participant's feedback before submitting the thesis. It is therefore difficult to establish whether the participant finds the findings credible or not. This is unfortunate as it might affect the trustworthiness of the research. The general feeling I got when conducting the interview was that most of the answers I received were quite straightforward and difficult to misunderstand. In the few cases where I was unsure if I understood the answer or not, interpreting questions were used to verify my interpretations.

In general, the best way of establishing the credibility of this study is by presenting to the participant, to make sure there are no misunderstandings. This was something that was not done, making it valid to question the credibility of this study. At the same time, the research was conducted using different practices presented in TIØ5225 and by Bryman (2016). This reduces the chances of misunderstandings, increasing the credibility of the analysis, formulations and interpretations.

3.6.2 Transferability

An assessment of the transferability of a research is the consideration of how well the findings apply to other contexts (Lincoln and Guba 1985). This is the equivalent of external validity in quantitative research and might be an issue in qualitative research, due to the fact that qualitative research is concerned with depth, instead of breadth (Bryman 2016).

A factor that affects the transferability of the findings in this study is the fact that there was only one participant. This makes it difficult to get insights from a group of people with a wide range of experience from different companies and industries. At the same time, the findings are based on the participants experience from different industries and companies, which increases the transferability of the finding. This is not to say that the transferability of findings based on experiences from 10-30 years ago cannot be questioned. Findings from a context do not necessarily hold in the same context at another time (Bryman 2016).

The lack of response when conducting this study has led to me not being able to collect as much data as I wanted to. This resulted in me relaying on the experiences of one participant, over a long period of time. I believe this reduces the transferability of some of the findings. At the same time, I still believe some of the findings are transferable to many contexts.

3.6.3 Dependability

Dependability of a research is concerned with how well the research process was followed and documented (Lincoln and Guba 1985). A study with a good dependability will produce the same findings, interpretations and conclusions, if other researchers follow the documented process.

A way of increasing the dependability of a research is keeping complete records of

what has been done during research process. This is something I have done in this chapter, where I have documented everything I have done while conducting this study. In theory, this means that the same results should be achieved by following what I have done. Whether this is the case in practice or not is difficult for me to establish. Lincoln and Guba (1985) suggest that dependability can be ensured by a third party auditing the research. Although this might have been beneficial for this study, it seems excessive Master's thesis.

3.6.4 Confirmability

The last criterion used to establish the trustworthiness of a piece of research is confirmability. It is concerned with ensuring that the researchers has not overly allowed personal bias to sway the conduct and the findings of the research (Lincoln and Guba 1985). Bryman (2016) acknowledges that achieving complete objectivity is impossible in social research. Although this is the case, it is important to be as objective as possible when conducting research.

This was something I was aware of prior to starting the research process. I was therefore aware of my biases throughout the whole process and made sure they did not influence the way I conducted my research. I would therefore consider the confirmability of the study to be good. At the same time, Lincoln and Guba (1985) suggests that confirmability should be established by auditors. Like mentioned earlier, this is something that seems unnecessary for a research project with a small scale like this.

3.7 Personal Reflections

Although I had written a Bachelor's thesis before, this was the first social research project I have been involved in. As a result, I had little knowledge about how to conduct social research prior to starting my last year as a student. The knowledge I

acquired through the course TIØ5225 was therefore useful as a starting point when developing this study. By using this knowledge and reading the book by Bryman (2016), I believe I have managed to get a good understanding of how to conduct a research project.

Although the research process was challenging at times, I enjoyed it and felt that I learned a lot. The biggest challenge during this study was finding participants for the interview. It was difficult because of two reasons. The first reason was that most of the potential participants were people in management positions with a busy schedule. The other reason was that I wanted to interview people who has worked in established organizations, dealing with both incremental and radical innovations. This would help me answer some of my research questions, but it was not really necessary to answer the main research question related to whether supplier should be involved in radical innovations or not. It might have been easier to find participants, if I formulated the research questions differently and focused less on the importance of radical innovations in mature organizations. This would allow me to also focus in start-ups, where it might have been easier to find participants. At the same time, I believe this is an important question to raise and was a topic of interest for me.

Apart from not being able to find more participant, I was satisfied with the research process. The quality of the study is not perfect and could be improved as discussed in the previous sub-chapter. At the same time, I have tried to follow the steps and practices described by (Bryman 2016) to the best of my abilities and in accordance to what it appropriate for a Master's thesis.

Chapter 4

Empirical Data

This chapter will present the empirical data collected during this study. The interviewees personal information and the companies the person has worked for are given fictional names to ensure anonymity.

4.1 Background

Mary has an engineering background and have been working in various companies and industries for over 30 years. She has held various positions ranging from analyst to several management positions. When considering the S-curve of organizational evolution mentioned in section 2.1.1, Mary has worked for companies that cover all the stages of the S-curve. An overview of the different companies and industries can be seen in Table 4.1.

She started her career in the energy industry, where most of her work was in the intersection between technology and commercial issues. She started out in company Alpha, which was a mature organization that had been around for quite sometime. As an analyst in this company, she was involved in some of the projects with the

Company	Industry	Role
Alpha	Energy	Analyst
Beta	Energy	Management
Gamma	Finance	Management
Delta	Finance	Management
Epsilon	Finance	Management
Zeta	Software	Management
Eta	-	Management

Table 4.1: The interviewees professional background

highest technological risk. Following her tenure in Alpha, she switched to a management position in company Beta. Although Beta was not as old as Alpha, it was also a mature organization. During her time in Beta, she worked on business development of different technological solutions.

The next chapter of Mary’s career was in the finance industry. She held top management positions in companies Gamma, Delta and Epsilon. Gamma and Delta were mature organizations, while Epsilon was in the middle stages of the S-curve for organizational evolution.

Following her tenure in the finance industry, she switched over to company Zeta in the software industry. Like Epsilon, Zeta was also a company in the middle stages of the S-curve describing organizational evolution. The company went through the process of repositioning in terms of market and innovation focus during her time there.

In addition to working in companies in the middle and late stages of the S-curve of organizational evolution, she has also worked in a start-up. Eta is a start-up where

the goal is creating a new market based on a breakthrough technology.

4.2 Importance of Radical Innovations

As Eta is a start-up, it goes without saying that radical innovation is important for the company. Although the ways to compete are different in the energy, finance and software industries, it is fair to say that there is a lot of competition in these industries. The established companies Mary has worked for have therefore also used radical innovation as a means to stay competitive.

The energy industry is the biggest and most important industry in Norway. It comprises of big and established companies who compete to get licences. This is then often followed by partnerships with other companies to develop projects and fields. Innovation is important to get a competitive advantage in this industry. Although incremental innovations are predominant in this industry, radical innovations are sometimes needed. A good example of this is one of the projects Mary was involved in while she was in Alpha. Alpha managed to solve a difficult technical challenge through a breakthrough innovation to secure a partnership deal.

The finance industry is also an industry with a lot of competition. Competition in this industry is posed by both national and international actors. This industry was not very vulnerable for disruption during Mary's time in the industry, making incremental innovations the predominant type of innovation. This has changed with the digital development the past 10-15 years, allowing new actors to take position they were unable to take before.

Another very competitive industry is the software industry. The systems Zeta developed were very comprehensive, leading to high exit barriers for the customers. It is therefore fair to say that getting the customers was the difficult part, not keeping them. This allowed the company to take strategical positions. At the same

time, the technological development the last five years of Mary's time in Zeta, led to a lot of new actors entering the market. They were solving the problems Zeta was solving in a different way. In addition to the incremental innovations the company was developing, radical innovations were therefore important to move some parts of the company to the earlier stages of the S-curve and extend the life of the company.

Based on Mary's experience throughout her career, there is no doubt that innovation is important to achieve a competitive advantage. The development the past 10-15 years in terms of computing power and cloud-based solutions is enabling the use of AI and machine learning. This has led to new actors being able to take positions that they were unable to take in the past, in a very short time. This has increased the competition for industries using digital solutions, while traditional industries where physical products are produced might not need to worry too much about these issues.

4.3 Promoting Radical Innovations

Mary believes that the digital development the past 10-15 years has made radical thinking very important to survive. She believes that an ideal culture is an important factor for the promotion of radical innovations within organization. At the same time, achieving an ideal culture that promotes radical innovations is something she thinks is rare, unless the company is a start up. Most established organizations have a mixed culture. This will put more pressure on the management to facilitate the promotions of radical innovations and their success.

From Mary's point of view, a culture of innovation promoting radical innovations is a culture where individuals in the organization wish and are able to be curious about new things. It is therefore important to have curious and courageous em-

employees who are willing to take risks. This is something that comes with a cost and must be supported by the management and organizational culture. Some of the new products or services a company is developing might end up competing against existing products or services. Based on her experience, this competition is not only directly between products or services, but also in terms of resources and capital. This competition is something the culture must be able to withstand and accept. Another interesting thing that Mary mentioned based on her experience is that, not having time/slack is seldom a problem with a good culture for innovation.

In terms of how to conduct radical innovation projects in mature organizations, she has experienced the best results by conducting them like smaller companies. She mentioned lean start-ups, where products are developed through a feedback loop of building, testing in the market and learning. Start-ups use this method because of lack of resources, but it is also useful for mature organizations to reduce the risk of innovation. In addition to this, although she thinks it is important to assign curious individuals that are willing to take risks in these project it is important that the team is not homogeneous. The radical innovation project she has experience with have also had a lot of autonomy, with management usually only getting directly involved during milestones. Otherwise, the managements main responsibility is to make sure the projects are protected from organizational antibodies.

4.4 Supplier Involvement in NPD

Supplier involvement is something that has been common in all the industries and companies Mary has worked in. Although this is the case, the extent of involvement and nature of involvement is different from industry to another.

The energy industry were early out when it comes to involving suppliers. Like mentioned earlier, partnerships have been common for quite some time. Mary has

experience getting involved as a supplier while working in Alpha and involving suppliers as a customer in Beta. The customers competed to get licences, then involved suppliers to develop their fields and project. The suppliers in the energy industry were often responsible for developing technologies that made it possible to solve different problems.

The main type of suppliers used in the finance industry are IT suppliers. Unlike the energy industry, these suppliers were not expected to develop new technology or products. Companies in the finance industry rely heavily on the IT systems delivered by their suppliers to adjust, customize or develop their products and services. This gave the suppliers a big impact on the companies ability to develop new products or services. It was therefore common to involve the suppliers in NPD, as the development of products or services that were not compatible with the IT systems would be waste of time.

Based on Mary's experience, the software industry used a partner model where suppliers were involved in NPD in two ways. The first way of involving suppliers is by making them responsible for the delivery of a part of a total service. This was something Mary has a lot of experience with, as Zeta's customers often made the company responsible for the delivery of some parts of the services they developed. Another way of involving suppliers in the software industry was to involve them the in development of software, where suppliers would be involved in the programming the software.

In terms of which suppliers to involve in NPD, it depends on the product or service being developed. Based on Mary's experience, both long-term and new suppliers have been involved in the companies she has worked for. In general, she would say that involving long-term suppliers is more beneficial as it means that the customer and suppliers know each other well and how to work together. At the same time, it

might sometimes be beneficial to involve new suppliers, specially when working on radical innovations. A good example of this is when Zeta started with Machine learning. This was something their previous suppliers has little knowledge about, which led to the company involving new suppliers.

4.5 Benefits and Drawbacks of Supplier Involvement in NPD

Mary's overall experience related to the involvement of suppliers in NPD is that it has more benefits than drawbacks. This is especially the case when supplier are integrated into the project and the customers organization. Integrating suppliers into the project and organization is also not something she has experienced as challenging and has usually not been a problem in all of the companies she has worked in. At the same time, she believes that the software industry is where it is easiest to integrate suppliers, as the suppliers being involved have the same educational backgrounds are the customer's employees.

When asked about the advantages of involving involving suppliers in NPD, Mary pointed out new competences, new ideas and flexibility. All of these advantages are beneficial in in incremental NPDs, but might be even more beneficial in radical NPDs. New ideas and competences are needed when working on radical innovations to be able to develop breakthrough products or services. Flexibility in terms of outsourcing a service or part of a product, instead of doing it in house will also offer risk reducing benefits in projects with high technological uncertainty.

In terms of the drawbacks, Mary has not experiences many of them. The only drawback she mentioned is knowledge leaving with the suppliers when the project is over. She considers knowledge and competence transfer to be challenging, specially for when the customer does not gave individuals that understand what the supplier has been doing during the project.

Involving suppliers have been common in all of the companies Mary has worked in. This is the case for radical innovations, as well as incremental. When asked whether suppliers should be involved in radical innovations, her answer based on her experiences was that they should be involved. The only cases she thought involving suppliers in radical innovations might be a bad idea, was when patents are involved. But projects like this was not something she had experience with.

Chapter 5

Analysis

The purpose of this chapter is analyzing and discussing the empirical data presented in the previous chapter, using the theoretical framework developed in the theoretical background chapter. The theoretical framework presented in Table 2.1 is divided into two topic; innovation and supplier involvement in new product development. These two topics have three propositions each that will be investigated in this chapter. This chapter will have the same breakdown as the theoretical framework, with two sub-chapters that have three sections each.

5.1 Innovation

The three propositions analyzed under the innovation topic are related to the importance of radical innovations and the necessary organizational conditions to promote and help them succeed.

5.1.1 Radical Innovations in Mature Organizations

PI: Mature organizations should pursue both incremental and radical innovations to extend their lives.

This proposition is based on the fact that most industries today are very dynamic. As companies evolve from being new to mature, it is not surprising that they focus more in capturing value from their breakthrough innovations through incremental innovations. They also tend to build up both cultural and structural inertia, favoring incremental innovations throughout this evolution. At the same time, the dynamic environment many companies operate in requires them to be ambidextrous, as solely focusing on incremental innovations or fighting radical innovations has led to the fall of many great and well managed organizations.

The empirical data regarding the nontraditional industries in the previous chapter supports this proposition. This is evident in the finance and software industries, where the digital development the past 10-15 years has led to more competition and dynamics in the industries. The finance industry was not vulnerable for disruptions while the Mary worked in the industry, but it was her conception that this has changed the past years. This was further supported by some potential participants that were contacted during this study, who suggested contacting people from the finance industry.

Mary's experience in the software industry is perhaps what provides the best support for this proposition. Zeta pursued incremental innovations to improve their systems and satisfy their customers. While doing so, the company also worked on radical innovations. The radical innovations were used to move some parts of the company to the earlier stages of the S-curve for organizational evolution. This helps extend the life of the company, as the company will have parts of its business

in the early, middle and late stages of the S-curve.

An important point made by the participant is that traditional industries, producing physical products might not need to worry too much about focusing on radical innovations. This seems to be the case for the energy industry, where incremental innovations are the predominant type of innovations, while radical innovations were important to get a competitive advantage in the early days of the industry. This was also supported by some potential participants contacted during this study. Although they worked in companies in traditional industries, branded as some of the most innovative companies in Norway, their response was that radical innovations were not something they focused on.

To conclude, focusing on both incremental and radical innovations is important in dynamic industries that are changing all the time. These industries are specially the once affected by the digital development the past 10-15 years. Traditional industries producing physical products on the other hand, do not seem to focus much on radical innovations. This is mainly because their industries are not changing with the same pace as the nontraditional industries.

5.1.2 Organizational Culture Promoting Radical Innovations

P2: Organizational culture promoting radical innovations is important to be able to not fall into the trap of just focusing on incremental innovations.

Organizations that want to be ambidextrous and pursue both incremental and radical innovations must engage in paradoxical thinking to balance their portfolios with both incremental and radical innovation projects. There are different suggestions for how to achieve this balance, one of them being the internal marketplace for innovations suggested by Davila et al. (2012). At the same time, various methods that can be used to deal with the paradox of exploitation and exploration will

face challenges, unless the issue of cultural and structural inertia is dealt with. This proposition is therefore based on the conclusion that it is important to have an organizational culture that promotes and accepts radical innovation to be able to be ambidextrous.

The literature states that a culture promoting innovations through incentives, slack in the employees work schedule and patience are important to promote radical innovations. The importance of culture to be able to promote radical innovations is also evident in the empirical data. Nevertheless, the participant in this study believes that the most important characteristic of a culture promoting radical innovations is having curious employees who wish and are allowed to take risks. Although not said directly, it is fair to draw the conclusion that employees wishing and being allowed to take risks has something to do with incentives and patience from top management. Slack in the employees work schedule is something that is often considered to be important to promote radical innovations. Although Mary acknowledges this, her opinion is that this is not the most important characteristic of a culture promoting radical innovations. She believes that not having time will not be a problem if there is a culture of curiosity in organizations.

Having a culture of curiosity will help deal with cultural inertia, but the organizational culture must also be able to reduce the structural inertia to promote radical innovations. Based on Mary's experience, radical innovations will often compete against existing products/services in organizations. In addition to direct competition, they will also compete for resources and capital. Structural inertia will lead to a resistance towards allowing the radical innovation projects to get the resources and capital they need, in addition to favoring the existing products/services. According to Mary, a culture promoting radical innovations must therefore be able to withstand and accept the competition caused by radical innovations.

Based on the empirical data it is fair to conclude that culture is important to promote radical innovations. The participant believes that an organizational culture promoting radical innovations is, a culture of curiosity that is able to withstand and accept the competition between radical innovations and existing product/services.

5.1.3 Conducting Radical Innovation Projects

P3: Radical innovation projects should have low complexity in their stakeholder environment, while the project team should have a high level of autonomy.

This proposition is based on the model by Artto et al. (2008), describing the different contextual positions projects can have. Radical innovation projects are revolutionary projects aiming to renew the parent organization, by challenging organizational culture through radical ideas. To be able to achieve this, the project team should have the ability to explore the ideas they want, while being protected from organizational antibodies and conflicting stakeholder requirement. This suggests that radical innovation projects should have low levels of complexity in their stakeholder environment, while the project team should have a high level of autonomy.

In terms of how to conduct radical innovation projects in mature organizations, the participant had the best experience conducting them like smaller companies. This was done by using the lean start-up methodology, where products are developed through a feedback loop of building, testing in the market and learning. This is supported by Eisenhardt and Tabrizi (1995) who thought design iterations, testing, less time between milestones and authority to the project manager were more important than supplier involvement to reduce the development time of radical innovations.

This proposition is not about supplier involvement in radical innovations, but how to conduct them to facilitate their success. It is therefore important to understand

what it means to conduct these projects as smaller companies would do. Smaller companies consist of a small group of people working together to generate new ideas and develop and sell new products. What this means is that their stakeholder environment has low levels of complexity. Furthermore, they will also have a lot of autonomy as they are small group of people working together. Therefore, a mature organization wanting to conduct radical innovations should assign a small group of curious individuals to these projects. Although curiosity is important, Mary points out that they should not be homogeneous. The project team should also have a lot of autonomy, just like the individuals in smaller companies. This is supported by Mary's experience with radical innovations, where she points out that the management was usually only involved during milestones.

The empirical findings support this proposition, suggesting that mature organization should conduct radical innovation projects like small companies would do. Small companies consist of small group of individuals working together to generate new ideas and develop new projects. The complexity in their stakeholder environment of the companies is low due to their size. Furthermore, these companies will also have a flatter structure with a lot of autonomy for the individuals involved in the companies.

5.2 Supplier Involvement in New Product Development

The last three proposition that will be analyzed are under the topic supplier involvement in NPD. The first proposition is related to supplier involvement in incremental innovations, while the others are related to supplier involvement in radical innovations.

5.2.1 Supplier Involvement in Incremental Innovations

P4: It is beneficial to involve suppliers in incremental innovation projects?

Most of the literature within the field of supplier involvement in NPD have concluded that supplier involvement in incremental innovations is beneficial. The benefits include reduced development times, lower costs and better qualities. The purpose of this proposition is therefore to investigate whether the participant in this study agrees with this proposition based on her experiences.

Involving suppliers in NPD has been common practice in all of the companies Mary has worked in. Although the extent and nature of involvement is different, the empirical data suggests that supplier involvement has more benefits than drawbacks. One of the challenges pointed out in literature is related to integrating suppliers into the project team. This is something that has not been challenging in all of the companies the participant has worked in. This has something to do with the fact that the suppliers often had the same background as individuals in the companies Mary worked in. Furthermore, the buying companies often had long-term relationships with their suppliers and integrated them into the project and their organizations.

In terms of the benefits of involving supplier in NPD, the participant pointed out new competences, new ideas and flexibility as the benefits of the involvement. The literature related to supplier involvement in NPD considers reduced development time, reduced costs and better quality to be the main benefits of supplier involvement in NPD. One could argue that there is a correlation between the benefits mentioned by Mary and the benefits researchers have found. Development time can be reduced by adding new competences to the project team or by providing the project team flexibility by outsourcing some of the NPD efforts to suppliers.

Costs of NPD can be reduced through new competences, new ideas and with the flexibility of outsourcing some parts of the NPD to suppliers, which reduces the risk in case the project fails. Better quality on the other hand, can be achieved by new competences and new ideas added by suppliers.

The participant overall experience suggests that supplier involvement in incremental NPDs is beneficial, supporting this proposition. The only potential drawback mentioned by her was the possibility of not being able to transfer knowledge and competences when supplier leave. A potential solution to this issue mentioned by Mary was, making sure the buying company assigns individuals that understand what the suppliers are doing to work with the suppliers.

5.2.2 Radical Innovations using New-to-the-world Technologies

P5: Suppliers should not be involved in radical innovations using new-to-the-world technologies.

This proposition was made based the source of technological uncertainty in radical innovations, the characteristics of radical innovations and the necessary conditions for their success. The technology used in radical innovations is a big source of technological uncertainty. Among the technologies that can be used in products/services, developing new-to-the-world technologies for the purpose of radical innovation leads to the highest levels of technological uncertainty. Developing these technologies will require the project team to generate radical ideas and challenge organizational culture. To be able to do this, the project team should have a high level of autonomy and low complexity in their stakeholder environment. Involving suppliers would increase the complexity in the stakeholder environment, in addition to possibly reducing autonomy and leading to slower decision making due to conflicting stakeholder interests.

When examining the empirical data, the first and most obvious use of new-to-the-world technology is found during Mary's time at Alpha. Alpha was a supplier in this case and developed a new technology to solve a difficult technological challenge for a customer. This was a common practice in the energy industry, where the suppliers were often involved to develop new technologies or products for their costumers. Although this industry have relied more on incremental innovations than radical innovations lately, Mary worked in this industry in a time where radical innovations were necessary. Her overall impression of involvement of suppliers in radical innovations was that suppliers were always involved.

In terms of the finance industry, the companies in this industry relay heavily on the IT systems delivered by their suppliers. The new products or services developed by these companies must be compatible with these IT systems. Based on Mary's experience, this made it necessary to involve suppliers in radical innovations. Therefore, weather the technology is totally new or not did not have a lot of effect on the involvement of suppliers, as developing radical innovations that were not compatible with the IT systems provided by the suppliers would be waste of time.

Just like the finance and energy industries, involving suppliers in the software industry was also a common practice. The companies in this industry either outsourced some parts of their NPD effort to suppliers or involved their suppliers in the coding process of software development. Based on Mary's experience, whether the innovations were incremental or radical had no effect on this process. The same can be said about whether the technology was new-to-the-world or not. In fact, outsourcing parts of the NPD when the technological uncertainty was very high was used as a means to reduce the risk.

Overall, it is fair to say that the empirical data does not support this proposition. It

is evident that suppliers were involved in all of the companies and industries Mary has worked in, when dealing with new-to-the-world technologies. The suppliers who were involved were usually long-term partners, but also new suppliers when it was necessary. One interesting thing mentioned by her was that it might be beneficial to not involve suppliers when dealing with patents. This is very relevant in terms of new-to-the-world technologies, but it was unfortunately something she did not have any experience with.

5.2.3 Radical Innovations using existing Technologies

P6: Suppliers with knowledge about the technologies, should be involved in radical innovation projects using technologies that are new to the company, but not the world.

Contrary to the previous proposition, the technology used in this case is an already existing technology. This type of projects will have a lower technological uncertainty due to the exiting information about the technologies. This uncertainty can further be reduced by involving suppliers that have knowledge about the technology. Furthermore, the involvement of suppliers with the right knowledge will also mean that the project team will not need to "reinvent the wheel". The trade-off here will be reduced autonomy and a more complex stakeholder environment. At the same time, the benefits in terms of better quality and reduced development time and costs seem to outweigh the drawbacks.

Out of the industries the participant in this study has worked in, the energy and software industries are the relevant industries for this proposition. The suppliers involved in the finance industry were involved because of the IT systems they delivered and did not have anything to do with the development of the technologies needed for the innovations.

The finding from the energy and software technologies support this proposition. The suppliers in the energy industry were responsible for the development of the technologies or products needed to solve different problems. They were therefore involved based on their knowledge and capabilities related to the necessary technology. There is also evidence in the empirical data from the software industry supporting this proposition. Although Zeta usually involved long-term suppliers, they were forced to involve new suppliers when starting to work with machine learning. This was something their previous suppliers did not have knowledge about, leading Zeta to find and involve new suppliers with the necessary knowledge.

To conclude, the empirical data supports this proposition in line with the participants' overall impression that suppliers have been involved in all types of projects in the companies and industries she has worked in. Based on Mary's experience, knowledge about technologies has been an important factor when selecting suppliers to involve in the energy and software industries.

Chapter 6

Conclusion

The objective of this study was to get a thorough understating of radical innovations and the potential effects of supplier involvement in radical innovations projects, to be able to determine if suppliers should be involved in these projects. For this purpose, the research in this study was guided by the following main research question:

Should suppliers be involved radical innovation projects?

Since innovation is considered to be a change process in this study, the focus of this research has been mature organizations. When evolving from new to mature, organizations often shift focus from exploration to exploitation. This is a natural transition, as it is important to capture value from breakthrough innovations. The consequence of this is that incremental innovations become the preferred type of innovations in these organizations. This is due to the destructive side of radical innovations, in addition to the cultural and structural inertia that is developed during this evolution. At the same time, most industries today are dynamic and very competitive. This is especially the case for industries that have been affected by the

digital development the past 10-15 years. This development has allowed new actors to take positions they were previously unable to take in a short time. This calls for organizational ambidexterity, by simultaneously pursuing both incremental and radical innovations. Incremental innovations will help capture value from previous breakthrough innovations, while radical innovations move some parts of the organizations to the earlier stages of the S-curve for organizational evolution. This will help extend their lives and make them prepared for the threat of disruption.

Since the evolution of organizations from new to mature favors incremental innovations, organizations who wish to be ambidextrous must be able facilitate the right conditions to also promote radical innovations. The finding in this study suggest that culture is the most important factor affecting the promotion of radical innovations. Organizations with a culture of curiosity, where employees wish and are allowed to take risks are more likely to be ambidextrous. Not only will they be able to engage in paradoxical thinking to balance their portfolios of projects with the right amount of incremental and radical innovation projects, they are also more likely to withstand and accept the internal competition caused by radical innovations. In addition to selecting radical innovation projects, the right conditions must also be facilitated while the projects are being conducted. The findings suggest that mature organizations should conduct radical innovations project like smaller companies do. This includes multiple iterations of building, testing and learning. Furthermore, the project teams are required to develop radical ideas and challenge organizational culture. They should therefore be given a lot of autonomy to be able to explore the ideas they want without restrictions. In addition to this, it is impossible to have a perfect culture where everyone supports radical innovations. It is therefore important to protect these projects from organizational antibodies trying to kill them. This can be achieved by keeping the complexity of their stakeholder environment low.

In addition to having to be ambidextrous, organizations operating in dynamic and competitive industries will also need to improve the performance of their innovations. Since research within the field of supplier involvement in NPD started, most researchers have concluded that supplier involvement in NPD has a positive effect on the performance of the products. The three main benefits identified are shorter development time, improved quality and lower costs. Although this mainly applies to research related to incremental innovations, the proponents of supplier involvement in radical innovations also believe these benefits can be achieved with radical innovations. This is supported by the findings in this study, where the identified benefits were new competences, new ideas and flexibility. These benefits are correlated with the benefits identified in literature and will contribute to achieving shorter development time, improved quality and lower costs.

One of the main differences between incremental and radical innovations is the level of technological uncertainty. Incremental innovations are a series of predictable steps, while radical innovations are unpredictable. The main source of opposing views regarding supplier involvement in radical innovation evolves around their unpredictability. The proponents of supplier involvement in these projects believe that the issues caused by technological uncertainty can be mitigated, while others disagree. At the same time, different radical innovations can have varying amount of technological uncertainty. This is something that depends on the newness of the technology used in products. Using new-to-the-world technologies in products will have the highest amount of technological uncertainty, while technologies that are new to the company but not the world will have lower levels of technological uncertainty.

The first four theoretical propositions in this study were related to radical innovations and supplier involvement in NPD in general. They were all supported by the

findings in this study and are summarized above. The last two were directly related to supplier involvement in radical innovations. They were based on the different sources of technological uncertainty, the characteristics of radical innovations and the necessary conditions for their success, and are as follows:

P5: Suppliers should not be involved in radical innovations using new-to-the-world technologies.

P6: Suppliers with knowledge about the technologies, should be involved in radical innovation projects using technologies that are new to the company, but not the world.

The findings in this study support proposition P6, while proposition P5 is not supported. What this means is that suppliers *should be* involved in radical innovations. This is also the case when using a technology that is new to the world. Suppliers can contribute with new ideas, competences and flexibility. Although these advantages are beneficial for incremental innovations, the findings also suggest that they might even be more beneficial for radical innovations.

6.1 Future Work

Several departure points for future research were unveiled during this study. Some of these departure points are related to the limitations of this study, while others were discovered when gathering data for the study. This section will therefore describe these topics, as I believe they are of interest for future research.

The first departure point for future research is, building upon this study and expanding it. It was difficult to find participant in this study, which ended up being limiting for both the methodology used in the study and transferability of the research. Therefore, future research might expand the scope of innovation to also

include innovation as an entrepreneuring process. This will open up more doors in terms of who can participate in the study. More participant will make it possible to use other research designs and will also likely improve the transferability of the research.

During the process of gathering data, a couple of interesting topics were also pointed out by the participant in this study. The first possible departure point for future research, unveiled when gathering data is conducting the same research with participant from tradition industries. Traditional industries producing physical goods, have not been affected by the digital developments the past 10-15 years to the same extent as the nontraditional industries. It might therefore be interesting to see if the answers to the research question and the sub-questions of this study would be the same in these industries.

Another interesting topic uncovered while gathering data is, the involvement of supplier when patents are involved. None of the companies the participant in this study worked in were dealing with patents. It would therefore be interesting to investigate the involvement of suppliers in radical innovations that can be patented.

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Sage publications.

Appendix

Interview Guide

Background Information

1. What is your educational and career background?

Innovation

1. How was the competition in the different industries you have worked in?
2. How important has innovation been to achieve a competitive advantage in the different industries?
3. What would you say are the most important measures to promote innovation and motivate employees to innovate?
4. From your point of view, how much focus should mature organizations have on radical innovations compared to incremental ones?
5. Which measures do you believe are important to promote radical innovations?
6. What kind of people should radical innovation project teams consist of?
7. Who has the decision-making power in these projects?
8. How should these projects be protected from organizational antibodies?

Supplier Involvement in NPD

1. How common would you say it is to involve suppliers in NPD in the different companies and industries you have worked in?
2. What kind of relationships did you have with the suppliers?
3. What measures did you use to integrate the suppliers into the projects?
4. How common was it to experience issues when involving suppliers in NPD?
5. What would you say are the advantages of involving suppliers in NPD?

Supplier Involvement in Radical Innovations

1. How often were suppliers involved in the radical innovation projects you have been involved in?
2. What determines whether you choose to involve suppliers or not?
3. Do you involve long-term partners or new suppliers?
4. Does the newness of the technology affect the decision to involve suppliers?
5. Does the high levels of technological uncertainty in these projects cause challenges?

