NO WAY THAT WILL FLY!

ORGANIZING THE FUZZY FRONT END OF RADICAL INNOVATION

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ABSTRACT

Today, the technology development is moving at a high speed. Companies today all work with innovation to some extent, and some companies also engage with radical innovation. Radical innovation is, according to many scholars, an area that needs different development methods and processes than those for incremental innovation. In order to understand how radical innovation development is ignited, the Fuzzy Front End framework was constructed by Reid and Brentani (2004). The purpose of this paper is to investigate how the early stages of processes in radical innovation development, in large incumbent companies, can be constructed in order to successfully develop radical innovation. This was investigated through a qualitative study with the means of multiple case studies and expert consultation. Four findings have been obtained. The first finding reveals that the definition of radical innovation depends on which industries companies are in, and also what the technological competences of the companies are. Secondly, the advantages and disadvantages with radical innovation development that companies identify similarly depend on which industry and context the companies are in. The third finding suggests that companies should ease the flow of ideas between the environment, the individual and the organization. A model was constructed in order to highlight the path that radical innovation has to take in order to be realized. The last finding highlights the importance of the individual and stresses that the empowerment of individuals to develop projects that she has passion for while also restricting her less, will most likely increase the radical innovation development within the whole organization.

KEY WORDS

Radical innovation, *Disruptive innovation*, *the Fuzzy Front End* and *Organize the Fuzzy Front End.*

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LIST OF ABBREVIATIONS

CEO   Chief Executive Officer
CIO   Chief Information Officer
CTO   Chief Technology Officer
FFE   Fuzzy Front End
ICT   Information and Communications Technology
KTH   Royal Institute of Technology in Stockholm (Kungliga Tekniska Högskolan i Stockholm)
NPD   New Product Development
PhD   Doctor of Philosophy
R&D   Research and Development
ROI   Return on Investment
SUV   Suburban Utility Vehicle

1. INTRODUCTION

This chapter supplies a description of the purpose, followed by the background and introduction to the research topic. Finally, the research questions are presented.

1.1. PURPOSE

The purpose of this paper is to investigate how the early stages of processes in radical innovation development, in large incumbent companies, can be constructed in order to successfully develop radical innovation.

1.2. BACKGROUND

PWC (2016) writes that the road transportation industry is currently experiencing the most dramatic transformation since the T-Ford rolled out of the factory in the early 20th century. One contributing factor is the coalescing of vehicles and digital technology, which makes the connected car. The car will facilitate full integration with digital features such as Wi-Fi; infotainment systems and apps and vehicle-to-vehicle communications that enable the vehicles to "talk" to each other where basic safety data can be exchanged. This exchanged data includes among other things, speed and position; real-time location; routing based on traffic conditions; and networked web-links that assist vehicle diagnostics and repairs. The intelligent car is another factor, which is successively going towards autonomous driving. Today, functions like self-breaking, self-parking, automatic cruise control based on road conditions, automatic accident-avoidance features, computer-operated power steering, and electric parking brakes, as well as electronic throttles and engine control are common appearances (PWC, 2016).

Volvo Group (hereafter referred to as 'Volvo') is one of the world's leading suppliers of commercial transport solutions, providing products such as trucks; buses; construction equipment; and drive systems for marine and industrial applications (Volvo, 2016). Thus, as a leading supplier, Volvo is challenged with the great transformation that the transport industry is going through and it is problematic for all suppliers in the industry to rely on small efficiency improvements or incremental innovations. This dilemma is also expressed in the name of the report by PWC (2016), "Automakers and suppliers can no longer sit out the industry's transformation". This is something acknowledged by Volvo and the company is taking action to maintain their position as a pro-active transport industry supplier. In January 2017 Volvo launched a new project called "The Innovation Garage" with the purpose of finding and developing new products that are too radical to fit into the standardized innovation processes. Volvo is recognizing the risk that good opportunities may be rejected because of formalized criteria in the common selection and evaluation processes. The Innovation Garage is one of several initiatives and will complement the existing standardized innovation processes. It will consist of a less rigid environment for the selection of new business opportunities and have a higher tolerance for risk; much like an innovation hub, as Leifer, Connor and Rice (2001) define it. The ambition of The Innovation Garage is to enhance the capability and

the probability of developing radical and disruptive innovation, in order to tackle the dramatic transformation of the industry, the [V1] Former Director of Technology Strategy & Innovation stresses.

As mentioned, the Innovation Garage is a newly launched concept and there are still many unanswered questions regarding the discovery and incubation phases of new radical ideas accepted onto the project. What is known, is the aim of accumulated learning in fields of emerging technology and in the best case transform them into new radical products. How to manage the early new product development (NPD) phases and what kind of scope The Innovation Garage will have, is a matter for discussion ([V2] Innovation Manager). This constitutes the context that this study is sprung from and the term that best describe the early phases of NPD is the Fuzzy Front End (Reid & De Brentani, 2004).

The study is performed in the context of multinational corporations. One main company, Volvo; eight case companies; and three experts within the field of innovation, have contributed in order to help answer the research questions.

1.3. RESEARCH QUESTIONS

Based on the background, the following main research question has been deduced:

- How to Organize the Fuzzy Front End of Radical Innovation?

To better understand the general topic of radical innovation it is decided to add two sub-questions. Before discussing any managerial issues connected to radical innovation, it is substantial to distinguish how literature and interviewees interpret the term. Similarly, it appears relevant to consider the potential advantages and the disadvantages with radical innovation development and how it relates to the corporate strategy.

Sub-questions:

- What is Radical Innovation?
- What are the Advantages and Disadvantages with Radical Innovation development?

1.4. RESEARCH OUTLINE

Introduction — Purpose, Background and Research Questions.

Theoretical Framework — Relevant Theories and Frameworks.

Methodology — Research Methodology.

Empirical Findings — Gathered data from Experts, Volvo and Case Companies.

Analysis — Comparison between Empirical Findings found in Theory, from Experts, from Case Companies and from Volvo.

Conclusion — Answers to the Research Questions and Future Research Suggestions.

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2. LITERATURE REVIEW

In this chapter, relevant theories for this study construed in previous research are presented. As introduction, the term radical innovation is defined. It is followed by the advantages and disadvantages with radical innovation development, including other strategic implications. Then, one large concept about radical innovation discovery is presented. Conclusively, a brief summary and summarizing model are disclosed.

2.1. RADICAL INNOVATION

The term radical innovation has attained great interest in theory, however, the definition of radical innovation or radical technology is not consistent in all publications; and by some scholars, not well defined at all (Dahlin & Behrens, 2005). In some cases, the radicalness of innovations is visually explained by graphs plotted along the axes of novelty in technology and level of market impact. In other cases, the term radical is explained by the dichotomy of radical and incremental innovation or synonyms to either of the terms (Dahlin & Behrens, 2005; Kristiansen & Gertsen, 2015; Markides, 2006; Pisano, 2015; Schilling, 2013). Radicalness could also be defined by metaphors, as in a report by Norman and Verganti (2014), who compare incremental innovation with hill-climbing, constantly reaching higher ground and reaching higher product quality. Eventually the incremental climbing will reach the top of the hill and the maximum product performance. The radical innovation process seeks out new hills that might be higher than the current hill, and thus enabling products to reach unexplored terrain and greatly improve the product performance (Norman & Verganti, 2014).

There are many ways to define radical innovation. In this section of the theoretical framework, the definitions that have deliberately been found will be explained, but also some of the definitions that have been stumbled upon during the construction of this paper. Finally, this section will conclude the definition that will be further used in the research.

2.2. WHAT IS RADICAL INNOVATION?

Schilling (2013) explains the relationship between incremental and radical innovation as a spectrum in which incremental innovation is placed on one end and radical innovation on the other. This makes a one axis relationship which, according to Schilling (2013), is dependent on the level of newness and differentness of innovation; the greater newness and discrepancy compared to other products, the more radical they are. However, there are no strict rules to which part of the spectra the innovation should be classified. The innovation can be new and different; to the world, to the industry, to the company or to the business unit. Thus the radicalness is dependent on who the observer is and in what context the innovation is applied. It can also be defined by the innovation's expected quality improvement or the potential advantage of a successful product launch. Slater et al. (2014) expresses the following; 'radical product innovation offers unprecedented customer benefits, substantial cost reductions, or the ability to create new businesses'. Time is a very important defining

factor acknowledged by Schilling (2013), who gives the example of the first steam engine that was truly radical when it was introduced but today the same technology is relatively simple. The radicalness of the technology of the steam engine-case shifts over time. Hence, what is radical today is not radical tomorrow. McDermott and O'Connor (2002) defines radical innovation as a significantly new technology or new idea to a non-existent market or to a current market that require dramatic behavior changes, and it should provide the foundation onto which future generations of products will be built upon. Similar to that definition, Kristiansen and Gertsen (2015) describe radical innovations as exploratory that may contribute to the future direction of the company. Though there is a problem with those definitions, as argued by Norman and Verganti (2014), when defining radical innovation by the future success-rate or the future dispersion. It is then impossible to define radicalness before the product is available in reliable and economic form and have been tested in the market. As part of the definition of radical innovation by Dahlin and Behren (2005) they included the criterion of degree of impact on future technology, which only can be analyzed ex post. They also have two other criteria that can be determined ex ante; the novelty, level of dissimilarity from prior inventions; and the uniqueness, level of dissimilarity from current inventions. Thus, the classification method by Dahlin and Behren (2005) requires analysis in three time periods to determine the technological radicalness; the past, the present and the future. Markides (2006) is applying the term disruptive innovation to ex post evaluated innovations, which can have the same features as radical innovations but is primarily defined by the effect on the market. It doesn't have to be new technology since old technology presented in the right context could make market disruptions. When Apple introduced gesture-based cell phones (the iPhone) it was considered a radical innovation. However, the idea did not spring out of thin air. Apple did neither invent multi-touch interfaces nor gesture control. Both technologies had long been integrated in computer design laboratories and several other companies had products on the market using similar technologies. Thus, Apple's ideas were not radical to the scientific community but they did create a major shift in the world of cell phones, due to the transformation from phone to camera; computer; gaming console etc. The product was given a new meaning (Norman & Verganti, 2014). In this example the technology was not new to the world or new to the market but new to the cell phone industry. According to the horizontal axis regarding the level of technical competence the iPhone was not particularly radical. However, when it was launched it completely changed the market and the success was of course connected to the multi-touch technology. To explain the iPhone radicalness some scholars, including Pisano (2015) add an extra axis to the spectrum of technology radicalness. Pisano (2015) categorizes innovations along the two axes; the vertical representing newness in business modeling, the horizontal representing new technical competence. Together they create the innovation landscape consisting of four quadrants; routine innovation, disruptive innovation, radical innovation and architectural innovation (see Figure 2.2.1.).
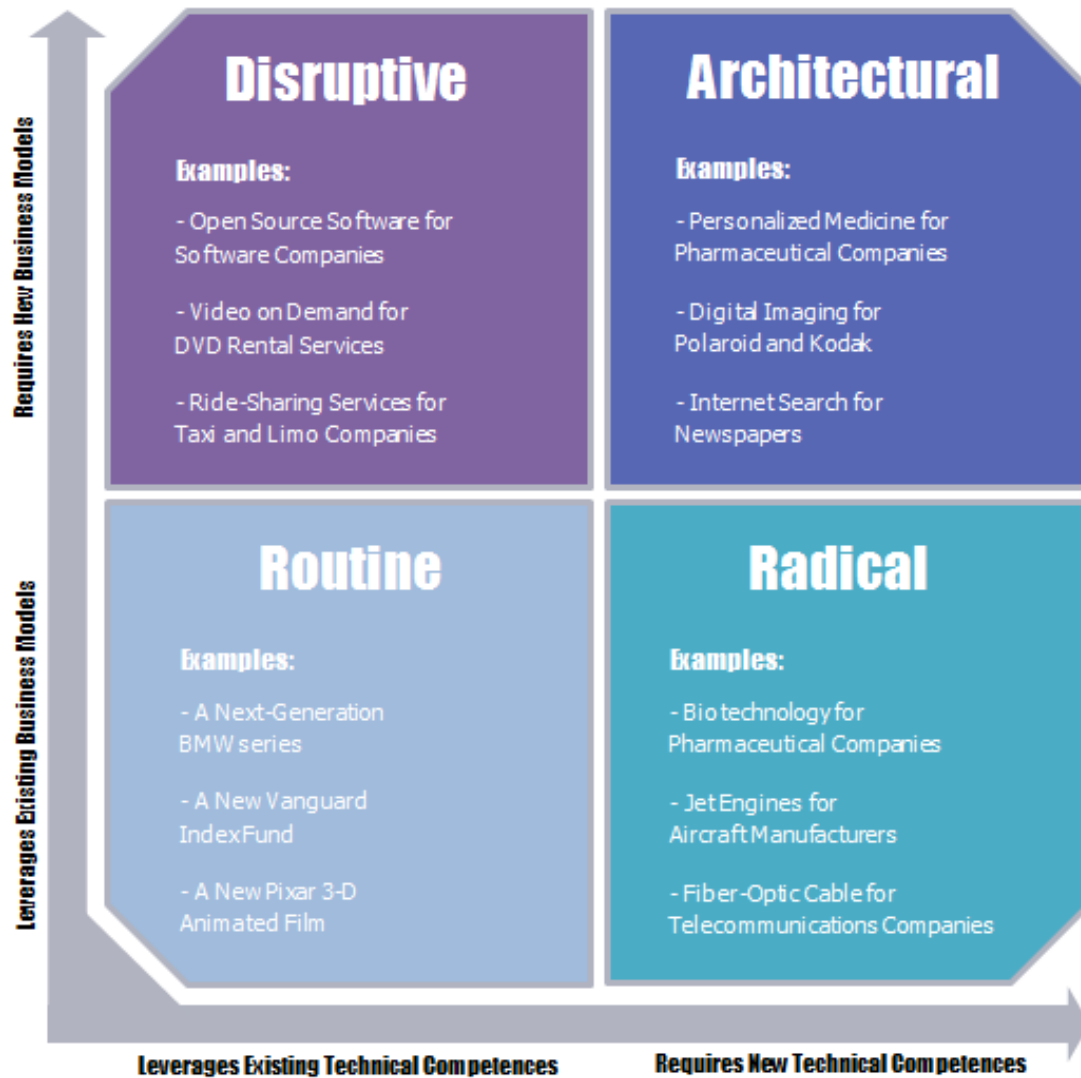
Concepts, such as disruptive innovation and radical innovation, are sometimes mixed and hard to separate. Pisano (2015) clearly separates the two terms and connects radicalness to new technical competence, while he connects disruption to new business modeling. He views architectural innovation as the most extreme level of novelty, where new business modeling is combined with new technology. Thus, the framework by Pisano (2015) clarifies some concepts connected to the innovation landscape.

Conclusively, radical innovation has various definitions and the concept is dependent on factors such as time and context. Commonly the concept is connected to technical novelty but in some cases the effect on future market or future changes in consumer behavior is considered a better evaluation criterion. In the context of evaluating early-stage-opportunities for radical ideas, the criterion of future impact is unknown. Thus, it is decided to use an approach that does not include future market success as a factor in the definition of radical innovation, but rather

focus on the current context of the project with an ex-ante approach. The framework of the innovation landscape by Pisano (2015), in combination with the definition by Slater et al. (2014) and McDermott and O'Connor (2002), will serve as the main inspirations.

Pisano (2015); '*radical innovation requires for firms to develop new technical competences*'.
Slater et al. (2014); '*radical product innovations offer unprecedented customer benefits, substantial cost reductions, or the ability to create new businesses, any of which should lead to superior organizational performance*'.
McDermott and O'Connor (2002); '*as a significantly new technology or new idea to the market*'.

The radical innovation definition for this thesis is; *New market applied technology with the potential to offer extraordinary customer advantages, substantial cost reductions or the ability to create new business*.

Radical technology will continue to be developed and applied in new contexts but will not always result in a market breakthrough. New to market applied technology, that is under development, should thus be considered radical since the future is unknown. Innovations that have the potential to challenge the market stability should be considered radical in combination with new technology to the transport solution industry.

2.3. ADVANTAGES AND DISADVANTAGES WITH RADICAL INNOVATION DEVELOPMENT

By definition, developing radical innovations gives an organization the opportunity to become a first-mover (Markides & Sosa, 2013) and be the pioneer of a new kind of product or service. Whether this is a desirable position depends on the situation a company is in and scholars have made various conclusions. There are other potential advantages rather than purely economic not necessarily connected to products even being launched, such as, competence building and increasing the dynamic capabilities of the company. In this section, two larger areas of strategic implications are presented. Then, other strategic aspects are discussed; and lastly a summarizing table about possible advantages and disadvantages from developing radical innovation is defined.

2.3.1. FIRST-MOVERS

If a company launches a radical innovation and manages to grasp a first-mover position within a new field of technology, that company can earn a long-lasting reputation as a leader, in terms of brand loyalty and technology leadership (Markides & Sosa, 2013). In turn, this could improve the image of the company among potential customers; sustain brand loyalty; and preserve market shares, even after competitors have introduced comparable products (Schilling, 2013). If a certain technology is difficult to imitate or if there is a patent connected to the technology, a company that manages to keep a technology leading position could reap large monopoly rents. As long as there are no comparable products, customers who desire the product need to pay what-ever price the supplier asks for. Another first-mover advantage is capturing scarce resources, such as key

locations; government permits; access to distribution channels; and relationships with suppliers. Late-movers might need to make heavy investments in order to attain resources due to the scarcity and the entry barrier created by the first-mover. The new product might as well require some commitment from the user. Today most computers use the QWERTY key-setting because of a 19th century innovation. There was a problem with keys jamming on mechanical typewriters which was solved by placing the keys in a specific order decreasing the risk of keys jamming. The QWERTY eventually became the standard and when new products arrived with alternative key settings, users did not want to switch from the system that they had already learnt. Hence, the benefit of a competing product must be higher than the cost of new learning or commitment. By being the pioneering supplier of a product a company will have the ability to influence the dominant design and form the market to match its resources and capabilities, and hence gain a competitive advantage (Schilling, 2013).

Being a first-mover also entails great risk. In a study on 50 product categories, Golder and Tellis (1993) found that market pioneers have a failure rate of approximately 47 percent and that the mean market share of market pioneers is 10 percent. One reason for this might be that first-movers carry the cost of the initial development, during the development phase the first-mover most probably explores other potential technical paths that are shut-down along the way and never gain any profits. Even though the initial returns are of monopolistic character they might not respond to the developing cost. Another reason for first movers to fail, according to Schilling (2013), can be underdeveloped infrastructure and lacking complementary products. Try to imagine the iPhone with only five applications or a car without roads or gas stations. Being the first-mover in such a scenario would be costly, and by the time the market has matured, competitors have had the opportunity to catch up as well. Thus, the value of a product can increase over time when complements and infrastructure are greater developed (Schilling, 2013). Convincingly, in the case of being a first-mover, a company could get the customer loyalty and earn a long-lasting brand reputation of being the most knowledgeable actor. There is also the opportunity of utilizing customers switching costs, since new products demands for them to invest time in learning. But these advantages needs to be put in relation to market uncertainty and the great investments connected to radical innovation projects (Schilling, 2013)

2.3.2. THE RESOURCE-BASED VIEW

The framework of the resource-based view suggests that companies can be conceptualized as bundles of resources that are utilized to compete in the market. The utilization process, as in leveraging resources, is usually referred to as capabilities. If a specific company attains resources and capabilities that are valuable; rare; inimitable; and none-substitutable, that company could achieve a sustainable competitive advantage to outperform other actors in the industry (Eisenhardt & Martin, 2000).

In a turbulent market environment, the capability to adapt could be the key to success, and to stay competitive in a changing environment, a company needs to be able to integrate, build and reconfigure its resources. This adaptive ability is referred to as dynamic capabilities (Teece et al., 1997; Leifer et al., 2001). Radical product innovations naturally face a more uncertain development process; a more complex customer adoption process and, by extension, a more difficult marketing process. Thus the radical product innovation requires a different

skill set and other capabilities than those required for incremental innovation (Leifer et al., 2001). Managers must be willing and able to articulate a strategic intent with a "stretch goal" that forces the company to compete in novel ways. Moreover, to develop a radical product innovation capability, company leaders need to support their key personnel with resources, psychological support, and appropriate metrics (Slater et al., 2014), which relates to the definition by Teece et al. (1997).

O'Reilly III and Tushman (2004) argue that in order for a company to succeed with radical innovation, ambidextrous leaders and teams need to exist. An ambidextrous leader or team has the ability to understand and be sensitive to the needs of very different kinds of businesses and products (O'Reilly III & Tushman, 2004). The radical innovation capability is a complex configuration of components that requires the management of a group with seemingly paradoxical skills. Companies must simultaneously manage both a proactive and a responsive customer orientation; a technological orientation; and a competitor orientation. They must also be willing to develop new, radical innovations, even when such innovations might cannibalize their existing successful products (Slater et al., 2014).

As stated by Kristiansen and Gertsen (2015), radical innovation capability is; 'the firm's ability to deliver superior output (in terms of satisfied customers, new technology and better quality, and speed-to-market) in a timely manner'. Thus, it would be desirable for companies to possess this dynamic capability and engage in activities that build tacit organizational knowledge. Kristiansen and Gertsen (2015) suggest that radical innovation often could be misunderstood and is often seen as a "money printing press" when it actually should be viewed as capability building activities.   A similar, but more general approach to the benefits of radical innovation is taken by Martinsuo and Poskela (2011). They conclude that ideas of front end innovation do not give immediate financial returns but rather enhances the business potential. By engaging in these kinds of activities a company can find new windows of opportunities and experience a strategic renewal of the company (Martinsuo & Poskela, 2011).

2.3.3. STRATEGIC IMPLICATIONS WITH RADICAL INNOVATION DEVELOPMENT

It is found that there could be both direct financial advantages/disadvantages and indirect financial advantages/disadvantages with radical innovation development. Authors propose different arguments and frameworks to evaluate whether investments in radical innovation should be undertaken or dismissed for less risky development. Schilling (2013) suggests that there is a turning point when old technology gives fewer returns in relation to the effort invested, than new emerging technology could give. This is when new entrants in the industry are likely to choose the new technology, hence initiating a disruption. In such a process there will be winners and losers. Incumbent companies then have to decide to either extend the life of their current technology or switch to the new technology. According to the logic of the resource based view, by holding dynamic capabilities, an incumbent company would effectively make this transition from the old to the new technology (Kristiansen & Gertsen, 2015; Slater et al., 2014).

Conclusively the literature has presented both advantages and disadvantages from focusing resources on radical innovation development (see Table 2.3.3.1.) and how this issue should be treated within a specific company is a strategic decision and needs to be evaluated based on the position of that company. However, what could be easily misunderstood in such a discussion is the relationship between new ideas and great financial returns. Instead some scholars emphasize that the capability building that can ensure the future survival, can be seen as possible great financial returns (Kristiansen & Gertsen, 2015; Slater et al., 2014).

TABLE 2.3.3.1. SUMMARY OF ADVANTAGES AND DISADVANTAGES WITH RADICAL INNOVATION DEVELOPMENT.

Advantages	Disadvantages
Long-lasting technology leadership position (Markides & Sosa, 2013; Schilling, 2013)	High development cost (Schilling, 2013)
Status and Brand Recognition (Schilling, 2013)	High Failure Rate (Golder & Tellis, 1993)
Industry/Technology Leadership and Patent holder (Schilling, 2013; Eisenhardt & Martin, 2000)	Market Not Ready for the Radical Product (Schilling, 2013)
Capability Building (Kristiansen & Gertsen, 2015)	Complements Not Ready (Schilling, 2013)
Strategic Renewal of the Company (Martinsuo & Poskela, 2011)	
Obtaining Scarce Resources (Schilling, 2013) - Key locations - Government permits - Access to distribution channels - Relationships with suppliers	

2.4. ORGANIZING THE FUZZY FRONT END OF RADICAL INNOVATION

This section will introduce the concept of the Fuzzy Front End (hereafter referred to as the 'FFE'), which is an important part of New Product Development (NPD), and the concept will be applied to radical innovation or discontinuous innovation as Reid and De Brentani (2004) prefer to call it. Although Reid and De Brentani (2004) describe the term discontinuous innovation, in this paper it was decided to use the term radical innovation instead since these two definitions are synonyms (Financial Times, 2017), in order to aid the reader (more about this in

section 3.8.4.). McDermott and O'Connor (2002) suggest that exploring the landscape of NPD is essential in order to successfully develop one's innovation management methods. By clarifying the FFE, the reader will more easily understand the complex process of radical innovation, and understand why incumbent companies have problems absorbing radical ideas. Finally, a model is presented, that describes the interplay of the environment, the individual and the organization, which is critical for radical ideas to be developed (Reid & De Brentani, 2004).

2.4.1. THE FUZZY FRONT END (FFE)

According to Achiche et al. (2013) the innovation process may be divided into three main parts, the FFE; the new product development (NPD) process; and the commercialization. Hence, Achiche et al. (2013) is describing the FFE as a phase prior to NPD. Reid and De Brentani (2004) claim that the FFE represents the earliest stages of the NPD processes and they describe FFE as the territory leading up to the organizational-level absorption of an idea or innovation. Boeddrich (2004) view the FFE as the part of an innovation process at which ideas are generated; collected; adopted; clustered; screened; selected; and improved. Hansen and Birkinshaw (2007) categorize the FFE as an early phase of the innovation process at which new ideas are developed to a stage where emerging ideas are sifted and ranked. It is clear that the FFE refers to early parts of the innovation process and/or NPD. However, it is not clear exactly when the phase starts or ends.

To better understand the FFE phase/process, Koen et al. (2002) used New Concept Development theory, which resulted in a model of five elements, idea generation; idea selection; opportunity identification; opportunity analysis; and concept definition (see figure 2.4.1.1.). These elements are driven by a core, consisting of leadership, culture and business strategy. In addition to the core and the elements, environmental factors play important roles, such factors are 'the corporation's organizational capabilities, customer and competitor influences, the outside world's influences, and the depth and strength of enabling sciences and technology'. Iteration and looping are necessary parts of FFE activities, thus the model has a circular shape, to suggest that ideas flow, circulate, and iterate between and among all the five elements.
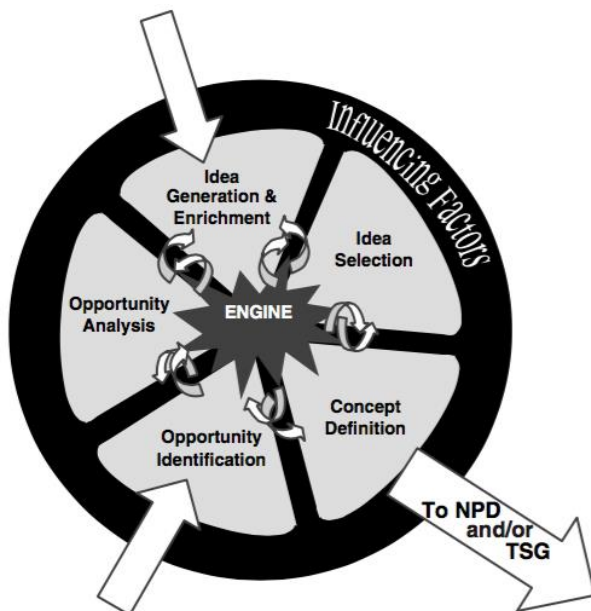
FIGURE 2.4.1.1. THE FUZZY FRONT END ADJUSTED TO THE NEW CONCEPT DEVELOPMENT (KOEN ET AL., 2002)

The arrows pointing into the model symbolize the fact that the starting points of innovation projects begin at either opportunity identification or idea generation. The exit-arrow represents how concepts leave the model and enter the new product development (NPD) or a Stage-Gate process (see Appendix 8 for definition) (Koen et al., 2002).

Reid and De Brentani (2004) constructed another model (see figure 2.3.1.2) to understand the FFE.

However, one important difference is the particular focus on radical innovation, that Reid and De Brentani (2004) have, in comparison to Koen et al. (2002) that do not separate radical or incremental innovation. Another difference is the linear process design in comparison to the circular. The model that is best suited for exploring the FFE is dependent on the context and for this paper the framework by Reid and De Brentani (2004) will be used. However, when The Fuzzy Front End Radical Innovation Landscape Model (more about it in section 2.5.) was constructed (see figure 2.5.1.) the circularity flow by Koen et al. (2002) was combined with Reid and De Brentani's framework (2004). The FFE framework by Reid and De Brentani (2004) consists of three perspectives and three interfaces, and they will be explored in the following section.

FIGURE 2.4.1.2. THE FUZZY FRONT END FRAMEWORK (REID & DE BRENTANI, 2004).
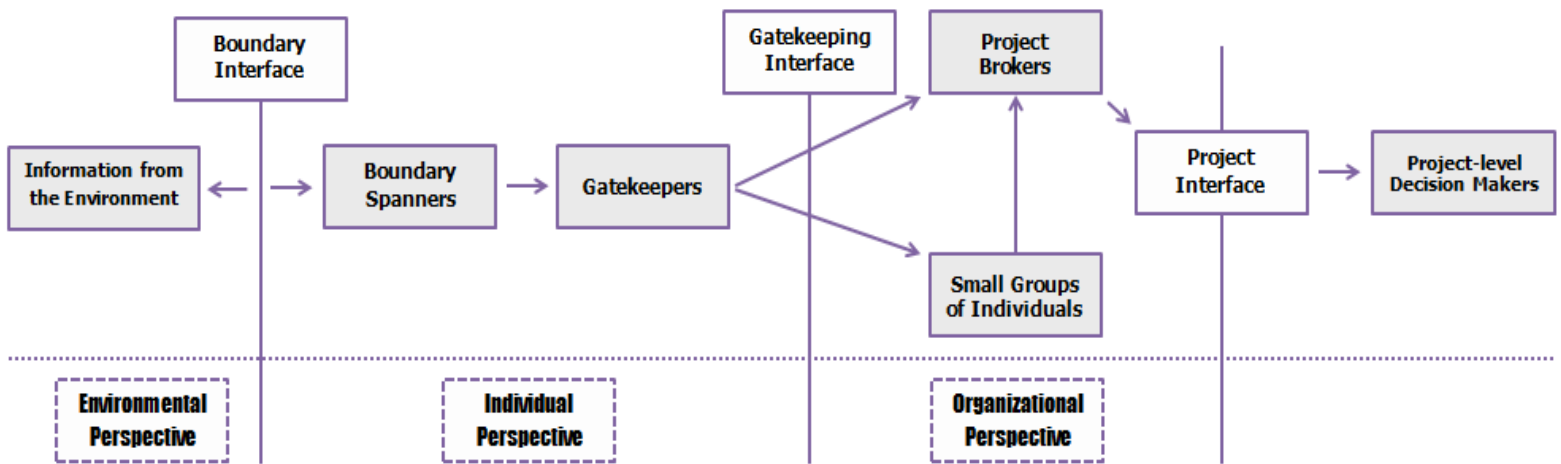
2.4.1.1. PERSPECTIVES

The perspectives related to radical NPD are categorized as environmental, individual and organizational, and they are all part of a network of interactions and knowledge exchange, in which radical innovation is developed (Reid & De Brentani, 2004).

The **(1) environmental perspective** constitutes of industries and markets, institutions and country aspects that influence innovation. Regarding radical innovation, it is concluded as an environmental-level phenomenon in itself, defined by macroeconomic deviations. Therefore, the environment is highly interrelated to the innovation development processes and is considered to be the main source of inspiration to radical innovation developers (Reid & De Brentani, 2004; Brentani & Reid, 2012). Wind and Mahajan (1997, p. 7) argue that identifying linkages in the market is considered as the 'forefront of the changing dynamics of competition and cooperation, especially in the R&D arena', which highlights the high impact the market in itself has on innovation. According to Brentani and Reid (2012), companies that have a better understanding of the market, will make superior innovations that have higher chance to generate early performance. Technology and markets both impact how radical innovation is developed. In a radical scenario, a company will have to depend on a complex and nebulous image of the future and the possible concurrences among existing products, services and business models.

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Creating a radical vision, calls for the capability of connecting new technologies with the forecasted market opportunities. Hence, in the case of radical new product development, the discovery of new technology is more probable when an organization searches outside its borders, and business opportunities are simply found when an organization understands its environment. Convincingly, the environment is an important perspective to consider when managing radical innovation development.

The **(2) individual perspective** is concerned with how individuals impact the innovation process by information interpreting and information transferring. According to Brentani and Reid (2012), the individual has a greater significance to radical innovation than to incremental innovation. In incremental innovation processes, problems and/or opportunities are initiated at organizational level, directing individual efforts for specified information gathering. Such directions, are possible because of technological and/or market conditions that are more easily anticipated, studied, and communicated at the organizational level. Additionally, the push for incremental innovation usually arises within the corporate level of decisions, as part of a company's stated NPD or growth objectives. For radical innovations, the process tends to work in the opposite direction. In other words, organizational-level involvement is more likely to be at the discretion of individuals, thus, radical innovation has a bottom up approach rather than top down. This is related to the idea that individuals identify and understand emerging patterns and new ideas using complex human capabilities e.g. intuition. The same individuals often decide on the value to the organization of externally derived information, as well as on whether such information should be shared (Brentani & Reid, 2012). This insight is supported by Frishammar, Dahlskog, Krumlinde and Yazgan (2016) who suggest that involving the right individuals that are creative and with different knowledge base and perspectives, is essential for succeeding with radical innovation, highlighting the importance of knowledge exchange and intrapreneurship (more about intrapreneurship in Appendix 8). To summarize the individual perspective, individuals are driving radical innovation and they transfer external information to the company. Individuals take part in informal networks and they act upon signals from the environment, on behalf of their organization. Three important roles that are held by individuals in the FFE are the boundary spanners; the gatekeepers; and the champions. The boundary spanner finds patterns in the environment and identifies market needs; the gatekeeper evaluates the potential ideas and their relevance to the organization; the champion promotes and transfers an idea to the organization that he or she finds relevant (Reid & De Brentani, 2004).

Finally, the **(3) organizational perspective** is concerned with company-level processes that contribute to the organization's success by strategic, structural, and resource planning. Thus, the organization is seen as a system that uses tools and processes to control resources and give direction to individuals (Reid & De Brentani, 2004). The organizational role at the FFE according Koen et al. (2002) is represented by the engine found in the middle of their model (2.4.1.1.). They imply that the five key elements, which constitute the FEE, is controlled and driven by leadership, culture, and business strategy. In addition, theories of Martinsuo and Poskela (2011) and their work connected to evaluation criteria for radical innovation, imply that the influences of an organization can be divided into formal and informal.

According to Brentani and Reid (2012) formal processes, such as stage gates, have little impact in discovering ideas for radical innovation; because formal organizational processes are unable (or unwilling) to detect

discontinuities, which could only be done by individuals. Since, Koen et al. (2002) apply another layout for describing the FFE, they are able to connect different organizational practices to different key elements and discuss what kind of approach is suitable for that particular element. E.g. the idea selection-element which is recommended to be managed by softer practices and informal criteria; due to the fact that financial analyses at such early stage are often wild guesses. This is in line with the arguments by Brentani and Reid (2012). However, the opportunity identification-element could, according to Koen et al. (2002), be more formally managed, as it should aim to align the corporation's organizational capabilities with customer and competitor influences and the outside world's influences.

Even if, Koen et al. (2002) supply some suggestions on how the organization can potentially manage the elements of the FFE, they also highlight that the same practices could be applied with various results depending on the mind-set and corporate culture. A formal process, e.g. technology-road-mapping, could potentially be viewed as a soft managerial processes designed to facilitate learning; or it could be viewed as controlling processes limiting the creativity but giving strategic direction. In this example the formal tool is being influenced by the informal managerial approach and corporate culture.

Another aspect of formal organizational processes is to acknowledge the none-sequential approach. If formal processes are applied at the FFE it should be dynamic and able to loop and make project pivots. The FFE is not a linear flow; it is circular or even iterative, according to Koen et al. (2002).

Brentani and Reid (2012) are promoting informal practices of empowerment and freedom for individuals within the organization. Some example suggested by them are to give boundary spanners access to the resources they request and free time to use them; embolden "skunk works" and intrapreneurial ventures; and encourage boundary spanners to attend industry conferences and occasionally, conferences that are tangential to their discipline. However, it is important to note; that individuals do not create, develop, or market new products; these activities are performed by the organization, and the individual initiatives need to be absorbed by the organization to get access to resources and networks in order for their ideas to become reality (Reid & De Brentani, 2004). Hence, the formal activities also play an important role in order for radical innovation to develop at the FFE and eventually reach the market. The informal approach could be seen as the general mind-set or the culture that allows for formal tools and practices to be used in a progressive way (Brentani & Reid, 2012).

Ultimately, the organizational perspective is highlighting the role of the company-level formal and informal processes, tools and practices; that enables individuals to pursue ideas with radical potential. For ideas to develop into products they need to be absorbed by the organization and then get access to resources. How the formal tools and practices influence the FFE process is determined by the informal aspects, such as culture, and the same practices can be used with various outcomes (Brentani & Reid, 2012).

2.4.1.2. INTERFACES

Innovation happens through information flows in informal networks placed in-between the above mentioned perspectives. The links that connects the perspectives and describes the flow within networks are called interfaces and divided into the boundary-, the gatekeeping- and the project interface (Reid & De Brentani, 2004).

The **(1) boundary interface** is the process where information is transferred from the environment to the individual. As mentioned, the individual, the organization, and the environment are all part of a network of interactions and knowledge exchange. At the boundary interface, the interacting is occurring between the environment and the individual who interfaces with the environment (Reid & De Brentani, 2004). Koen et al. (2002) illustrate the boundary spanning interface with two arrows pointing into their model at opportunity identification activities or idea generation activities (see figure 2.3.1.1.). Either the individual has an idea, which later needs to be connected to an opportunity; or the individual is identifying an opportunity that has not been connected to any solution. Referring to Reid and De Brentani (2004), the individual is responsible for making this kind of analysis and he or she is an external contact responsible for organizational-level involvement in external and internal networks. In the boundary interface the individual uses pattern recognition and intuition to separate potentially relevant market and environment information from what is irrelevant. This is a human ability, not an organizational ability, therefore is this stage connected to the individual perspective, and not the organizational perspective (Reid & De Brentani, 2004).

The **(2) gatekeeping interface** is characterized by evaluation of potential ideas and their relevance to the organization. In the case of radical innovation, this is often performed by the individual that have identified new business opportunities from her environment scanning and market interpretations. Thus, the gatekeeping for radical innovation means for an individual to understand the potential benefit of absorbing the idea in the organization and convincing other individuals within the organization about her insights (Reid & De Brentani, 2004).

According to Koen et al. (2002), when it comes to idea selection, decision makers could use a more positive insolence. Instead of approaching a new idea with the attitude "the task of filtering out less attractive ideas", decision makers could ask themselves how an idea could be helped in order to move forward. Another thought could be how an idea can be modified to make it more probable to succeed. Koen et al. (2002) stress that screening is supposed to encourage creativity and is not meant to be restrictive and/or stifle new ideas.

The **(3) project interface** happens when a radical idea is concluded relevant by a group of individuals in an organization. It is then given resources and support to grow. Creating, developing, and marketing of new products are activities that are performed by organizations, not individuals. Consequently, radical ideas need to be transferred to an organizational-level from an individual level, and this makes the project interface. Individuals that are dedicated to an idea could promote it and highlight the relevance to internal stakeholders, representing the organizational interests, and this is referred to as championing. The project interface is connected to organizational evaluation. When a champion has tried to convince internal stakeholders regarding the benefits of an idea, it can either be absorbed or dismissed. When an idea is absorbed by the organization and caught in the

"strategic web", the project is evolved into a formalized product development process, and the project interface has been successfully passed, meaning that the company officially commits to the idea. The fundamentals of the project interface are to transfer ideas from individual level (group of individuals) to organizational level and turn the ideas into projects (Reid & De Brentani, 2004).

Now the radical innovation landscape at the FFE by Reid and De Brentani (2004), have been introduced. From the key perspectives and the fundamental interfaces, a model was constructed to visualize the interdependencies and the flow of information and ideas (see figure 2.5.1.) and will be described further in section 2.5.. Reid and De Brentani (2004) describe the relationships as linear (see figure 2.4.1.2.) but Koen et al. (2002) stress the importance of circularity for innovation success (see figure 2.4.1.1.).

2.4.2. MANAGERIAL IMPLICATIONS REGARDING THE FUZZY FRONT END OF RADICAL INNOVATION

Brentani and Reid (2012), suggest some managerial implications with the incubation of radical innovation in the FFE. Their advice regards the individuals. Brentani and Reid (2012) do not propose formal processes, but rather enhancing the freedom of individuals and push responsibility of radical innovation down the organizational lines. According to their approach, radical innovation is not controllable in such early phases, and what should be done is to strengthen the knowledge exchange and the informal networks, which will spontaneously make radical innovation work, where individual learning and enthusiasm are the drivers. A similar approach is taken by Frishammar et al. (2016), who identify senior management support; vision strategy; and resources and culture, as critical to radical front-end performance. They concluded that radical innovation is much more than processes, structure and methodology. It is essential to involve the right individuals that are creative and have different knowledge bases and perspectives to succeed. They highlight the importance of knowledge exchange and intrapreneurship. In line with Frishammar et al. (2016), Koen et al. (2002) suggests that the engine of FFE is driven by a core, consisting of leadership, culture and business strategy.

Even if, tolerance and softer managerial actions could be initially undertaken, protecting radical ideas and encouraging innovativeness among employees; eventually the idea needs to be confronted at the project interface. Decision parameters are designed to limit the company's exposure to expensive failures which often result in the termination of radical projects. This is hence the first encounter for an idea to strict evaluation criteria. The solution would be to prepare an idea, in the FFE stages, to survive a formal evaluation by gathering information and learning. That would reduce the level of uncertainty, and that is what organizations should encourage when softly managing FFE of radical innovation (Nicholas, Ledwith & Bessant, 2015; McDermott & O'Connor, 2002).

In some cases, isolation of radical ideas could be a solution. The evaluation could be postponed until the radical idea has matured, but it still might be tough to manage a transition from isolation to the main organization. Available resources generally become an immediate issue. McDermott and O'Connor (2002) write that isolation of radical projects might protect the initiative from counterproductive forces within the mainstream, but it also cuts

of the most important sources of learning, competencies and resources. Projects staying too long in isolation have trouble gaining legitimacy when seeking a new home.

In line with The Fuzzy Front End Radical Innovation Landscape Model (see Figure 2.5.1., shown in section 2.5. below), the above authors are enlightening important challenges of the information flow within the informal networks that might lead to radical innovation. However, the essential logic inherent in the model and the reasoning by Reid and De Brentani (2004) is to decrease distances between the different perspectives. Thus, for radical innovation to succeed; environment, individual and organization need come together. The greater the separation between the perspectives is and the more complex the interfaces are, the lesser is the chance for the radical innovation to occur.

2.5. SUMMARY AND THE FUZZY FRONT END RADICAL INNOVATION LANDSCAPE MODEL

In this chapter so far, correlations between theories found in the literature review have been presented, which all have been displayed in the Radical Innovation Landscape Model (see figure 2.5.1.). It will serve as the foundation for the analysis and the conclusion of this paper.

How radical innovation is defined is depending on the observer's perspective and the innovation context. Nonetheless, it was found necessary to present the interpretation of existing definitions to the reader, this resulted in the following definition: "New market applied technology with the potential to offer extraordinary customer benefits, substantial cost reductions or the ability to create new business" (Pisano, 2015; Slater et al., 2014).

Radical innovation development can lead to considerable advantages and disadvantages. As stated by Schilling (2013), a company can become a first-mover and thereby gain status and brand recognition. At the same time radical innovation activities are complex and costly. Being a first-mover involves greater risks, and not all market pioneers succeed (Golder & Tellis, 1993). However, Kristiansen and Gertsen (2015) argue that radical innovation can be misunderstood as a "money printing press" when it essentially should be considered as capability building activities. Their logic is related to the resource based view and the development of dynamic capabilities.

Since, the aim is to investigate the early stages of radical innovation development, it was chosen to look at the FFE of radical innovation. By using the framework by Reid and De Brentani (2004) and the framework by Koen et al. (2002) the FFE landscape of radical innovation has been explored and key perspectives and key interfaces have been identified. In order for radical innovation to be developed, environmental; individual; and organizational perspectives need to come together. The greater the separation between the perspectives is and the more complex the interfaces are, the lesser is the chance of radical innovation to succeed. Koen et al. (2002) also stress the importance of iteration and looping when developing radical innovation.

In the Radical Innovation Landscape Model, radical innovation is the result of successfully managing the six aspects presented in the FFE landscape. Formal and informal directions at organizational level have direct impact on individuals and their ability to interact with the environment and their ability to transfer ideas in to the organization.
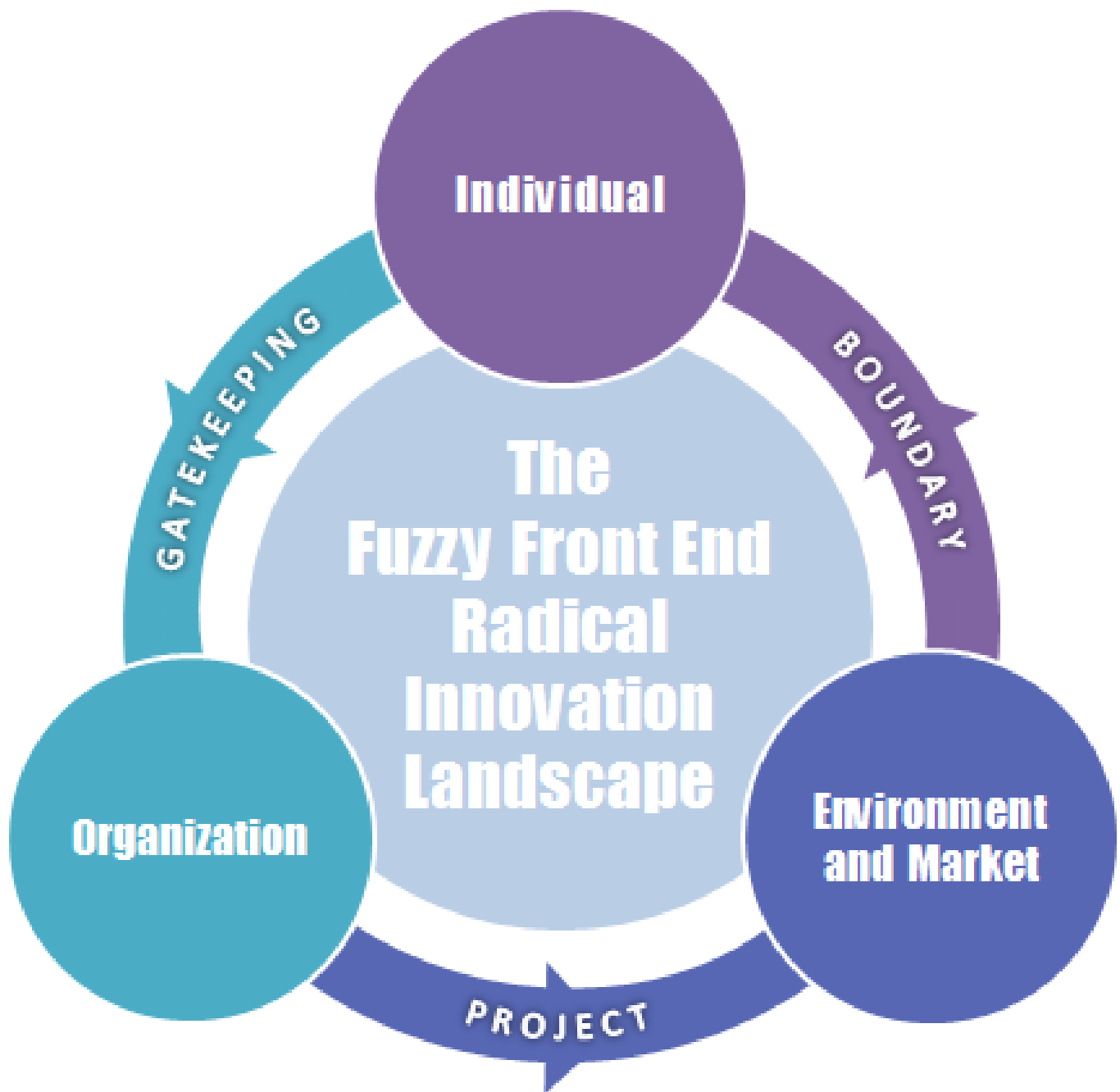
3. Methodology

First, the research background, research strategy and research design are described, and these are followed by the research method where the ingredients of the secondary and primary data are defined. Then, the selection process of external cases and experts is discussed. The practical approach taken in this paper is designated in the pragmatism section. In the data analysis section a portrayal of how the analysis was carried out is described. Lastly, the quality of the study is deliberated.

3.1. RESEARCH BACKGROUND

The primary focus of the thesis, in the beginning, was to investigate the selection criteria for radical ideas for the internal incubator at Volvo (The Innovation Garage). However, scholars in the field suggest different approaches, and they discuss the complexity rather than any concrete criteria. Also, many of the external cases that were analyzed did not have any explicit strategy to select radical ideas. Hence, the focus of the research moved from determining criteria for evaluation of radical ideas, to better understanding the complexity behind organizing the FFE of radical innovation.

3.2. RESEARCH STRATEGY

To elucidate the notion of innovation, and rather, radical and disruptive innovations, an investigation on the elements of which radical and disruptive innovations consist of, required undertaking. An extensive review of existing academic literature was carried out in order for a convincing theoretical framework to be built. This research was meant to uncover answers on how to organize the FFE of radical innovation. Case studies and interviews were conducted at Volvo and at companies involved with radical innovation development and manufacturing, in order to compare possible radical innovation development structures and processes. The main methodology was to perform qualitative research to acquire comprehensive data and information about the theories, strategies and the approaches used in the steering of processes to organize the FFE of radical innovation. This kind of unstructured information is according to Bryman and Bell (2011) available by conducting interviews, through which individuals' ideas and perspectives on the subject can be grasped. Acquiring this rather complex type of knowledge is difficult through the usage of quantitative analyses, since the answers undoubtedly differ a lot. The qualitative research methodology creates some room for flexibility, to fine-tune for example, interview questions during the process of the study in order to probe questions that are in line with the discoveries made and the evolving hypothesis. Another reason that the qualitative approach was used was the fact that the research had emphasis on words rather than data, when data was collected (Bryman & Bell, 2011). The qualitative research strategy also has downsides, that need to be taken into consideration. Bryman and Bell (2011) states that one large disadvantage is that results can be misinterpreted when the researchers conduct the analysis, which can result in incorrect results. Consequently, the results of the paper can be generalized only in similar contexts of the study.

3.3. RESEARCH DESIGN

This research compared and acquired data through the use of case studies and qualitative interviews. Because the definitions of radical innovation and disruptive innovation were dissimilar according to different individuals, this type of approach was arguable. Comparative case studies were constructed in accordance with the theories stated by Bryman and Bell (2011) who explain that discussions on broader topics without concrete answers; need to be dealt with by comparing case studies. Qualitative interviews were hence carried out at Volvo and other case companies. By doing different case studies comparative analyses were possible. Because the theories on what radical and disruptive innovations are, and how they are managed in the most profitable way, are so widespread, a study of multiple cases was encouraged. Bryman and Bell (2011, p. 66) explain the advantage of multiple-case studies, 'The main argument in favor of the multiple-case study is that it improves theory building. By comparing two or more cases, the researcher is in a better position to establish the circumstances in which a theory will or will not hold'. Furthermore, professors and experts within the field of innovation were asked to contribute to the research, which also is suggested by Bryman and Bell (2011). The reason for this was to acquire both guidance and unbiased knowledge in the construction of the paper. Valuable insights regarding which important areas to cover in the theoretical framework, and how to carry out the empirical research, were assimilated. To identify interesting data to analyze, the thoughts and ideas from individuals were the main focus of examination. Informal settings were however also observed and analyzed in order to comprehend how the thoughts and ideas were dealt with in the daily work.

3.4. RESEARCH METHODS

In order to conduct the paper, a deductive methodology was used. This method is described by Patel and Davidsson (2003) and means that one first studies relevant theories and previous empirical studies, in order to create a theoretical framework through which empirical findings can be analyzed. With extended levels of basis knowledge the applicable interview guides were constructed, which later were used when interviewing the respondents. Some adjustments and complementary theory was added to the theoretical framework in tandem with the empirical data collection. In line with the Grounded Theory approach (see section 3.7.), an imperative approach was taken throughout the paper construction (Bryman & Bell, 2011)

Primary and secondary data constitute the information that is used to answer the research questions.

3.4.1. SECONDARY DATA COLLECTION

The secondary data was mainly established through academic literature, but also on information from company websites. To deal with the research questions, literature can primarily be used in order to identify explanatory sources to the terms radical and disruptive innovation. In order to find the relevant literature, the electronic database GUPEA (where Business Source Premier and Emerald can be found) was browsed. When ranking the

articles and books, the number of citations were regarded. Some of the key words that were used when scanning were "radical innovation", "disruptive innovation", "the Fuzzy Front End" and "organize the Fuzzy Front End". The references of interesting articles could be scanned in order to find other research that was similar and relevant for the subject.

It is worth highlighting that the work '*The Fuzzy Front End of New Product Development for Discontinuous Innovations: A Theoretical Model*', by Reid and De Brentani (2004) was treated as an important source of information in the theoretical framework. It paid an important role in the analysis of the organizational activities that companies employ in the FFE phase of radical innovation development. The reason for this was that the framework well summarizes the first stages of radical idea development and is a well-cited work. A concrete explanation on how the FFE could be organized for radical ideas appeared to be a topic without much previous research, except for this work. Given the objective of the study, which was to more deeply explore how large incumbent companies can organize FFE of radical innovation, the impression was that the downsides of grounding a major portion of the theoretical framework on Reid and De Brentani (2004) would not affect the study to a high extent.

3.4.2. PRIMARY DATA COLLECTION

In order to obtain primary data, qualitative interviews were conducted. Semi-structured interviews are according to Bryman and Bell (2011) most applicable, mainly because of the dominant ambiguity in results as of each interview. The respondents were steered by a framework of issues and topics, but the order and wording of questions were reformed throughout each interview. By doing so, interviews were according to Eriksson and Kovalainen (2015) given room to move in different directions and unexpected insights could be discovered. Conversely, the semi-structure pledges a line of focused context while also offering guidance to the interviewer and interviewee (Bryman & Bell, 2011). First, the internal interviews at Volvo were conducted in order to grasp understanding of the basic elements of the radical innovation approach. Then, interviews were conducted on other case companies involved in radical innovation and the production industry. Lastly, interviews were done with experts within the field of innovation.

3.5. SELECTION PROCESS

Different original ways of answering a research question is strived after when conducting a multiple case-study. When selecting case companies to study, the selection was based on if innovation was considered an important topic for the company, and if the company was in the manufacturing industry. During the first visit to Volvo, the [V1] F. Director of Technology Strategy & Innovation, mentioned a set of other companies conducting similar radical innovation activities similar to the one that Volvo is curious on creating. The [V1] F. Director of Technology Strategy & Innovation encouraged picking companies that were engaged in the type of industry that Volvo was in. The [V2] Innovation Manager gave an introduction to an existing company network, through which some of the first contacts were made.

When relevant case companies had been identified, the contacting process started. In order to get in touch with these companies, emails were sent to updated private email addresses that were found primarily in the company network. Also, several search engines, such as Google and LinkedIn, were used in order identify updated mail addresses to individuals of companies that had been identified.

It was favored for the interviewees to have deep knowledge in their employer's methods and strategies regarding innovation, and to have positions connected to innovation at the companies. Therefore, most of the interviewees consist of managers that directly work with innovation management and managers with a more holistic perspective and insights in the product development processes. The case companies were screened in order to identify individuals with the right competencies and relevant positions. When approaching the individuals, a humble question regarding if they had time to participate was always stated. In case an individual would not have time to participate, it was asked if there was any suitable colleague that perhaps would have time to be part of an interview instead.

When contacting the potential interviewees, emails were sent explaining what the research was about and how it was aimed to be carried out. Also, a list of which other companies that had expressed their interest in participation was added. Some companies were reminded after a few working days. In total, 40 emails were sent to managers from 25 different companies. In the end, eight of them answered positively towards participating. Finally, these eight companies functioned as external case companies in the thesis.

One interviewee per case company functioned as a representative, through which the activities and concepts that their company among others employed, were described. Since the main research question aims to identify the different types of activities that companies can use, one interviewee per case company felt applicable enough, which helped identify several sets of activities. Eight interviewees were found at Volvo. The study was conducted in cooperation with Volvo in order to guide them towards creating profitable radical and disruptive innovation development processes, and hence, more extensive interviews were done there. The aim was to interview individuals with different responsibilities, knowledge and insights at Volvo. This approach is in line with Beitin (2012), who suggests that by asking individuals from different positions, different types of valuable information can be obtained.

When identifying the relevant experts to interview for this study, this topic was discussed with the supervisor of this paper who advised contact to be made with three individuals who have been active within the fields of innovation for a long time. These were contacted, along with another pair of experts that were considered to be interesting in the light of the paper. Three experts in total agreed to participate in interviews.

TABLE 3.5.1. LIST OF EXPERTS

Expert	Position of interviewee	Date	Interview Approach
[E1] Expert	Affiliated Professor at Centre for Business Innovation at Chalmers	13 Mar. 2017	Audio Telephone
[E2] Expert	Senior Lecturer at the department of Innovation and Entrepreneurship at the University of Gothenburg	16 Mar. 2017	Audio Telephone
[E3] Expert	PhD Innovation Management	30 Mar. 2017	Audio Telephone

TABLE 3.5.2. LIST OF VOLVO DEPARTMENTS, VOLVO BUSINESS UNITS AND INTERVIEWEES

Department / Business Unit	Position of interviewee	Date	Interview Approach
Volvo Group Trucks Technology, ATR	[V1] F. Director of Technology Strategy & Innovation	22 Nov. 2016	Face to Face
Volvo Group Trucks Technology, ATR	[V2] Innovation Manager	12 Dec. 2016 – 8 May 2017	Face to Face
Volvo Group Trucks Technology, Q&CS	[V3] Strategic Planner	28 Mar. 2017	Face to Face
Volvo Group Trucks Technology, ATR	[V4] Emerging Technology Program Manager	28 Mar. 2017	Face to Face
Volvo Trucks	[V5] Director of Environment & Innovation	31 Mar. 2017	Face to Face
Volvo Group Trucks Powertrain	[V6] Software Leader & Software Engineer	6 Apr. 2017	Face to Face
Volvo Group Trucks Technology, ATR	[V7] Director of Technology Strategy & Innovation	6 Apr. 2017	Face to Face
Volvo Group Trucks Technology, ATR	[V8] Knowledge Management Specialist	12 Apr. 2017	Corridor chat Face to Face

TABLE 3.5.3. LIST OF CASE COMPANIES AND INTERVIEWEES

Case company	Position of interviewee	Date	Interview Approach
Packaging Company [C1]	Director of Development Strategy and Planning	1 Mar. 2017	Audio Telephone
Technology and Security Company [C2]	Innovation Manager	2 Mar. 2017	Face to Face
Home Appliances Company [C3]	Open Innovation Project Manager	3 Mar. 2017	Audio Telephone
	Open Innovation Project Manager	3 Mar. 2017	Audio Telephone
Automotive Company [C4]	Director of Corporate Innovation Office	6 Mar. 2017	Face to Face
Bearings Company [C5]	President of Business and Product Development	9 Mar. 2017	Face to Face
Construction Equipment Company [C6]	Director of Emerging Technologies	10 Mar. 2017	Audio Telephone
Industry Tools and Machines Company [C7]	Manager Mechatronics Department, R&D	14 Mar. 2017	Video Telephone
Communications Company [C8]	Change Leader	23 Mar. 2017	Face to Face

3.6. PRAGMATISM

The interview guides were conducted based on the defined research questions, in harmony with the foundations of the theoretical framework. The interviews that were conducted had slightly different angles, and therefore, different types of interview guides with minor alterations were created for case companies (Appendix 4) and the experts (Appendix 5). Numerous questions were stated below each question subject, which were used as guidance when asking applicable questions in different situations. The structure of the interview guide secured that the interviews touched upon the different expertise areas relevant for the research questions. The interview guide also helped to elude leading questions.

In order to make sure that all data was treated, all interviews were recorded. In the interviews, full attention was directed to the interviewee and no extensive notes were made while the interview was being conducted. The notion was to direct full attention to what was said and ask the most relevant and data awarding questions. All interviews were later transcribed, meaning that all spoken words were written into text. Interviews were conducted through face-to-face meetings in quiet environments and telephone. By sending the interviewees the transcription from the interview, the levels of misunderstandings in the interpretation of data were lowered.

The TSI department at Volvo has throughout the time of the construction of the paper shown their support. This helped providing a wide understanding for the work that was being conducted there in a somewhat informal environment with several unstructured interviews and discussions in the corridors.

Figure 3.6.1. concludes and demonstrates the approach taken in this thesis, comprising the research methodology.

FIGURE 3.6.1. THE THESIS RESEARCH METHODOLOGY

Multiple Case Studies & Expert Consultation

Qualitative Research

Semi-structured interviews & Secondary Data

Research Methodology
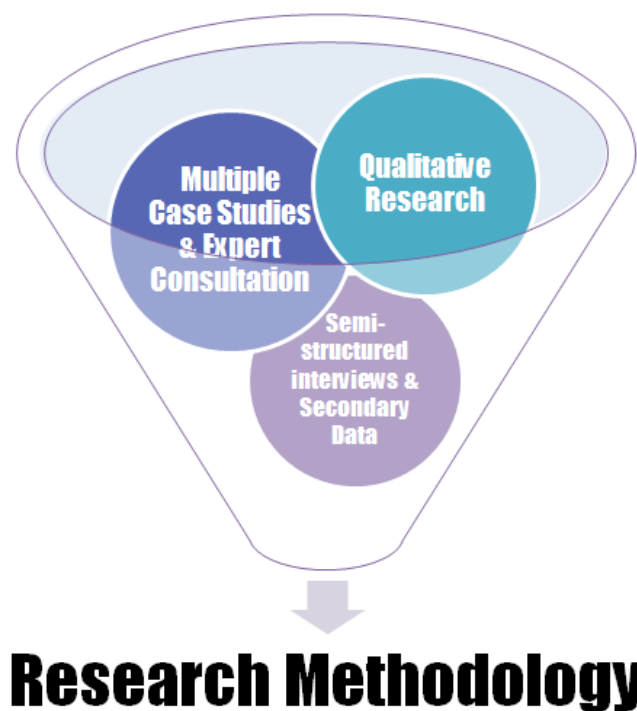
3.7. DATA ANALYSIS

In the data analysis part of this thesis, the intention was to use the Grounded Theory approach (Glaser & Strauss, 2009), which suggests that the analysis of data was executed in tandem with the gathering of data. Using a Grounded Theory approach in combination with a multiple-case study is in line with the literature written by

Bryman and Bell (2011, p. 66) who stress that '… the comparison may itself suggest concepts that are relevant to an emerging theory'. During the data gathering process, different hypotheses and ideas were established, and new theoretical data was investigated in order to explain the appearing phenomenon.

After having finished a preliminary theoretical framework, interviewing started, and the questions used were in line with the theoretical framework created. As already mentioned, semi-structured interviews were conducted. Audio recording was favored, since it would provide the opportunity to capture everything that was said unerringly and thereby be able to code all the data from the interviews, and hence leave no room for misinterpretations. If audio recording would be disregarded, one pen and paper about what the interviewee said during the interview would be used, so that the other interviewer could pay as much attention to what was said as possible. When having finished the interviews, these were coded, transcribed and summarized in a written document. Key findings were identified after some careful analysis and then connected to the expectantly conforming theoretical framework. Because the Grounded Theory approach was used, the theoretical framework had been developed and had ripened by the time the last interviews had been conducted. This would advocate that the theoretical framework consisted of sufficient relevant literature so as for a possible and interesting analysis to be transacted.

3.7.1. THE CHANGE OF SCOPE

In the beginning of the construction of this paper the aim was to answer how Volvo should organize their innovation garage in the most efficient manner in order to promote radical innovation development. However, while conducting the research it was comprehended that the data that had been collected contained a great deal of information that could be used in order to explain how companies organize the FFE process. In the light of the grounded theory approach, the theoretical framework was slightly adjusted in order to fit with the new research questions.

3.8. QUALITY OF THE STUDY

3.8.1. VALIDITY

To ensure the validity of qualitative studies is rather problematic (Bryman & Bell, 2011). The level of validity explains how well one measures what one is supposed to measure. As previously specified, the aim was not to emphasize one universal solution that all incumbent companies can use in order to succeed with the FFE of radical ideas and radical innovation development, but rather to reconnoiter what activities and methods exist in order to handle the FFE of radical innovation development and how companies possibly can organize for it. According to Bryman and Bell (2011), a study that aims to have a high level of external validity, needs to be relatively generalizable so that it can be relevant and applied in other contexts. As this qualitative study consists of a small number of case studies, it makes the external validity lower. Also, the fact that each case company is represented by one individual lowers the validity, and the answers that are described by these interviewees are to seen as examples of how large companies can conduct activities, and does not summarize everything that the

specific company does. In order to increase the levels of external validity however; the formulation of the research questions were carefully defined. Also, the interviewees of this paper were prudently chosen dependent on the experience they have, the position they held and their level of influence on the radical innovation development work (see the Selection Process section for more).

3.8.2. RELIABILITY

Certified reliability of qualitative studies is also something that is probed (Bryman & Bell, 2011). The level of reliability clarifies the level of possible duplication of a study, and since the environmental settings of the case companies and their employees can differ a lot, it is problematic to replicate the answers of this study. Conversely, through careful explanation of the verdicts that have been made regarding the practicalities and paper construction procedures, the level of reliability is arguably increased. Also, the internal reliability has been increased due to the bi-validation between the two authors in terms of what has been heard and observed, something which Bryman and Bell (2011) defines as significant 'inter-observer consistency'.

3.8.3. UNEXPECTED RE-ORGANIZATION

Worth to mention is the fact that there was an announcement of a re-organization of Volvo which affects some of the parts in this organizational presentation of Volvo. However, since this was an announcement made during the latter parts of the construction of this thesis, it will not be taken into further account throughout the thesis. The re-organization is however not expected to cause any damage to this paper, since this paper is not giving advice that is exclusively dependent on the organizational structure of Volvo.

3.8.4. DIFFERENT DEFINITIONS OF RADICAL INNOVATION AND DEFINITION ADJUSTMENTS

During interviews and the search for relevant literature various definitions of radical innovation were touched upon. As was mentioned in the introduction of this paper, there is no true definition to the concept of radical innovation (Dahlin & Behrens, 2005). Depending on who the observer is, and depending on the time and context, radical innovation is perceived differently and described by diverse terms (Schilling, 2013; Slater et al., 2014). Some terms, that have been equated to radical innovation during the thesis are architectural innovation; breakthrough innovation; disruptive innovation; discontinuous innovation; and game-changer innovation. The definition radical innovation has been used, and has replaced the term discontinuous innovation since discontinuous innovation and radical innovation are synonyms (Financial Times, 2017). This is done in order to aid the reader in the understanding and navigation of this paper.

4. EMPIRICAL FINDINGS

In this chapter, the reader will be presented the results of the empirical data collection. Each interview, or interview case, will be connected to the research questions of this paper and presented in tables. General discussions have been, to the best ability of the authors, coded into short statements or quotes that summarize the most central answers by the interviewees.

There are three empirical groups providing data. First, the data acquired from the group consisting of experts is presented. The information provided by the experts constitutes supplementing data for the theoretical framework. The second group, consists of Volvo employees. The information obtained from Volvo interviewees is handled in two ways; as deepened knowledge to the case of Volvo, and to answer the research questions. The third and last group consists of the case companies, which provide essential information regarding the existing practices and attitudes towards radical innovation, in these companies. The empirical data will be presented in accordance with the structure of the theoretical framework, in order for the reader to effortlessly navigate.

4.1. EXPERT CONSULTATION

4.1.1. THE BACKGROUND OF EXPERTS

A summarizing description of the experts' roles can be found in Table 3.5.1.

4.1.1.1. EXPERT [E1]: AFFILIATED PROFESSOR AT CENTRE FOR BUSINESS INNOVATION AT CHALMERS

Has had a significant background at two large Swedish corporations, Akzo Nobel for 17 years and SCA for 17 years. Currently he is an affiliated Professor at the Centre of Business and Innovation at Chalmers, and he has before been a lecturing Guest Professor in Lund for 6 years. Apart from the academic context, he is hosting workshops and seminars on innovation management, and he is the CEO of his own company and Co-Owner at Googol Business Navigator.

4.1.1.2. EXPERT [E2]: PROFESSOR AT THE DEPARTMENT OF INNOVATION AND ENTREPRENEURSHIP AT THE SCHOOL OF BUSINESS, ECONOMICS AND LAW, AT THE UNIVERSITY OF GOTHENBURG

Is performing research in the fields of; Innovation, Entrepreneurship, Strategy and Organization, Science and Technology Policy/Studies. Lecturing in the fields of; Strategic Management, Entrepreneurship, Research methods and Innovation. Author of 16 published articles related to his research field. Apart from academia he has worked as management consultant and was appointed board member of Venture Cup West.

4.1.1.3. EXPERT [E3]: PHD INNOVATION MANAGEMENT

Has been active in innovation development the last 10-12 years. He has knowledge from both working practices with innovation, and from the academic perspective. He has a PhD in Innovation Management from KTH in the area of Integrated Product Development / Innovative Product Development. He wrote his Master Thesis for Volvo AB. After that, he worked as a consultant for; Volvo Cars; a few years at Electrolux in Italy as a Project Leader, back in Sweden he worked a while for Volvo again, and he then finally ended up at SCA. He brings a wide knowledge from four large Swedish multinational companies product development initiatives.

4.1.2 EMPIRICAL FINDINGS FROM THE EXPERT CONSULTATION

In Appendix 5, you can find the interview guide that has been the foundation for the semi-structured interviews with the experts.

TABLE 4.1.2.1. EXPERTS' ANSWERS TO THE QUESTION "WHAT IS RADICAL INNOVATION?"

Question: What is Radical Innovation?	
Interviewee	**Response: The Radical Innovation…**
[?] Example Interviewee	*… Is for example…*
[E1] Expert	… can be divided into adjacent innovation and transformational innovation. Adjacent innovation is about going with new solutions to the customers of today, or looking for new customers with a current solution. Transformational innovation constitutes something that is entirely new for the industry. The core business is about incremental innovation, and doing the things we did yesterday for the customers that we had yesterday. … needs to be categorized, because when the type of innovation is defined, this explains what one's innovation strategy really is and what kind industry one is in. If radical innovation is not clearly defined, incremental innovation will be developed instead.
[E2] Expert	… is in general, innovation constituting some kind of renewal. … is determined by the degree of newness, hence comparing an innovation to the current offerings available.
[E3] Expert	… implies that the company, goes beyond its comfort zone, creates a product that is different from the current offering. Thus moves outside the core focus area.

Question: What are the Strategic Implications with Radical Innovation?		
Interviewee	**Response**	
[?] Example Interviewee	+ Positive arguments	– Negative arguments
	… Other thoughts	
[E1] Expert	+ Good for a company that wants to be a lead innovator and fast-follower.	– Not as useful for a company that is in a slow-moving industry and that is happy being a medium-fast-follower. – Costly procedure to find out which ideas are valuable or not. – Changing the existing development activities could disturb the organizational processes.
	… If one is a lead innovator one is either a tech driver or need-seeker. If a firm shall be a lead-innovator, you need to, on average, spend 1/4 of its total development potential on unexpected breakthroughs. … Defining radical innovation can align an organization and make it more successful in its development of radical innovation. … The composition of the three different types of innovation differs remarkably in companies, depending on which innovation strategy one has. … Companies sometimes say: "We always want to invest in profitable ideas", which is almost like saying "Lottery tickets are great. I only buy winning lottery tickets". It is costly to find out which ideas are valuable or not. … It is very rare for ideas to appear prior to the demand from market has become reality. … Large incumbent firms will most likely focus on what they are good at in terms of innovation development (incremental innovation). They are also good at developing such innovation. Engaging in radical innovation development.	
[E2] Expert	+ Can result in increased competitiveness and economic growth. + Possible future long-term success.	– Hard to develop the competence needed for radical innovation development.

			– Hard for large companies to the utilize resources of activities and processes that do not promise profit – Uncertainty is costly – Hard for large incumbent firms to develop radical innovation since it requires to be developed through close dialogue with market, which is hard for a large company to do from an organizational perspective.
		… Regarding radical innovation, it could be beneficial, but it is easier to succeed if a radical innovation is connected it to current competences. … In order for radical innovation to survive an open culture towards discussions is required, and nothing can be black and white. … Radical innovation should be considered for the long-term perspective … All types of innovation can result in value creation … There is a lot of uncertainty in the light of radical innovation and one needs to be brave to be able to discuss it in the open. … For large incumbent firms focusing on incremental innovation is highly argued, since that is where the revenue streams come from. … Whether radical innovation is beneficial or necessary for an organization is determined by the contextual characteristics and what position the organization would like to hold. … Telecom company would need more high pace development than a food producer. … From a business perspective, it is always about increasing competitiveness.	
[E3] Expert	No specific		– If a firm is happy being a follower, focusing on radical innovation can be unnecessary. – It is expensive for a large firm to re-arrange their existing incremental innovation development activities to radical innovation development activities, since that means uncertain profits.
		… Engaging in radical innovation can change the way a company is perceived by its existing and new customers … Large companies seem to focus more on the exploit phase of innovation, meaning	

	that companies exploit the steady resources that they already have instead of trying to explore new grounds, which does make sense, since the existing business is what in many cases contributes to the company's profits in the first place.

Question: How to Organize the FFE of Radical Innovation?	
Interviewee	**Response**
[?] Example Interviewee	*… Making examples…*
[E1] Expert	… Using a "Stage-Gate" model is a sure way to ensure mediocrity, and not good for the development of radical innovation. Since radical innovation is about developing something entirely new, then it should be done in a completely new manner. … Engaging with radical innovation processes through a so-called Lean Startup approach. … Collaborating more with start-ups since it is incredibly rare that large incumbent firms succeed in doing it on their own. … Appointing an Open Innovation Director. To create radical innovation a firm need to reduce its pride and look for competence outside the company boarders. … Creating an internal incubator could stimulate innovation but these rarely succeed if the acceleration process is not managed properly. Innovators need to get direct access to potential customers to test their ideas. … Developing radical ideas in continuous dialogue and symbiosis with the market in order to understand the actual demand.
[E2] Expert	… Decreasing the focus on numbers, potential market shares, ROI and so on. These measuring exercises require that you have knowledge about the market and it becomes quite obvious that one cannot get this type of information when evaluating radical ideas. … Increasing the level of open climate is suggested. … Ensuring that radical innovation activities actually yield returns in other measures than economic profit. … Focusing more on which strategic areas in which the company wants to become profitable in, in the future, and perform activities that increase knowledge in these areas. … Increasing the trust in the people of the company, since they constitute the

	foundation of the capability building.
[E3] Expert	… Increasing the level of trust in the workers of the company. If a worker does not feel he/she has trust from other colleagues, then that worker will not feel encouraged to tell the other colleagues about his/her new idea. … Find a balance between exploring and exploiting. Exploring means finding new opportunities, while exploiting is about utilizing earnings from existing offerings. … Defining the area from which you want new ideas from, at an early stage. It is difficult to find an idea on the outside the company, bring it to the company, and say "Hey, look at this opportunity!". The demand for new ideas needs to start with internal demand to get attention. … Specifying a task that you want solved, can boost creativity.

4.2. VOLVO

4.2.1. THE BACKGROUND OF VOLVO

Volvo Group was founded in 1927, as a subsidiary of SKF. The company is a global player in the fields of trucks, buses, construction equipment and marine power and genset engines. Volvo Group employs approximately 95 000 people, has production in 18 countries and has market presence in more than 190 countries (Volvo, 2016). Volvo Group Trucks is one out of six business areas, and like the name implies, mainly constructs trucks. Volvo Group Trucks consists of five departments, where Volvo Group Trucks Technology is one of them, where most of Volvo Group's technical development takes places. Within Volvo Group Trucks Technology exists five focus areas, where Technology Product Project and Powertrain are two of them. Technology Product Project consists of five focus areas, where Advanced Technology and Research is one of them. Advanced Technology and Research makes room for another five areas of development, where Technology Strategy & Innovation is one of them. Technology Strategy & Innovation is a department that is active globally, which drives five main areas; Development of the Group Technology Plan; External Research Collaborations; Group Trucks Innovation Framework; Emerging Technologies Investigations; and Technology Intelligence. As previously mentioned, some organizational changes have been made since the writing of this paper (see section 3.8.3. Unexpected Re-organization for details, and Figure 4.2.1. for the Organizational Chart of Volvo).

FIGURE 4.2.1. THE ORGANIZATIONAL CHART OF VOLVO
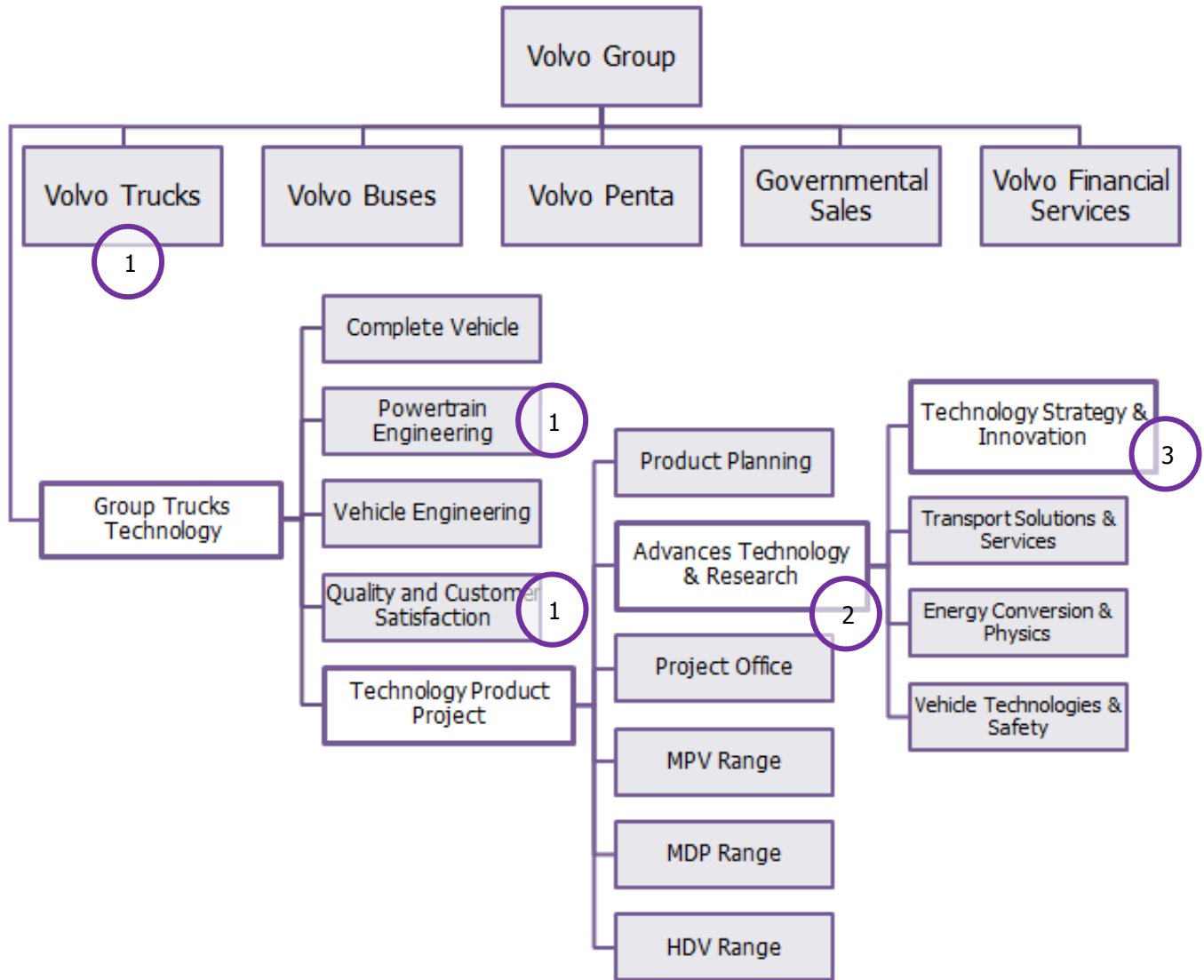
The interviewees are constituted mainly by individuals present at the Advanced Technology and Research department, except for three. One of them is active at Volvo Trucks, one at Quality & Customer Satisfaction, and the other at Powertrain Engineering.

The thesis started through dialogue with the [V1] F. Director of Technology Strategy & Innovation.
Secondly the [V2] Innovation Manager was appointed this thesis' supervisor, and has therefore answered questions throughout the writing of the thesis. The individuals; the [V4] Emerging Technology Manager; the [V7] Director of Technology Strategy & Innovation; and the [V8] Knowledge Management Specialist, are all present at the Technology Strategy & Innovation department. Their knowledge was considered very valuable since the thesis work regarded as such innovation that was being developed at this department. However, interviewing the [V5] Director of Environment & Innovation at Volvo Trucks; the [V3] Strategic Planner at Quality and Customer Satisfaction; and the [V6] Software Leader & Software Engineer at Powertrain was essential, in order to grasp

important insights from other organization units as well. The interviewees and their positions are defined in Table 3.5.2.

4.2.2 EMPIRICAL FINDINGS FROM VOLVO

In Appendix 4, you can find the interview guide that has been the foundation for the semi-structured interviews with the Volvo interviewees.

TABLE 4.2.2.1. VOLVO INTERVIEWEES' ANSWERS TO THE QUESTION "WHAT IS RADICAL INNOVATION?"

Question: What is Radical Innovation?	
Interviewee	**Response: The Radical Innovation…**
[?] Example Interviewee	*… Is for example…*
[V1] Former Director of Technology Strategy & Innovation	… Is such innovation that offers a different and new type of business model and/or technological suggestion."
[V2] Innovation Manager	… According to me is something that requires a significant shift in technical competence.
[V3] Strategic Planner	… Is when one develops an offer that is new in terms of business model offer and technology. Then it can be called radical I think.
[V4] Emerging Technology Program Manager	… Is new in terms of business model and technical competence. … Is such development that requires different types of innovation processes and technology knowledge compared to incremental innovation.
[V5] Director of Environment & Innovation	… Is when we do something extraordinary and when we search for new opportunities of business. … Is when we do something ahead of our competitors. … Is for example, The Dynamic Steering.
[V6] Software Leader & Software Engineer	… Is a new area of development for Volvo. … Is for example, iSee (Volvo Trucks [A], 2017) and iShift (Volvo Trucks [B], 2017) that were developed at Volvo Group Trucks Power Train. … Is not developed through incremental innovation development processes.
[V7] Director of Technology	… Constitutes new types of business models and/or technologies, compared to

Strategy & Innovation	what already exists.
	... Is for example, electric driven vehicles and autonomous vehicles.
[V8] Knowledge Management Specialist	... And the degree of radicalness depends both on knowledge of company and individual.
	... Is more radical when the degree of knowledge gap is larger.

TABLE 4.2.2.2. VOLVO INTERVIEWEES' ANSWERS TO THE QUESTION "WHAT ARE THE ADVANTAGES AND DISADVANTAGES WITH RADICAL INNOVATION DEVELOPMENT?"

Question: What are the Advantages and Disadvantages with Radical Innovation Development?		
Interviewee	**Response**	
[?] Example Interviewee	*+ Positive arguments.*	*− Negative arguments.*
	... Other thoughts.	
[V1] Former Director of Technology Strategy & Innovation	+ Not be outrun tomorrow + Not lack behind in terms of knowledge in technology in the industry + Have the chance to gain economic growth.	− Disrupt existing company development processes.
[V2] Innovation Manager	+ Make novel ideas survive. + Develop knowledge capabilities and long term success. + Stay prepared for the future. + Obtain new economic rents. + Be able to stay in the forefront when it comes to the product offer.	− Difficult to combine with existing business. − High risk to pursue radical opportunities.
[V3] Strategic Planner	+ Failing means that you learn. Edison once said that he knew 10 000 ways of not creating a lighting bulb. + To generate knowledge that can be applied in the future.	− Difficult to connect radical innovation development with existing incremental innovation development. − Uncertainty is the most expensive factor. − Expensive to re-allocate or employ

		new resources to focus on radical innovation.
[V4] Emerging Technology Program Manager	+ To stay in the forefront in future challenging technologies, and survive in a future intense market. + Keep an industry leading position.	− Hard for a large company like Volvo to make reality.
	… Top managers believe that the radical innovative ideas that grow in Volvo and at departments like ours are geeky ideas with little real value. In order for radical innovation to be able to grow top managers believe that the re-organization of the core processes and resources is too problematic.	
[V5] Director of Environment & Innovation	+ Can contribute to the growth of the business in the future, according to macro-economic-trends today.	− Volvo is already very good at incremental innovation. Perhaps not necessary to be good at radical innovation as well. − Hard to motivate radical innovation development since it follows such an unstructured process compared to the traditional incremental innovation development.
[V6] Software Leader & Software Engineer	+ For the sake of influencing a creative culture at Volvo. + To stay in the forefront of knowledge building and stay as an industry leader.	− If all resources would be invested in such innovation, it could negatively affect revenue streams.
	… Radical innovation is a new area of development for Volvo	
[V7] Director of Technology Strategy & Innovation	+ Can decrease the level of threat felt from competitors.	− Volvo does not have the perfect organizational structure for radical innovation to be realized. − Radical innovation is not yet an area where large sums of money are gained from.
	… Since we are in the business-to-business field, our markets move slower than for example the electronics B2C market, where great radical innovation company examples like Apple exist. There is simply a difference between business-to-customer and B2B.	

	... If Volvo suddenly offered radical products to market, the market would be surprised and perhaps even disrupted since the customers are not prepared for change.	
	... It is natural for the top management to direct the majority of their resources on incremental innovation development, since this is the area where the large majority of revenue is generated from.	
[V8] Knowledge Management Specialist	+ Obtaining the benefits of being the first-mover, such as growth possibilities and competitiveness.	− Carrying greater costs.
	... If a company should engage in such activities, they need to weigh the costs and benefits for each case. The cost is connected to the knowledge gap.	

TABLE 4.2.2.3. VOLVO INTERVIEWEES' ANSWERS TO THE QUESTION "HOW TO ORGANIZE THE FFE OF RADICAL INNOVATION?"

Question: How to Organize the FFE of Radical Innovation?	
Interviewee	**Response**
[?] Example Interviewee	*... Making examples...*
[V1] Former Director of Technology Strategy & Innovation	... Focusing on the outside of the Core Business as well. ... Creating an incubation unit (like the Innovation Garage) to grasp ideas outside the existing business, can help influence a creative culture throughout the company. ... Using an incubation unit helps a company get out of the regular and rather static incremental innovation development process that hinders radical ideas to grow.
[V2] Innovation Manager	... Creating a parallel organization or incubation unit. ... Implementing the roles of innovation coaches who can help motivate and encourage idea creators to test a novel idea. The innovation coach should also function as a network creating unit.
[V3] Strategic Planner	... Changing the existing KPI:s would be needed, since it makes people so focused on the incremental innovation. ... Changing the culture through leaders who are stronger at leading rather than

	organizing. … Strengthening the communication and connection and thereby decreasing the information gap between the later parts of the emerging technology development phases and the first stages of the product development process.
[V4] Emerging Technology Program Manager	… Simplifying the organizational chart so that decisions are more easily and faster made. … Decreasing the number of high level decision-makers. … Implementing the roles of innovation coaches, who could help idea creators develop a strong business case, in order to make it possible for the idea to be further developed in the existing product development process.
[V5] Director of Environment & Innovation	… Creating a supporting culture, where roles and responsibilities are clear. … Shaping motivational incentives towards radical innovation. … Freeing more time and capital for these incentives … Giving more power to the operational individuals, since many radical innovations from the past have grown from creative, engaged and smart individuals at these levels. … Forming idea-jams. … Decreasing the collaboration and communication gaps between radical innovation developing units and incremental innovation developing units. … Measuring radical innovation to a higher extent. It could help give directions for initiatives. … Supporting and inspiring suppliers to work with innovation and new solutions. Volvo annually gives an innovation prize to the most innovative supplier of Volvo. Most of the innovative solutions that are built inside Volvo's products come from innovative suppliers. … Giving people "free-time" to work with projects that interest them. There are examples historically where development managers allowed "skunk work" or some kind of grey zone, in which people got time to work with things that were not normal and usual tasks, and these individuals managed to come up with radically innovative products and solutions. However in a company like Volvo that wants to control costs to a high extent it is difficult to allow for such work and processes. Today all working hours need to be reported and that does harm radical innovation development, since every time someone wants to develop something outside the box, they need to ask for time and money. Being required to ask for time and money each time does harm creativity and thus the radical innovation development. … Having a good understanding for the environment and the trends that might be relevant to the developing company. In order to be succeed with the development

	of radical innovation there needs to be a unitary understanding for the trends in the environment, all the way from technology developers to the marketing and sales departments of an organization.
[V6] Software Leader & Software Engineer	… Allowing people free time to develop what they believe. … Making the top-management change the ideology towards radical innovation into something positive. … Supporting those individuals who have novel ideas (and possible future successful innovations). … Not solely focus on which processes should exist in order for radical innovation to be developed, since many ideas are best developed under the grid, outside processes, because those who feel motivated and enthusiastic enough will do it under the grid, on their free time, are probably also those who have what it takes to manage develop and network their idea throughout the organization. … Emphasizing an acceptance towards a radical innovation culture does a lot to the outcome. A shift in the attitude towards radical innovation at any department could result in that a few successful radical innovations come through. … Allowing individuals to visit exhibitions in order to gain knowledge in different areas. … Arranging innovation workshops/competitions internally ("Hackatons") and externally (student competitions) in order to generate new interesting ideas. These events help emphasize a creative culture and also help attract engineering students to Volvo Group for the future. … Setting up goals that are hard to manage, in the workshops and competitions in order to make people think differently and come up with gracious solutions.
[V7] Director of Technology Strategy & Innovation	… Creating a platform where developers can test their ideas. … Offering something like a starting-kit that is offered to anyone who wants to develop a radical idea. Such a starting-kit could contain working hours and other types of tools in order for the idea developers to get the initial support that they might require in an early stage of development. … Releasing time and resources towards radical innovation development processes. … Taking care of ideas from the outside in the right manner. … In order to take care of external ideas, the right questions need to be asked. Asking how the use of Volvo Buses in Gothenburg could be done differently could be good question, while the question regarding the construction of the engine of the Volvo Buses might be a bad question to ask, since the inventors on the outside might have ideas that work against the current constituents of the vehicle engines.
[V8] Knowledge	… Decreasing the gap between the people developing extreme radical knowledge

Management Specialist	and those people who hold knowledge in incremental innovation development. … Increasing the presence of people (e.g. innovation coaches) who can bridge these types of knowledge gaps, who also can persuade others to support radical initiatives.

4.3. CASE COMPANIES

In this section, eight case companies have been approached and they have contributed with answers by semi-structured interviews. Note that, there is only one representative from each company (except at the [C3] Home Appliances Company). Hence, the innovation activities are presented from a single person's perspective and each respondent might not grasp in detail, the complete innovation situation at these companies. However, all respondents have positions that are associated with innovation and possess general knowledge about corporate innovation initiatives. However, the purpose of the case companies' participation, is not to learn in detail about each specific company's innovation activities, but rather investigating the greater issues of radical innovation in large multinational corporations. This information will be of great inspiration to the main case of Volvo and to other large companies struggling with issues of radical innovation.

4.3.1. THE BACKGROUND OF INTERVIEWEES AT CASE COMPANIES
4.3.1.1. [C1] PACKAGING COMPANY

The interviewee has worked for [C1] Packaging Company since the 1980s. He started his career as an engineer but has during his time become more involved in strategic issues and held titles such as Director Development Strategy & Planning; Innovation Portfolio Manager; and today he is Portfolio Strategy Manager.

4.3.1.2. [C2] TECHNOLOGY AND SECURITY COMPANY

Three years ago the interviewee started working for the CTO at the [C2] Technology and Security Company, who manages the innovation programme. Today, he is employed as a consultant Innovation Manager on assignment for the [C2] Technology and Security Company, together with the Vice President for R&T with Product Portfolio Management and Innovation.

4.3.1.3. [C3] HOME APPLIANCES COMPANY

The interviewees are placed at one of many corporate Open Innovation Centres. Both have the title Open Innovation Manager, and both manage the whole spectra of open innovation activities. However, one is more focused on business driven solutions, while the other is focusing on global technology and industrial operations.

4.3.1.4. [C4] AUTOMOTIVE COMPANY

The interviewee realized, a few years back, that it is important to continuously challenge the core business. In 2009, it was decided to create an internal organization for Innovation to support the strategic development of the company, and she was part in developing this new internal organization. Today, her title is Director of Corporate Innovation Office.

4.3.1.5. [C5] BEARINGS COMPANY

The interviewee started her career as an engineer at the [C5] Bearings Company's research centre, 21 years ago. Since then she has worked in different roles at the company and over time gained more interest in business management. Today, she is the CTO and works at the same level as the CEO.

4.3.1.6. [C6] CONSTRUCTION EQUIPMENT COMPANY

The interviewee is the Director of Emerging Technologies and has responsibility for a department of research engineers, who work with future advanced engineering processes/solutions. She also has responsibility for the Fuzzy Front End of innovation at the [C6] Construction Equipment Company.

4.3.1.7. [C7] INDUSTRY TOOLS AND MACHINES COMPANY

The interviewee is manager at the Mechatronics Department and R&D, at the business unit of Industrial Technique. He is also part of an R&T-board deciding on innovation investments. The interviewee was recommended by his colleagues, due to his commitment to innovation activities.

4.3.1.8. [C8] COMMUNICATIONS COMPANY

The interviewee is one out of seven Innovation Coaches, and acts as gatekeeper for the Innovation Garage and is highly involved in the innovation activities at the Gothenburg site. He holds the title Change Leader and has a background in engineering.

4.3.2. EMPIRICAL FINDINGS FROM THE CASE COMPANIES

In Appendix 4, you can find the interview guide that has been the foundation for the semi-structured interviews with the case company interviewees.

Question: What is Radical Innovation?	
Case Company	**Response: The Radical Innovation…**
[?] Example Company	*… Is for example…*
[C1] Packaging Company	… Is such innovation that is new in terms of business model and/or new in terms of product offer and business model. … Level depends on how it's communicated, and thus it is important to create a common language to be able to talk about innovation and make progress. (See Appendix 6 for more details on the innovation categorization). … Should be defined since innovation derives in communication. … … Definition made by an organization can help align it and make it strive towards the same goals.
[C2] Technology and Security Company	… Means the renewal of any area within the company; products, services, processes, business models or marketing. … Differs in process methodology compared to incremental innovation. …. Is about taking one big leap, while incremental innovation is about taking many small steps.
[C3] Home Appliances Company	… Is not really defined in any categorization system. … Along with incremental innovation constitute the processes of developing ideas into products and other solutions, by identifying customer benefits and adapt in order to fit the local markets.
[C4] Automotive Company	… Is one out of three existing innovation levels; incremental, evolutionary and radical at the [C4] Automotive Company. The categorization is determined by the degree of challenges the innovation implies to the following areas; technology, customer and market, organization, and resources. If every area is challenged by an idea or innovation project, it is considered radical.
[C5] Bearings Company	… Is not labelled in a specific way. Innovation as a wider term is described as solutions that solve real customer problems. There is no value to categorize innovation, and such a distinction could only be done by customers.
[C6] Construction Equipment Company	… Is categorized as such when there is a significant level of newness in technology and in business model.

[C7] Industry Tools and Machines Company	... Is when you do something completely different from the current product offering.
[C8] Communications Company	... Is not clearly defined. ... Is not actively strived for. The company has a more pragmatic approach and constantly seek new business opportunities.

Question: What are the Advantages and Disadvantages with Radical Innovation Development?	
Case Company	**Response**
[?] Example Company	*+ Positive arguments* *– Negative arguments*
	... Other thoughts
[C1] Packaging Company	+ Stay in business in a long-term perspective. + Survive more than just one product life cycle. – Costly, since the delivery of and design of the product differs a lot, if it is a radical or incremental product
	...The new radical product can affect the brand image both positively and negatively. ... One example of how radical innovation development went wrong is the case of Nokia, where they only focused on their current product and field, which made them miss out on new opportunities when the industry started to change. Nokia was disrupted when new business models emerged and they made the wrong choices. Hence, organizations need to acknowledge the B and C type innovations to stay competitive. ... Innovation derives from communication. ... It is important to have separate processes to manage different levels of innovation, since different innovations need different managing techniques.
[C2] Technology and Security Company	+ Stay competitive and relevant. + To survive in the future. – Organizationally problematic due to cost management.

	… The [C2] Technology and Security Company has been driven by a demanding customer in the shape of the Swedish government and since Sweden has not been part of NATO a lot of the military technology has been demanded to be developed with a long-term perspective by the [C2] Technology and Security Company. It has been demanded by the government to perform various scouting activities where radical innovation development has been the result.	
[C3] Home Appliances Company	+ Possible early profits and brand reputation.	– If one fails it can be very costly. – Needs to free resources from areas which already generate revenue streams.
	… The level of risk is dependent on the radical degree that is embedded in the solution. Thus, there is no clear answer and it depends on what specific product that the [C3] Home Appliances Company has in its pocket.	
[C4] Automotive Company	+ Be in the forefront of technological knowledge.	– Tricky in terms of organizational structure, which can affect the core business.
	… The strategy could be described as a bubble that limits innovation to specific areas, most people need to be in that bubble to work efficiently. However, some employees need to question the boundaries of the bubble and that the [C4] Automotive Company should have a few people working outside the bubble.	
[C5] Bearings Company	+ Possible to keep future leading positions (through innovation development, not radical innovation development specifically).	– Taking too major leaps in technology means too high risk. – The business model can be damaged if a company offers products that are not in line with the existing product offers.
[C6] Construction Equipment Company	+ In order to not lag behind in technology development.	– Time allocation is expensive.
	… The company wants to have the position as the technology leader, thus, innovation is even more important. The world is more and more about software and everything becomes more and more connected. These facts have forced the company to understand that radical innovation is important and that it will be pointless to keep old technology and products alive forever. The product life cycle of the current products will end if the company don't manage to integrate emerging technology. The company would according to the interviewee not survive in the long-	

	term if it was not integrating new technology constantly. … We use future accountants who grade how much they believe in ideas for the future. Some radical ideas have large future potential.	
[C7] Industry Tools and Machines Company	+ In order to not be disrupted in one's business + Radical innovation development was what made us successful and strong towards competitors twenty years ago, when we managed to create machinery that was a lot more efficient compared to the machines of competitors.	– Some businesses, like ours, do not have so much radical changes, and therefore it can be seen as pointless in investing in, and investments in radical innovation can confuse existing core customers. – Some unrealized incremental projects are definite profit makers, and these would have to be put off in order to focus on radical innovation. – Since profitability needs to be constant and not fluctuate as much, in order for a business to do well short-term, it can be hard to motivate radical innovation development, since it can create such fluctuations short-term.
	… the company is in a relatively stable and slow-paced industry.	
[C8] Communications Company	+ Hard for competitors to imitate, since radical innovation is connected to many dimensions, such as technology, business modelling and delivery. + To obtain growth from areas that currently are not profit generating. + In order to stay in business and be updated on emerging technology. + Can result in future leading successes.	– Time consuming to manage in terms of cost.
	… The company is in an industry which moves at an immense speed, and the need for innovation development is thus high. … If a company should engage in such activities, they need to weigh the costs and benefits for each case. The cost is connected to the knowledge gap.	

Question: How to Organize the FFE of Radical Innovation?	
Interviewee	**Response**
[?] Example Company	*... Making examples...*
[C1] Packaging Company	... Selecting business ideas based on facts. ... Directing breakthrough of innovation by aligning the external environment with strategic priorities and current/future customers' preferences. ... Aiming to be an ambidextrous organization, both making core business more efficient and stay open to change. ... Encouraging intrapreneurship ... Using company specific analysis methods, such as the DFV analysis
[C2] Technology and Security Company	... Utilizing portfolio management in order to spread risks and simultaneously invest in radical and incremental ideas. ... Using strategic and technical road-maps in order to steer innovation activities. ... Measuring more radical innovation. What gets measured, gets done! ... Encouraging a culture that encourages failing in development processes. Creativity is not enhanced by blame. ... Creating a culture that encourages passionate individuals. ... Establishing a network of innovation coaches who can support passionate individuals and help them build a business case. ... Utilizing the capabilities of venturing organizations order to bridge the gap between the company and external business environment. Such departments can spin ideas in and out.
[C3] Home Appliances Company	... Utilizing Open Innovation Units for the process of boundary spanning in the organization and find new opportunities for new products. ... Implementing Open Innovation Networks since this can result in the greatest of innovations. Examples of external partners in such networks are; private inventors, universities, external R&D-centres and start-ups. ... Defining the direction of what the Open Innovation Units should focus on. This can be done by senior boards, top managers and product line managers, who together set strategic road-maps, which guides the search for new ideas and the selection of new ideas. ... Considering to a higher extent the...

	• Customer benefits. • Strategic fit in relation to innovation focus areas. • Unique selling points. • Features of the general business case … Looking for alliances that might contribute to new solutions. … Using innovation ambassadors who are distributed in the global organization and who are trained in open innovation processes who can sponsor new projects within their function. … Making sure that people working with innovation have access to proper resources. In terms of financial resources, people, assets and time to be able to innovate. … Stop implying the "you cannot fail!"-ideology, which will not contribute to new innovation. Employees will then only improve what they already have. Why would they take the risk to innovate if there is no tolerance for failure?
[C4] Automotive Company	… Making ambidextrous organizations which are meant to manage to facilitate both the incremental and radical development in symbiosis. … Having a Corporate Innovation Office, where a set of people who promote innovation throughout the organization. They look for intrapreneurs and supply them with networks and resources.
[C5] Bearings Company	… Using development processes that are fast and agile. Hence, minimizing the risk of going in the wrong direction and at the same time improving the hit-rate of new products. Scrum management as an example of such a process. … Decreasing hierarchy. Senior committees should not be in control of New Product Development processes. … Empowering people with knowledge to make qualified judgements. … Giving engineers free time to work with their own creative projects, which potentially could benefit the company or the company's customers. … Empowering developing engineers with the ideology "freedom with responsibility". … Embracing external collaborations, instead of doing everything in-house. … Starting with looking at customer benefits, since this is usually the starting point for innovation … Connecting your ideas to real-use-cases as early as possible.
[C6] Construction Equipment Company	… Networking more internationally, cross functionally and across different experience levels, which can generate new innovation projects and ideas. People who come up with new ideas are encouraged to take part in the development process to keep motivation.

	… Protecting ideas, otherwise they die. Therefore, the company has setup a special process for such ideas being very similar to an incubator. Inspired by start-ups these processes don't have any fixed activity structure. These projects aim to make the organization ambidextrous.
	… Using a sponsor group that manages this special process, consisting of representatives from R&D, sales/marketing, resellers, Volvo Venture Capital and financial services.
	… Selecting among different ideas, with less focus on the profit/risk and instead focus on the opportunity.
	… Offering more freedom to the people and project teams working with radical innovation. It has been concluded that what people need, working with radical innovation, more than anything is just that. Hence, the company is giving great autonomy to radical innovation project groups. The mind-set by the innovation coaches is represented by the quote "let's see how far you can get in three months?". Until that deadline, the cross-functional team are free to spend their time on the issues they believe are the most relevant to solve. Usually the team members that work in radical projects need to dedicate least 33% of their time to the project. Otherwise the daily tasks would hinder that individual to fully engage in the project.
	… Involving the customer early in the development process, since customer feedback is a very important part of the development process.
	… Decreasing the amount of reporting requirements for the people involved in radical innovation development. Generally, at Volvo Group employees always need to account for their time but in the radical innovation process all employees (except R&D) can join without adding costs to the specific project. This is a way that these radical projects are beneficially subsidized in order to survive.
[C7] Industry Tools and Machines Company	… Encouraging intrinsic motivators, since they are seen as important to the stimulation of innovation.
	… Allowing free hours, on a weekly basis, for engineers to engage in projects that they personally feel motivated to do.
	… Implementing innovation workshops. The company regularly hosts "creative days" where employees can engage in explorative problem-solving. These days are not mandatory but the start-up-meeting is mandatory, even if you do not want to work with creative processes. At the start-up-meeting the employees who would like to engage in a project present their idea with focus on the hypothetical customer benefit. After the start-up-meeting, the employees are dedicated 24 calendar hours of creativity. Even if, the employees only get paid for 8 hours, many of them work more than those 8 hours on their own initiative. Some work late in the afternoon and

	some arrive exceptionally early in the morning to work on their projects. There is always a great and inspiring atmosphere during the creative days. During those 8 hours, which sometimes result in 12 hours, there is great productivity but also a lot of joy among the employees. One of the activities implemented is "The A3-process" which helps mature new ideas. When an employee has an idea that person constructs a business case and presents it on an A3 canvas, which is later presented to co- workers and managers for feedback and re-evaluation. When the canvas is filled with notes and the idea has matured it can be presented to a Senior Board and possibly get further funding. The Senior Board pick ideas ad hoc based on experience and the arguments on presented by the A3-canvas. However, customer- value is always considered and every new idea needs to be connected to a potential area of application. The A3-process is one of the processes that make the employees work longer than they are paid for. … Using cross-functional teams. When a team is composed at the company, the cross-functional ability is prioritized. Engineers are usually teamed up with individuals from the marketing and/or sales department.
[C8] Communications Company	… Implementing an innovation garage. The "Innovation Garage" was recently created. This is a forum where ideas can be discussed in the open. The leaders of The Innovation Garage encourage collaborations with external companies and a type of Open Innovation approach is practiced. … Increasing external collaborations. All ideas are welcome to The Innovation Garage, but the ones that we prioritize are connected to an external partner. The Innovation Garage is a tool to collaborate with other companies and to conquer new ground. … Using innovation coaches. Innovation coaches contribute in the Innovation Garage by supporting idea creating groups to get the support they need to develop their product/idea further. The Innovation Coaches also help with the networking part of the idea development process.

5. ANALYSIS

In this chapter, the empirical findings will be studied from an academic lens obtained from the theoretical framework and the expert consultation. First, the definition of radical innovation will be discussed. Then, the advantages and disadvantages with radical innovation development will be highlighted. Lastly, the organizing activities for the FFE and the Fuzzy Front End Radical Innovation Landscape Model will be conversed based on the viewpoints of the theory, experts, case companies and Volvo.

5.1. WHAT IS RADICAL INNOVATION?

In the theoretical framework it was found that there is not any consistency to the term radical innovation. It seemed to vary depending on factors such as time and context. However, radical innovation is commonly referred to as new technology and business model novelty, as stated by Pisano (2015). While some scholars propose evaluation by the effect on future markets or future changes in consumer behaviour. This was treated by Dahlin and Behren (2005) and their theories regarding two different approaches;

ex ante - focusing on the current situation and the future business potential, or
ex post - no definition beforehand only looking at the market impact, which cannot be determined before a product launch.

At the FFE the future is unknown, hence defining radical innovation in that context should turn towards an ex ante approach, and the word "potential" is central to such definition rather than actual outcome.

Only two out of nine case companies have a corporate definition of radical innovation. One is the [C4] Automotive Company which categorizes innovation in three levels; incremental, evolutionary and radical. The categorization is determined by the degree of challenges the innovation implies to the areas technology; customer and market; organization; and resources. If every area is challenged by an idea or innovation project, it is considered radical. The [C1] Packaging Company also has a three-dimension definition. They have level A, B and C. Type A stands for sustaining innovation and improvement of existing products or processes; type B stands for business model innovation that redefines the way the [C1] Packaging Company does its business; and type C is considered as new business creation. The other case companies did not have any corporate definition. The answer received from most interviewees was instead their own interpretation of the term. The most commonly mentioned definitions touched upon the combination of new technology with new business modelling.

The [C5] Bearings Company implies that there is no value for the organization to categorize innovation. That kind of distinction could only be done by customers. Hence, the [C5] Bearings Company takes an ex post approach towards the innovation categorization, not defining anything before the effect of a new product is actually realized. A similar approach is taken by the [C3] Home Appliances Company, that do not have a categorization

system but drive innovation from customer benefits and market opportunity. The [C1] Packaging Company has a definition because it has concluded that innovation derives from communication. Thus it is important to speak a common language to make innovation progress. This is in line with [E1] Expert who implied that organizations need to define radical innovation, otherwise they will only do incremental projects. Innovation should be categorized, because when innovation is defined, it explains the company's innovation strategy, whether the company is a lead innovator, or a tech driver, or a fast-follower, or a need seeker ([E1] Expert). Together the [C1] Packaging Company and [E1] Expert suggest that a common definition of radical innovation could align an organization and make it more successful in its development of radical innovation.

Conclusively, radical innovation should always be considered as something subjective that is interpreted in different ways, by organizations and by individuals. Schilling (2013) discussed the importance of context when discussing innovation labelling. It was also a common finding among the case companies to relate to radical innovation as something new to the company, as Volvo interviewee [V6] Software Leader & Software Engineer stated; 'radical innovation is a new area of development for Volvo'. The [C4] Automotive Company define radical innovation dependent on the level of organizational challenges in areas of technology, customer and market, organization, and resources. Hence, the companies' own situations seem to be central to the determination of what is radical or not. This is not in line with theory that rather suggests that a radical innovation is new to the market or the world.

TABLE 5.1.1. LIST OF THOSE COMPANIES THAT CATEGORIZE INNOVATION AND THOSE WHO DO NOT

Do Categorize Innovation	Do not Categorize Innovation
[C1] Packaging Company	[C7] Industry Tools and Machines Company
[C4] Automotive Company	[C3] Home Appliances Company
	[C8] Communications Company
	[C2] Technology and Security Company
	[C5] Bearings Company
	[C6] Construction Equipment Company
	Volvo

Volvo interviewees	Case Companies
[V1] F. Director of Technology Strategy & Innovation	[C1] Packaging Company
[V3] Strategic Planner	[C6] Construction Equipment Company
[V4] Emerging Technology Program Manager	
[V7] Director of Technology Strategy & Innovation	

5.2. ADVANTAGES AND DISADVANTAGES WITH RADICAL INNOVATION DEVELOPMENT

Worth to consider when reading the mentioned advantages and disadvantages is that the factors mentioned here is what has been mentioned by the interviewees in their answers. This means that some interviewees might agree about an advantage or disadvantage although they have not mentioned it. However, what one can conclude from the stated advantages and disadvantages is that these factors are relatively important in comparison to other factors according to the interviewees, since they did mention them in the interviews. It is also important to take into account the fact that only one interviewee represents one company and therefore the company as a whole can have a different view on the advantages and disadvantages. The advantages and disadvantages listed are the most commonly mentioned advantages and disadvantages with radical innovation development, according to the data providers (such as the theoretical framework, experts, case companies and Volvo) of this paper.

5.2.1. ADVANTAGES

TABLE 5.2.1.1. ADVANTAGES WITH RADICAL INNOVATION DEVELOPMENT MENTIONED BY THE INTERVIEWEES

Advantages with Radical Innovation Development	Theory	Experts	Volvo	Case Companies
Growth	YES	1/3	4/8	3/8
Long-Term Persistence	YES	1/3	5/8	5/8
Attaining Industry Leadership	YES	1/3	4/8	4/8

5.2.1.1. GROWTH

An advantage that some empirical groups consider when working with radical innovation development was the opportunity of growth. When engaging in radical innovation development it means that an actor engages in areas that the actor is not familiar with since before. Schilling (2013) mentions that a company who engages in radical innovation development has the chance in obtaining new customer bases by early obtaining scarce resources; key locations; government permits; access to distribution channels; and early strong relationships with suppliers. Schilling (2013) argues that a technology leader who has developed technology that is difficult to imitate or is covered by a patent, could secure monopoly rents, and therefore also secure growth. If a company manages to obtain scarce resources and key locations etc. at an early stage, it means that the competitiveness that they gain from it can result in economic growth.

The [E2] expert stated that all types of innovation can result in value creation, and from a business perspective, it is always about increasing competitiveness, which the growth opportunity does. It was also stated by the [V5] Director of Environment & Innovation at Volvo that the economic trends prove that radical innovation can lead to growth. The [V1] F. Director of Technology Strategy & Innovation, the [V2] Innovation Manager and the [V8] Knowledge Management Specialist all discuss the possibility of economic growth. For the [C7] Industry Tools and Machines Company, radical innovation was what made them successful and strong towards competitors twenty years ago. The radical innovation implemented some years ago made their machines more efficient compared to the machines of competitors, and thereby contributed to their growth. The [C3] Home Appliances Company mentions that radical innovation can result in possible early profits and brand reputation. The [C8]

Communications Company also highlights that radical innovation development can mean that the company obtains growth in areas that have not already generated profit.

5.2.1.2. LONG-TERM PERSISTENCE

A second advantage that a larger part of the empirical groups agreed upon as being significant was the Long-Term Perspective. The long-term existence of a company, according to Raish et al. (2009), depends partly on that company's ability to pursue searching activities, and thus radical innovation development, while pursuing the advancement of existing business capabilities. Also, Schilling (2013) and Markides and Sosa (2013) stress that launching radical innovation products can result in a long-lasting reputation, in terms of brand loyalty and technology leadership.

The [E2] expert says that a company is required to consider the long-term perspective, and one of the activities to do so is to engage in radical innovation development. At Volvo, the [V3] Strategic Planner stresses that developing radical innovation can be very important for a company in the long run, since it generates knowledge that can be applied in the future. The [V1] F. Director of Technology Strategy & Innovation, the [V2] Innovation Manager, the [V4] Emerging Technology Program Manager and the [V5] Director of Environment and Innovation agree with the [V3] Strategic Planner and all stress the future as important in their comments. Throughout the years, the [C2] Technology and Security Company has been driven by a very demanding customer, the Swedish government. Since Sweden has not been part of NATO, much of the defense capabilities have been developed within the country. the [C2] Technology and Security Company has been demanded to perform various scouting activities where radical innovation development has been the result. The radical innovation development can be seen as one of the big reasons for the [C2] Technology and Security Company's long-term survival. The [C1] Packaging Company stresses that surviving more than just one product life cycle is a reason for radical innovation to be developed. The [C5] Bearings Company explains that the future is considered when they develop products. The [C6] Construction Equipment Company uses Future Accountants who look at the future potential when it comes to innovation and some of the radical innovation is expected to have high future impact. The company would not survive in the long-term if it was not for its constant integration of new technology that emerges. The [C8] Communications Company also believes that radical innovation has the chance to improve the chances of future success.

5.2.1.3. ATTAINING INDUSTRY LEADERSHIP

A third advantage that some of the empirical groups endorsed as important is the opportunity of attaining the industry leadership. When engaging in a new type of technology, a company could improve its image among potential customers, sustain brand loyalty as well as keep market shares, even after competitors have introduced comparable products (Schilling, 2013; Eisenhardt & Martin, 2000).

According to the [E2] expert, engagement in radical innovation can result in competitiveness, and thus a leading position in the industry. According to the [V1] F. Director of Technology Strategy & Innovation and [V2]

Innovation Manager at Volvo, radical innovation is important in order to stay prepared for the future and be able to stay in the forefront when it comes to product offers. Also, the [V4] Emerging Technology Program Manager and the [V6] Software Leader & Software Engineer stress that radical innovation can motivate an industry leading position. The [C6] Construction Equipment Company strives upon having the position as a technology leader, and thus, innovation development is very important. Since the world is becoming more and more focused on software, the [C6] Construction Equipment Company tries to tackle this by adjusting their innovation development model towards new software development. The [C6] Construction Equipment Company has understood that radical innovation is important and it would be pointless to keep old technology and products alive forever. the [C2] Technology and Security Company does not specify that they want to be an industry leader, but they stress that they want to stay competitive and relevant, as well as survive in the future, and that radical innovation can help them in getting such results. The [C4] Automotive Company say that radical innovation can assist them in being in the forefront of technological knowledge capability. The [C5] Bearings Company stress that through innovation they can keep leading positions in the future. The [C7] Industry Tools and Machines Company argue that radical innovation can help them avoid being disrupted in their business. The [C8] Communications Company describe that radical innovation is required in order to stay in business and updated on emerging technology, which can result in future leading successes.

5.2.2. DISADVANTAGES

TABLE 5.2.2.1. DISADVANTAGES WITH RADICAL INNOVATION DEVELOPMENT MENTIONED BY THE INTERVIEWEES

Disadvantages with Radical Innovation Development	Theory	Experts	Volvo	Case Companies
Costly Development	YES	3/3	4/8	6/8
Disruption from Existing Core Business	NO	1/3	5/8	4/8
Developing Technology that is Not Demanded by the Market	YES	3/3	2/8	2/8

5.2.2.1. COSTLY DEVELOPMENT

According to Golder and Tellis (1993), 47 percent of the radical innovation that was developed failed. Schilling (2013) explains that one reason can be that the radical innovation developer carries a large portion of cost.

Costly development seems to be a common disadvantage regarding radical innovation development among the interviewees. The [E2] expert expounds that companies are afraid of engaging in radical innovation development because it is costly to find out which ideas are valuable or not. It is difficult to evaluate if that idea could create value outside the building. The [E2] and [E3] experts agree and stress that uncertainty is a costly factor for companies. The [V3] Strategic Planner also highlights the problem of uncertainty. In terms of radical innovation development the uncertainty is what affects the perceptions of costs the most. Not only is the research and development expensive, but a research development that does not manage to advance in the company does also cost a great deal. If a company has previously been focusing on incremental innovation development that company needs to either free time or hire new individuals in order to be able to focus on radical innovation development and hence also re-organize workforce resources. The [V5] Director of Innovation and Environment explains that it is hard to motivate radical innovation development since unstructured activities are required to succeed with radical innovation. Unstructured activities also mean increased costs for a set of activities that you are not certain will generate profit. The [V7] Director of Technology Strategy & Innovation and the [V8] Knowledge Management Specialist agree with the two colleagues above, and stress that it is costly to re-arrange development processes which have long been meant for incremental developments into radical development. According to the [C3] Home Appliances Company, engaging in radical innovation is important, yet costly. A company that engages in radical innovation needs to free resources from areas which already generate revenue streams. The [C7] Industry Tools and Machines Company stresses that a large problem for incumbent companies is the cost management. The profitability needs to be constant and not fluctuate too much, which radical innovation naturally can result in. The [C1] Packaging Company also highlight the costs. The [C2] Technology and Security Company stresses that it is due to cost management organizationally problematic. The [C6] Construction Equipment Company mention the time allocation that is expensive, while the [C8] Communications Company mention that radical innovation is time consuming which relates to cost management.

5.2.2.2. DISRUPTION FROM EXISTING CORE BUSINESS

As stated by Slater et al. (2014), a company that wants to engage in radical innovation development needs to support their employees with the right types of resources, psychological support and appropriate metrics. In order to succeed with radical innovation development, a company needs to conduct complex configurations of components that require seemingly paradoxical skills. Since the development of radical innovation is in need of very contextual needs, a simple development process framework will not work, and this is why the authors of this paper believe that radical innovation can disrupt existing core business. Experienced employees that have worked with the structured incremental innovation development processes of a company for a long time can be afraid of new radical and un-structured development. The integration between incremental and radical innovation is difficult, and requires a fine-tuned ambidextrous organization, as stated by O'Reilly III and Tushman (2004). The

literature does not state the problem of disruption from the core business, but the authors of this paper have tried and explain why companies might identify this as a possible problem.

The [E1] expert states that large incumbent companies are good at developing products that are similar to the ones that they already have. If they would try and produce products that were new to the company, that could disturb the organizations processes. At least that is the belief of many company top managers, according to [E1] expert. The [E2] expert also highlights that a large company that engages in radical innovation can be perceived differently by its existing and new customers, and hence that could disrupt their core business. According to the [V4] Emerging Technology Program Manager, the top level managers still believe that radical innovation is harmful to the Volvo brand, and that the suggestions that grow in the Technology Strategy & Innovation department are usually viewed as geeky solutions. In order for the rest of the company to put such ideas into development, it needs to adjust other core processes in order for the new idea to fit, and that demands too many resources to be re-organized. This idea is agreed on by the [V7] Director of Technology Strategy & Innovation, the [V5] Director of Environment & Innovation, the [V1] F. Director of Technology Strategy & Innovation and the [V3] Strategic Planner as well. Since the majority of the existing development processes at Volvo are meant for incremental innovation, introducing more radical innovation activities might harm the existing processes. Also, today it would be difficult to combine the existing incremental innovation development process with the types of radical development processes, according to all five interviewees. The [C5] Bearings Company stresses that the Business Model can be damaged if a company quickly offers products that are not in line with the existing product offers. According to the [C1] Packaging Company, there are big differences between the development processes for incremental innovation and radical innovation, in terms of the delivery and the design of product. Hence, the demanded altered offer can therefore affect the brand image that a company has, both positively but also negatively. The [C4] Automotive Company mention the trickiness in terms of organizational structure that needs to be arranged, which most likely at first disrupts the core business. The [C7] Industry Tools and Machines Company stresses that since they are in an industry that is very stable, engaging in radical innovation development too much can confuse existing customers, and thereby also the core business.

5.2.2.3. DEVELOPING TECHNOLOGY THAT IS NOT DEMANDED BY THE MARKET

According to Schilling (2013), the existing infrastructure and complementary products might be lacking, in order for a new developed technology to be demanded by the market. The example of the iPhone is given. It is unlikely that the Apple would be as demanded if it was not for the variety of applications that existed upon its release.

The [E1] expert announces that it is very rare for ideas to appear before the actual demand from market. In order to create a product that is demanded by the market, one needs to do so in symbiosis with the market. The [E2] Expert agrees that it is difficult for large incumbent companies to develop products through close attention to the demands of the market. The size of the company hinders it from making adjustments in accordance with the requests from the market. All experts [E1], [E2] and [E3], stress that large incumbent companies naturally will focus on what they are already good at, which is incremental innovation development, since that is what positively affects the revenue streams and is known to be demanded by the market. According to the [V5]

Director of Environment & Innovation and the [V7] Director of the Technology Strategy & Innovation, Volvo is in a slow-paced industry where the importance of radical innovation is not seen as too large. They explain that if Volvo would suddenly offer radical products to market, the market would be surprised and not ready for those products since customers are not prepared for that change or offer in products. The [C5] Bearings Company explains that there are different ways in offering a radical product. Either one can develop a radical innovative product that the customer is unprepared for, or one can develop a radical innovative product in cooperation with a customer. It is through the second alternative that the level of uncertainty can be decreased, according to the [C5] Bearings Company. The [C7] Industry Tools and Machines Company stresses that since they are in a business that is moves at a slow pace, much like what Volvo explained previously, too radical innovation development offers to customers would not be demanded, since the complementary products do not exist yet.

5.2.3. STRATEGIC IMPLICATIONS WITH RADICAL INNOVATION DEVELOPMENT

As have been shown above, numerous advantages and disadvantages are stressed regarding the development of radical innovation. There is no advantage or disadvantage that is mentioned by every interviewee and the reason for that is simply that the interviewees have different individual work situations and experiences. The companies that the interviewees work at are also active in different contexts and markets. For example, the [C7] Industry Tools and Machines Company mentioned something about each of the three most commonly mentioned disadvantages, and that could have to do with the fact that the company is in an industry which does not face much change at this moment. Therefore, can radical innovation development seem as something troublesome for the company, although they have mentioned several advantages with radical innovation development as well. Similarly, the [V5] Director of Environment & Innovation and the [V7] Director of the Technology Strategy & Innovation at Volvo stressed that Volvo is in a slow-paced industry where the importance of radical innovation is not seen as too large. In comparison, it is interesting to read how the [C8] Communications Company looks at the advantages with radical innovation development. It is shown that the [C8] Communications Company mentions all of the three most commonly mentioned advantages and that could presumably be connected to the industry in which the company is in. The [C8] Communications Company is in the industry of communications (see 4.3.1.8.) which is an industry where technology is developed at an immense speed. This could be one simplified explanation to why radical innovation development is observed with a more positive attitude among companies in fast-paced industries compared to companies who are in industries in a slower pace. Conclusively, the contextual aspects that surround each company and interviewee seem to affect how they evaluate the work with radical innovation development.

5.3. ORGANIZING THE FUZZY FRONT END OF RADICAL INNOVATION

5.3.1. ACCORDING TO THE THEORETICAL FRAMEWORK AND EXPERT CONSULTATION

Reid and De Brentani (2004) explain how their model of the FFE Framework describes the interplay of the environment; the individual; and the organization. A balanced interplay is demanded in order for radical

innovation to be developed, according to Reid and De Brentani (2004). The FFE framework created by Reid and De Brentani (2004) consists of three perspectives and three interfaces, where the interfaces are what connect the three perspectives. The perspectives are the environmental (and market); the individual; and the organizational. The three interfaces comprehend the boundary; the gatekeeping; and the project. As have been visualized, The Fuzzy Front End Radical Innovation Landscape Model (see Figure 2.4.1.) will be used in order to, in more detail, describe the constituents of the different parts in the FFE process. In this section, those constituents will be described and compared to the arguments by the three experts; [E1], Affiliated Professor at the Centre for Business Innovation at Chalmers; [E2] Expert, Professor at the Department of Innovation and Entrepreneurship at the University of Gothenburg; and [E3] Expert, PhD Innovation Management.

5.3.1.1. ENVIRONMENT AND MARKET

The Environment is the region, conferring to Reid and De Brentani (2004), where industries, markets, institutions and countries affect what is being innovated. The environment is considered to be the main source of inspiration to radical innovation developers (Reid & De Brentani, 2004). [E1] Expert somewhat agrees and explains that in order for companies to manage radical innovation they should use a so-called Lean Startup methodology, which means that you unremittingly develop a product in symbiosis with the customer and/or market. Exploring the environment is also an activity to grasp what might fit into the outside market, [E3] Expert suggests. Teece et al. (1997) and Leifer et al. (2001) explain that some companies succeed because of their dynamic capability, which is about reconfiguring one's resources in accordance with the changing market. Reid and Brentani (2012) explain that a company has to depend on a complex and nebulous image of the future and the possible concurrences among existing products, services and business models. In order to grasp inspiration from outside of the company, [E1] Expert suggests that companies can implement Open Innovation activities, meaning that collaborations are created with other companies, outside the company's borders. Through such collaborations can the company teach the surroundings about their knowledge while getting other knowledge back in return. Although the environment is important in order to get inspiration, [E3] Expert highlights the importance of internal demand for ideas as well. He stresses that if a company does not have an internal demand in the first place, it is hard for ideas from the outside to get any attention. In order to counter such consequences, companies can specify in which type of areas the company is interested in new ideas. It is about specifying a task that one wants solved, which can increase the room for creativity of developing ideas. [E2] Expert agrees with [E3] Expert in that companies can do well in specifying what areas they are interested in discovering new technologies and knowledge, in order to make the company work more effectively with radical innovation development.

The environment can be engaged by an individual who has the function of a boundary spanner. This means that the individual scans the outside to understand what new ideas inspired from the outside might fit with the company that they work at. It can be difficult for the company to form boundary spanning activities efficiently. One suggested solution, according to [E1] Expert is to implement a Director of Open Innovation, who can emphasize the importance of external collaboration and help guide employees into this dimension of idea

searching. Similarly, Brentani and Reid (2012) argue that individuals should have the option to attend industry conferences that are tangential to their discipline.

5.3.1.2. INDIVIDUAL

The individual perspective defines, according to Reid and De Brentani (2004), how individuals impact the innovation process by interpreting information and transferring information. The individual has big importance when it comes to radical innovation, since they are the ones that can understand emerging patterns in the environments due to their human capabilities such as intuition. Incremental innovation development is more easily initiated at organizational level because technological and/or market conditions for such innovations are easier to predict and anticipate. [E3] Expert acknowledged the need for trust in employees. He stressed that each worker need to feel trust from their surroundings in order to feel brave enough to develop something that is outside of the box. If they do not feel that there is a support and positive attitude in the surroundings, the encouragement to develop something new will not exist. Frishammar et al. (2016) suggest that involving creative individuals with different knowledge bases and life perspectives is essential to succeed with radical innovation. [E2] Expert agrees with [E3] Expert as he thinks individuals institute the radical innovation development capabilities of the company. According to [E1] Expert, a Lean Startup methodology should be carried out in order to succeed developing new ideas and products. [E2] Expert adds that the capabilities of different individuals need to be put together, almost like a small company, because it is easier then, to drive the business cases forward, and for people with different competences to collaborate. Experts [E1] and [E2] are agreeing in that the process of radical innovation development could be seen as the creation of a small business that continuously listens to the market demand and the opinions of the company. All experts, [E1], [E2] and [E3], agree that the individual matters a lot in order for a large incumbent company to develop radical innovation. [E2] Expert also highlights the role of intrapreneurship since radical innovation needs help in avoiding the process-orientation generally existing in large companies. According to Reid and De Brentani (2004) individuals institute important roles in the FFE process, and more specifically there are three, such as the boundary spanner, as have been already mentioned, the gatekeeper; and the champion (these two roles are described in 5.3.1.1. and 5.3.1.3.).

The gatekeeper is an individual who has the mandate to share an individual's idea throughout the rest of the company. A gatekeeper could for example be an innovation coach, which will be (described in more detail in Appendix 8). One aim for a gatekeeper could be for example to efficiently help develop ideas that are valuable to the company. Another aim for a gatekeeper can be to keep ideas that are too irrational outside the innovation development processes, which is a tricky part when it comes to radical innovation development (Schilling, 2013). [E2] Expert mentions that in order to succeed with radical innovation, individuals who act as gatekeepers should be able to consider other measurements than return on investment, potential market shares and so on. Thus, he implies that such individual needs to be flexible and not be as strictly influenced by formal measurements, which generally exist in large companies.

5.3.1.3. ORGANIZATION

The last perspective, emphasized by Reid and De Brentani (2004), is the Organizational, and concerns the company-level processes that contribute to the organization's success by strategic, structural and resource planning. It is the organization that can decide how resources are controlled and directed. The ideas by individuals need to be given resources in order to be further developed. The individual also needs help from the organization in order to market products. The organization thus needs to be able to influence the individuals to scan the market for ideas, while managing to incorporate them into the company and absorb their ideas in order to utilize possible future radical innovation profits. Reid and Brentani (2012) mention formal tools and informal processes as means to promote such successful idea scanning (boundary spanning) and individual incorporation. Firstly, formal tools can be described as fixed and structured tools similar to processes like the Stage-Gate model (see Appendix 8 for definition). The Stage-Gate model has lately become a common development tool that companies use in order to develop incremental innovation (Koen et al., 2002). [E1] Expert described this process as something that is not applicable for radical innovation development. The Stage-Gate model demands the user to unceasingly estimate the future profits according to different profit valuation KPIs, but since radical ideas can be hard to measure in terms of future profit they would die fast in a Stage-Gate development process. [E1] Expert nevertheless, explains another type of formal tool that could accentuate ideation and individual incorporation, and that is the tool of incubators. He argues that an incubator (see definition in Appendix 8) could stimulate innovation development. Secondly, Informal processes are other means to promote successful incorporation, according to Reid and Brentani (2012). Such informal processes touch upon culture management and learning activities among other things. A formal process such as an incubator, as suggested by [E1] Expert, could help influence a positive culture towards radical innovation, and could thereby affect the culture management of the company, and thus affect the informal processes as well. Another formal method that informally can affect a company is mentioned by [E2] Expert and that is to decrease the fixation on numbers, potential market shares, ROI and so on. He stresses that such measuring exercises require that you have knowledge about the market and it becomes quite obvious that one cannot get this type of information when evaluating radical ideas, since they are as uncertain as they are. Experts [E2] and [E3] agree that the environment is where ideas appear in the first place, and they stress that it is important to define what areas one is interested in exploring new ideas. If a company would to define the areas in which curiosity towards new ideas exists, it would be easier for the employees to know where to look, without being struck down when coming with a suggestion. The suggestion of more clearly defining a scope of interest is hence another example of a formal tool that can affect the organization informally.

According to Brentani and Reid (2012), another type of individual that is important in the context of the organizational perspective and in order for the organization to reach the market with newly developed ideas, is the individual who has enough authority in order for the larger part of the organization to listen to him/her. Such individuals can have an important role in the development of radical innovation, since they are thought to have the power to affect other higher level managers in a company. When they emphasize that an idea is good, it is likely that their colleagues agree with that. It is common, as have already been mentioned, for radical ideas to not get enough attention. Through the help of a champion, that problem could be avoided, and companies could

be introduced to new interesting radical ideas and possible future successes (Brentani & Reid, 2012). The role of a champion is not mentioned by any of the experts.

ORGANIZING THE FUZZY FRONT END OF RADICAL INNOVATION

5.3.2. ACCORDING TO THE CASE COMPANIES
5.3.2.1. ENVIRONMENT AND MARKET

As concluded in the theoretical framework, the environment is the starting point for radical innovation (Reid & Brentai, 2004). The empirical findings indicate that the case companies all have some kind of association with the external environment at the FFE. However, the level of association with the environment seems to be different among the case companies. In the table (5.3.4.1.1) three out of nine case companies are categorized as to have a higher level of association with the environment, due to a clear focus on environmental inspiration at the FFE; either expressed as direction by top management or is incorporated in the FFE process-design and partnerships.

TABLE 5.3.2.1.1. COMPANIES' LEVEL OF ENVIRONMENTAL ASSOCIATION

High Environmental Association	Lower Environmental Association
[C3] Home Appliances Company	[C1] Packaging Company
[C8] Communications Company	[C2] Technology and Security Company
[C5] Bearings Company	[C4] Automotive Company
	[C6] Construction Equipment Company
	[C7] Industry Tools and Machines Company
	Volvo

The [C3] Home Appliances Company is one company categorized to have high association with the environment, mostly because of its Open Innovation Centers. By having externally focused business units constantly dipping into networks of universities, external R&D-centers and start-ups; the information exchange between environment and individuals within the organization is considered strong. It is un-mistakable that top management of the [C3] Home Appliances Company, has acknowledged the importance of the inflow of external competences, since The Open Innovation Centers are established in many countries and have access to quite extensive resources. These resources are not necessarily financial resources, the interviewees implied that senior managers and personnel from products lines were to some extent engaged in the progression of the Open Innovation Concept. Similar to an Open Innovation Center, the [C8] Communications Company has the

"Innovation Garage" with high focus on external collaboration. For ideas to be accepted onto the Innovation Garage they need to have a contemplated external application and preferably an external partner, which can be involved at the FFE-phase and continue to be involved during the whole NPD process. Volvo also has an Innovation Garage (although, not yet fully implemented) but the main difference between the [C8] Communications Company and Volvo is the extensive external focus by the [C8] Communications Company.

The [C5] Bearings Company is also categorized in the column of high association with the environment. The company has acknowledged the importance of external collaborations when exploring unfamiliar ground. Instead of promoting in-house innovation activities the top management promote new collaborations for its innovation activities.

All of the other case companies have some kind of organizational directed boundary spanning activities towards the environment. For example, some companies have corporate experts in a specific technology area that visits industry conferences; and some companies keeps close contact with customers and/or suppliers to co-develop and/or improve products. However, the three companies in the left column (see table 5.3.2.1.1.) seemed to have particularly strong environment focus, represented by designing organizational structures and processes to embrace the environment connectedness.

Finally, the environment could be verified as an important perspective for the FFE of radical innovation, in line with Reid and Brentani (2004); however only three out of nine companies in table 5.3.2.1.1. is signaling its importance by resource allocation, top management directions and incorporating an open innovation approach, which is validated as the best practice to develop radical innovation by Experts [E1] and [E3].

5.3.2.2. INDIVIDUAL

The individual perspective is concerned with how individuals impact the innovation process by information interpreting and information transferring. According to Brentani & Reid (2012), the individual has a greater significance to radical innovation than to incremental innovation. Additionally, the push for incremental innovation usually arises within the corporate level of decisions, as part of the firm's stated NPD or growth objectives. For radical innovations, the process tends to work in the opposite direction. In other words, organizational-level involvement is more likely to be at the discretion of individuals, thus, radical innovation has a bottom up approach rather than top down. To facilitate this bottom up approach Brentani & Reid (2012) suggest individual acknowledgement by freedom and intrinsic motivators. Koen et al. (2002) stress a greater processes orientation, instead promote practices that are empowering individuals rather than controlling them. This reasoning was to great extent supported by the case companies and in this section the individual perspective will be debated from the case companies' viewpoints and related to the individual roles presented by Reid and Brentani (2004).

TABLE 5.3.2.2.1. COMPANIES' LEVEL OF INDIVIDUAL ACKNOWLEDGEMENT

High Individual Acknowledgement	Low Individual Acknowledgement
[C1] Packaging Company	
[C2] Technology and Security Company	
[C3] Home Appliances Company	
[C4] Automotive Company	
[C5] Bearings Company	
[C6] Construction Equipment Company	
[C7] Industry Tools and Machines Company	
The [C8] Communications Company	
Volvo	

The boundary spanner finds patterns in the environment and identifies market needs. This role is acknowledged by all companies to some extent, at least for subject specialists within the firm. E.g. at Volvo, people with interest in and knowledge within a specific field are allowed to spend time strengthening their knowledge by researching, networking and visiting industry conferences; the [V6] Software Leader & Software Engineer for example. Another practice is employed by the [C3] Home Appliances Company and the [C8] Communications Company; they also facilitate forums in terms of Open Innovation Centers and Innovation Garages at which boundary spanning activities can be performed by almost any enthused individual within the firm. The general boundary spanning activities that reach the greater mass of the personnel are hard to assess. At most companies there is a desire of boundary spanning activities to take place but it seems difficult to assign resources, the focus is generally fixed towards the standardized tasks that cultivates incremental innovation.

The gatekeeping role evaluates potential ideas and their relevance to the organization. For incremental innovation the individual has very little impact on evaluation processes and it is generally controlled by processes and criteria. Radical innovation is to a higher degree controlled by personal conviction of the business potential of radical ideas (Martinsuo and Poskela, 2011). Some of the firms facilitate forums in which the individual preferences can trump, the otherwise rigid processes developed for incremental improvements (see table 5.3.2.2.2). E.g. the [C7] Industry Tools and Machines Company has a Senior Board that evaluates, among other things, A3-sheets by employees who have new business proposals. The Senior Board's evaluation criteria are not specified, instead they make ad hoc decisions based on gut feelings and use their aggregated experiences to view a business case from the larger perspective. Another example of individual acknowledgement in the gatekeeping

role is presented by the [C5] Bearings Company. It is aiming to decrease the hierarchical levels of the organization and decreasing layers of complexity. If an engineer truly believes in their idea, that engineer has approximately 20% of her time to allocate to projects of choice. If investments need to be made the decision power is pushed down the organization, empowering people with knowledge in that particular area. Also mentioned, was the direct communication between top R&D management and the employees. Anyone with a visionary idea can come up to the top R&D managers and discuss them, enhancing the possible influence of individuals who are visionaries.

TABLE 5.3.2.2.2. EXAMPLES OF HOW FIRMS FACILITATE FORUMS IN WHICH THE INDIVIDUAL CAN BE HELPED TO OUTDO EXISTING RIGID PROCESSES

Company	Activity
[C7] Industry Tools and Machines Company	Senior Board that evaluate A3-sheets and base their decisions on experience and intuition.
[C4] Automotive Company	The CIO which is separated from the regular NPD-processes.
[C6] Construction Equipment Company	Innovation coaches and IT system
[C5] Bearings Company	Decrease hierarchy and available free time that gives the individual the opportunity to take own initiatives.
[C8] Communications Company	The Innovation Garage and innovation coaching
[C3] Home Appliances Company	The people working with open innovation had great liberty but otherwise it was unclear, although they had innovation ambassadors.
Volvo	The Innovation Garage, although yet not fully launched

Regarding the championing role, an example was found at the [C4] Automotive Company. A new business idea of combining vehicles with online shopping, which was at first accepted onto the CIO, gained great attention when an influential manager caught the idea and believed it would fly. Instead of continuing with the dynamic process plan of the CIO, the top management wanted the idea (the new potential product) to be launched immediately. Greater resources were assigned, directions were given for different departments to allocate personnel to the NPD and suddenly a radical product leaped through the FFE and became a viable product. Otherwise the champion role was not really discussed by the case companies.

Most case companies mentioned the intrapreneur as an important role for radical innovation, which is a phenomenon that incorporates, to some extent, all the previous mentioned individual roles: boundary spanner,

gatekeeper and champion. The [C1] Packaging Company claimed that it is important to protect radical initiatives and encourage visionaries to pursue their goals to facilitate radical innovation. This was said while discussing the topic of intrapreneurship. The [C2] Technology and Security Company, believes in creating a culture that encourages passionate individuals and potential intrapreneurs by establishing a network of innovation coaches who can support these individuals and help them build a business case. At the [C5] Bearings Company, developing engineers are empowered with the ideology "freedom with responsibility", giving them greater autonomy and room for new business initiatives. In table 5.3.2.2.3. the companies that tangent the concept of intrapreneurship in their reasoning regarding FFE of radical innovation, are presented.

TABLE 5.3.2.2.3. LIST OF COMPANIES WHO RECOGNIZE INTRAPRENEURSHIP AS AN IMPORTANT PART OF THEIR BUSINESS DEVELOPMENT

Company	Definition
[C1] Packaging Company	Intrapreneurship
[C2] Technology and Security Company	Passionate individuals
[C4] Automotive Company	Intrapreneurship
[C7] Industry Tools and Machines Company	Passionate individuals
[C8] Communications Company	Passionate individuals
[C5] Bearings Company	Passionate individuals
Volvo	Intrapreneurship

Two companies did not mention intrapreneurship, although that does not necessarily imply that these companies do not adhere to the intrapreneurial logic. Due to the different mentalities, the above is putting rather great responsibility on the individuals of the organization to network and perform promoting activities on their own, while the below tries to minimize the risk of individuals with potential not stepping up to the intrapreneurial role.

- [C3] Home Appliances Company – greater trust in the Open Innovation Centers with a clear networking focus.
- [C6] Construction Equipment Company – greater trust in facilitating formal and informal platforms to for networking.

According to [E2] Expert, innovation is all about creating a small little company, and that is why intrapreneurship is quite a good term, because it's about creating a small company with entrepreneurs who drive the business case forward and doing business. The more radical something becomes, the more separated this business case/group is from the rest of the company.

What was found among the case companies was great support for the individual role at the FFE for radical innovation, This strengthens the theory of Brentani and Reid (2012), Koen et al. (2002), and Reid and Brentani (2004). It seems likely that the information flow at the FFE is bottom-up rather than top down, at least by analyzing how the companies organize for these kind of activities. In general, the management technique seems to be focused on a liberal approaches empowering rather than controlling, giving individuals the opportunity to grow their own ideas and be motivated by that.

Regarding the allocation of terms, such as boundary spanners, gatekeepers and champions, which exist in the FFE according to Reid and Brentani (2004), these were not necessarily supported by the case companies. In some cases, it was found that these roles did exist but in general most companies bundled these terms together and described intrapreneurs instead. However, the assessment of the terms of these three individual roles was helpful when examining the activities performed by the case companies at the FFE; and they could be beneficial to consider when designing future FFE activities. Finally, the findings regarding the individual perspective is in line with the experts who highlighted the individual role and referred to the concept of intrapreneurship.

5.3.2.3. ORGANIZATION

Insights from the literature review suggested that the organizational perspective is concerned with firm-level processes that contribute to the organization's success by strategic, structural, and resource planning. The organization could be seen as a system that uses tools and processes to control resources and give direction to individuals, and they can be employed in a formal and informal, "hard or soft", way (Martinsuo & Poskela, 2011; Reid & Brentani, 2004; Koen et al., 2002). Essential to note in the context of radical innovation or any NPD process; is that individuals don't create, develop, or market new products; these activities are performed by the organization. Hence, ideas from individuals need to be absorbed by the organization to get access to resources and eventually reach the market (Reid & Brentani, 2004). Thus, the ability for the organizational processes and tools to absorb and manage radical innovation is crucial for the innovation success. The organizational perspective of the FFE is highlighting the role of the firm-level processes (actions) that enable individuals to pursue ideas with radical potential. In this section the firm-level processes of case companies will be analyzed through their ability to achieve innovation success.

Five out of nine case companies (Volvo, [C4] Automotive Company, [C3] Home Appliances Company, the [C8] Communications Company and the [C6] Construction Equipment Company, see table 5.3.4.3.1.) facilitates a special path for NPD of radical innovation, separated from the NPD of incremental innovation. Volvo has its new Innovation Garage, with the purpose of finding ideas of radical potential and realizing them by cross-functional agile management teams, financed by a specially dedicated budget. The [C4] Automotive Company has the CIO office which aims to work outside the traditional scope, ideas come from different parts of the organization and if they seem promising there are some kind of stage-processes specially designed to accelerate radical innovation. The [C3] Home Appliances Company has its Open Innovation Offices spread out over the global organization, with the purpose of boosting innovation (though, not particularly radical innovation) by increasing environment connectivity. To guide the open innovation efforts there are technology road-maps and when ideas have a

consistent business case they are sent to the product lines for further development. The [C8] Communications Company has started Garages at different corporate locations to enhance innovation and to find new business opportunities. Individuals can approach the Garage Managers, who act as some kind of innovation coaches, with their ideas and if the ideas have potential they can be accepted onto the Garage. The [C6] Construction Equipment Company has built a digital forum for any kind of innovation, at which employees can debate the future development of the company and create threads regarding new product development. Innovation Coaches can see what kind of threads that attracts attention; or the idea holders could ask for Innovation Coach support. If the threads are connected to any of the five AE programs (Machine Intelligence/User Experience, Concept and Structure, Engines and Hybrids, Service Solutions, and Methods) they might be accepted onto the program and be further developed. The FFE at the [C6] Construction Equipment Company constitutes a mix of crowdfunding of ideas, Innovation Coach support and finally an innovation development program.

TABLE 5.3.2.3.1. COMPANIES THAT ORGANIZE TO FACILITATE THE FFE OF RADICAL INNOVATION

Has got alternative paths for Radical Innovation	Trust in standardized NPD processes
Volvo	[C1] Packaging Company (Promoted Ambidexterity)
[C4] Automotive Company	[C2] Technology and Security Company
[C6] Construction Equipment Company	[C5] Bearings Company
[C8] Communications Company	[C7] Industry Tools and Machines Company
[C3] Home Appliances Company	

It seems clear that the five, above mentioned case companies, have an organizational strategy to facilitate the FFE of NPD or at least they have dedicated organizational resources to boost NPD. As mentioned in section 5.1 there is no holistic view of what radical innovation is and most companies do not define it at all. Hence, it is not correct to conclude that they are exclusively organizing for the FFE of radical innovation, however, they are organizing for ideas not fitting the standardized processes of incremental NPD. As suggested by Reid and Brentani (2004) the purpose of their FFE framework is to make the information flow from the environment, to the individual, to the organization as open for radical innovation as possible; the above actions taken by Volvo, the [C4] Automotive Company, the [C3] Home Appliances Company, [C8] Communications Company and the [C6] Construction Equipment Company] seem to be designed to do this. Another case company worth mentioning in this context is the [C1] Packaging Company that acknowledges the importance for having separate processes to manage different levels of innovation. Since different innovations should be managed differently, the [C1] Packaging Company implies ambidextrous organizational management as critical for radical innovation to grow

within large incumbent companies. Even if no concrete example at the [C1] Packaging Company was discussed for an alternate path, the [C1] Packaging Company seem to adhere to the concept of the alternate path for radical innovation.

Above, some case companies have presented examples of formal processes for managing the FFE of radical innovation, in terms of alternative paths (incubators, garages or innovation centers) besides the incremental or traditional NPD process. However, other kinds of formal practices were mentioned by the case companies to manage the FFE. The [C1] Packaging Company suggests the Lean Startup Methodology (see Appendix 8) which is iterative in its process approach. Similar to this, the [C5] Bearings Company referred to "Scrum Management" which is taught among the employees with the purpose to work in a more agile way. "Scrum Management" which, according to the [C5] Bearings Company, is a more "trial and error" approach is implied compared to traditional NPD processes and it has a better hit rate when products are finally launched. The [C6] Construction Equipment Company also suggest that their NPD is in line with the "Lean-Start-Up" methodology and that processes are iterative with customers and resellers being able to make pivots at the FFE of innovation. Other than organizational measures such as creating incubators, garages or innovation centers; the FFE can be designed to better facilitate innovation by embracing more iterative processes such as Lean-Start-Up or Scrum Management. This claim is in line with Koen et al. (2002) and their iterative model and the Experts [E1] and [E3] also discuss the importance of Lean-Start-Up Methodology. [E1] Expert says 'Innovation builds on experimenting throughout the process, and thereby understanding along the way'. What can be resolved for this is that not only how a company is formally organized but also the formal process methodology seems important for innovation and should be accounted for when organizing for the FFE of radical innovation. Preferably an iterative approach should be applied.

Whether above mentioned organizational initiatives and formal processes will be successful at developing radical ideas to radical innovation and radical products is dependent on informal organizational factors (Koen et al., 2002). They are built by culture and leadership and what is suggested by theory is that the informal should be softer managed for radical innovation than for incremental innovation (Brentani & Reid, 2012). What was found among all case companies is that the organizational culture was acknowledged as important but the question remains what kind of culture facilitates radical innovation and how to create such culture? Not all companies had any answer to this question but some presented basic advice and a brief description of their culture.

the [C3] Home Appliances Company, would like to spread the mentality of Open Innovation throughout the whole organization. This is done via Innovation Ambassadors that have been trained in Open Innovation practices and spread their knowledge to their "home" department. Another action taken is to spread success-stories regarding Open Innovation to boost the positive association of Open Innovation. Something else that is important to the [C3] Home Appliances Company's culture is the tolerance for failure. If failing is not acceptable employees will instead only improve what they already have. "Why would they take any risk to innovate if there is no tolerance for failure? ". This is supported by the [C2] Technology and Security Company, who described a true innovative culture as based on the open climate between the people in the workplace. A rich innovative culture should be carried by leaders characterized by curiosity and inspiring co-workers to explore new ideas. Some radical ideas

will fail and for people within the organization to feel encouraged and safe it needs to be ok to fail. As advice the [C2] Technology and Security Company suggests that the organization should try, is to capture value from that failure. Clearly the [C3] Home Appliances Company and the [C2] Technology and Security Company is implying an experimental and open culture where it is ok to fail.

Another example was given by the [C7] Industry Tools and Machines Company that works with inspiration activities, the company regularly hosts "creative days" where employees can engage in explorative problem-solving. These days are not mandatory but the start-up-meeting is mandatory, even if you do not want to work with creative processes. At the start-up-meeting the employees who would like to engage in a project present their idea with focus on the hypothetical customer benefit. After the start-up-meeting, the employees are dedicated 24 calendar hours of creativity. Even if, the employees only get paid for 8 hours, many of them work more than those 8 hours on their own initiative. Some work late in the afternoon and some arrive exceptionally early in the morning to work on their projects. There is always a great and inspiring atmosphere during the creative days. During those 8 hours, which sometimes result in 12 hours, there is great productivity but also a lot of joy among the employees.

Clearly, there are many different ways for organizations to facilitate an innovative and open culture and from the case companies it is impossible to present any reliable best-practice but the tolerance for failure is one important factor according to the [C3] Home Appliances Company and the [C2] Technology and Security Company. While inspirational and creative days are facilitated by the [C7] Industry Tools and Machines Company and the powertrain department at Volvo to create enthusiasm. The other case companies also mentioned culture as important but didn't present any clear examples of their work. At the [C8] Communications Company, creativity is incredibly important in order to stay in business and up to date, and can explain why they have amplified focus on their newly implemented Innovation Garage. People are being increasingly encouraged to participate in the Innovation Garage and the Innovation Coaches that are engaged in it are allocated more hours to help idea creators develop their ideas. The [C1] Packaging Company explain how they encourage intrapreneurship (see Appendix 8 for description of definition). In order to succeed with radical innovation, the [C3] Home Appliances Company highlight the need of acceptance towards innovative activities, and the [C2] Technology and Security Company agrees, saying that a culture that encourages failing should be implemented. Another reason for success with radical innovation is according to the [C4] Automotive Company through the activity of "hunting" intrapreneurs in order to help them innovate. At the [C5] Bearings Company they believe that in order to innovate successfully, people need to be given freedom with responsibility. The [C6] Construction Equipment Company argue that in order for radical ideas to succeed, they need help in surviving in the first development phases. The [C7] Industry Tools and Machines Company believe that encouraging individuals with intrinsic motivators is important in order to stimulate innovation. Conclusively, all case companies argue that cultural support towards radical innovation is required in order to succeed with such innovation. What can be deduced is that culture is important to the case companies and managers can take inspiration from the initiatives that were presented in this section.

Other takeaways form this section would be that five out of nine companies provide alternative paths for outside-the-box innovation via garages, incubators and open innovation centers. This should be considered as new findings since it was not discussed in the theoretical framework. The alternative path could be related to what Expert [E1] and [E2] referred to as "the small business", where knowledge is more easily exchanged and extensive collaboration take place. Having this kind of separate path could facilitate the small business within the super large case companies.

Finally, the [C1] Packaging Company, the [C5] Bearings Company, the [C6] Construction Equipment Company also highlighted the importance of iterative processes, which strengthens the theory by Koen et al. (2002).

ORGANIZING THE FUZZY FRONT END OF RADICAL INNOVATION

5.3.3. ACCORDING TO VOLVO

5.3.3.1. ENVIRONMENT AND MARKET

The [V5] Director of Environment and Innovation describes that there is some attention directed towards the outsides of the company, and he mentions an innovation prize that is given annually to the supplier that is the most innovative. Through this initiative, Volvo wants to involve and inspire suppliers to work with innovation and new solutions. This is one example of a boundary spanning activity where Volvo is reaching out to the external environment to enable innovation, however it is unclear to what extent the suppliers' innovation activities are incorporated at Volvo?

The [V6] Software Leader & Software Engineer gives an example of boundary spanning activities at Volvo. The company is sending area specialists to conferences and exhibitions in order to get inspiration from the outside and deepen their knowledge in the subject area. This enables information transferring from the environment to individuals within the company and could ignite new innovation projects. However, the main role of the specialists is to support any part of the organization that might need input from a specific field of knowledge not necessarily to support innovation.

A third example of boundary spanning, also presented by the [V6] Software Leader & Software Engineer, are the external "student competitions". At these events groups of students are usually challenged by being given problems and a deadline. There are many purposes to host these events. One is to attract young and talented engineers to become future employees. Another more relevant in this context, is to experiment and find new solutions to complex problems. Although, there are some troubles getting solutions strait from the environment according to The [V7] Director of Technology Strategy & Innovation. Solutions from the outside have a tendency to not fit the structure and the current business model of Volvo. Thus, the external idea generators do not understand the existing business to a high enough extent, which means that the ideas that come from the outside rarely can be further developed in-house.

Another finding is that Volvo seems to focus on already existing technology. The [V4] Emerging Technology Program Manager argues that Volvo generally develops technology only after that technology has gotten global attention and acceptance, and he believes this will hurt Volvo in the long run. To include the environmental aspect to a larger extent in an earlier stage could strengthen the future innovation capability.

Conclusively, even if there are some boundary spanning initiatives connecting Volvo to the environment, Volvo do not seem to enthusiastically promote such activities. The general mind-set is not as open at Volvo, compared to the other case companies in terms of getting influences from the environment. When developing new innovations at Volvo, it is preferred to do so in-house, rather than involving external partners.

5.3.3.2. INDIVIDUAL

The [V6] Software Leader & Software Engineer implies that it is the operational employee that is the reason for why radical innovation suddenly happens in the company, and Volvo has gained a lot of new products due to some of such bottom-up radical innovations in its corporate history. But what enables individuals to become innovative and push their ideas through the FFE and how is the current situation at Volvo?

According to [V5] Director of Environment and Innovation, the individual freedom for employees at Volvo is quite restricted, while referring to the strict requirements of reporting hours at Volvo. Tasks are seldom carried out in-officially, since hours always need to be reported. He implies that individuals need to be given "free-time" in order to develop things outside the standardized processes that interest them. By allowing this type of "free-time", radical innovative products and solutions could be achieved. Today, anyone who is working with NPD, is usually 100% occupied with incremental projects. This is good from a short term financial perspective and it enables Volvo to control its costs. Compellingly, the individual needs time dedicated to radical innovation for it to succeed, which does not seem possible with the current time-reporting system.

Another enabler for individuals to engage in innovation activities would be Innovation Coaches (iCoaches) suggested by [V2] Innovation Manager. According to the [V3] Strategic Planner, the [V4] Emerging Technology Manager, the [V8] Knowledge Management Specialist and [V2] Innovation Manager it is important to facilitate a supportive culture to guide employees and their ideas through the FFE, which is also stressed by Koen et al. (2002) and Brentani and Reid (2012). An iCoach would act as a mentor of some kind, but the work tasks are not clearly defined. Individuals who have ideas that are outside the normal box could then be encouraged present their ideas or discuss them with iCoaches. The iCoach is envisaged as someone who has some knowledge about the existing innovation development process at Volvo, but who also is interested in new radical types of technologies and ideas. Because the iCoach has experience in the existing innovation development, that means that the iCoach presumably would have a network of relevant contacts in the company, and these could be contacted if an iCoach has received an idea that the iCoach thinks is interesting and ready enough for further development. The roles of iCoaches could help encourage the culture that was highlighted as important. This is in line with Brentani and Reid (2012), who suggest that organizations that want to succeed with radical innovation shall put less focus on formal processes, and let the individual take own responsibility, and this is something that

could potentially be realized through the implementation of iCoaches. The existence of iCoaches could also improve the informal networks, which according to Brentani and Reid (2012) could increase the radical innovation development. The [V6] Software Leader & Software Engineer thinks that the role of an iCoach can help radical innovation to be brought to life.

Volvo is acknowledging the importance of individuals to the FFE phase of radical innovation. However, is is more talk than actions. ICoaches as mentors and innovation culture promoters are discussed as potential enablers as well as more individual "free-time" but nothing is yet fully realized.

5.3.3.3. ORGANIZATION

At Volvo, it is important to focus outside the Core Business, the [V1] F. Director of Technology Strategy & Innovation, contends. One way of doing that would be to create an incubation unit (the Innovation Garage for example) where ideas outside the box could get a fair chance. Such a unit could help influence a creative culture throughout the company, and is also seen as essential in order for radical ideas to be developed, according to him. If not an incubation unit of this kind is created, Volvo would need to start a business outside the existing business, since radical innovation, as have been mentioned previously by Brentani and Reid (2012), cannot be developed if it is put through the same development process as normal product development. The [V4] Emerging Technology Manager and the [V8] Knowledge Management Specialist agree on that the existing incremental innovation development process is not suitable for radical innovation development. The [V3] Strategic Planner stresses that the existing KPIs (Key Performance Indicators) hinder the development of radical innovation, since they force the innovation developer to do such activities that result in definite financial profit. At the FFE of the Innovation Garage, selection will be based on what is new and challenging to Volvo not as much focus towards financials according to the [V2] Innovation Manager. The Innovation Garage creates a separate path for radical ideas and initially protects them from the rigid processes of the otherwise incrementally focused organization.

A suggestion by [V7] Director of Technology Strategy & Innovation is to introduce an innovation start-up kit. Individuals who would like to test an outside the box idea, would be given this start-up kit together with free time to develop the idea and find out whether there is a potential value connected to the idea. The start-up kit could for example include working hours, some coffee and/or other tools that would make the first phases of idea development easier to some type of degree. If implemented, Volvo could announce this, through their internal systems, that the start-up kit exists for those who want to develop a novel idea of theirs. The [V7] Director of Technology Strategy & Innovation, believes that such an activity could be successfully combined with the iCoach suggestion. If Volvo would announce that these types of opportunities exist in the company, he says that a majority would probably not want to use this opportunity for various reasons such as; people not feeling the urge to develop new ideas or people not feeling they have enough drive in order to engage. He thinks however that implementing an activity like such could positively affect the attitude towards radical innovation throughout the company. But as mentioned this is only a future suggestion, not yet realized.

An important problem for the FFE of radical innovation, acknowledged by the [V4] Emerging Technology Program Manager, is the great amount of hierarchical levels at the company. There are too many decision makers from which new projects need approval. In combination with the KPIs hindering innovation and the decision making issue, the company becomes slower than it could be.

At Volvo the ideas are realtively isolated from the external environment, which is reflected in the mind-set. When developing new innovations at Volvo, it is preferred to do so in-house, rather than involving external partners. Still, one of three potential innovations has so far been co-developed with an external partner at Volvo, but the general mind-set is more in-house oriented, rather than seeking external inspiration and competences.

In general, when studying the FFE of radical innovation at Volvo, there were not many formal initiatives to support such activities apart from the newly started Innovation Garage. Instead the interviewees talked about what could be done rather than what is done; or they described processes for incremental innovation which are very rigid and have long lead time, according to the [V3] Strategic Planner.

Culture as an informal organizational commitment was to some extent mentioned by all interviewees and considered important for the FFE of radical innovation. Except for the opportunities given to specialists to visit conferences and the future suggestions; iCoaches and Innovation start-up kits, there is only one thing that have not yet have been discussed, the Hackathons initiated by [V6] Software Leader & Software Engineer. Every 10 weeks a creative event is launched at which engineers experiment with whatever they want for 24 hours. These Hackathons create enthusiasm among the colleagues and the environment. [V6] Software Leader & Software Engineer believe that these event inspires an innovative culture and he managed to convince his managers that Hackathons is beneficial for the company. This would support the fact that innovation culture is important at Volvo however there are not many great examples of cultural stimulation.

6. CONCLUSION

In this chapter this paper's four main findings are accentuated. One finding was identified in both research question "What is Radical Innovation?" and "What are the Advantages and Disadvantages with Radical Innovation Development"" while two main findings were found in the research question "How to Organize the Fuzzy Front End of Radical Innovation". These research questions are answered and this concluding chapter is finalized with suggestions for future research.

6.1. WHAT IS RADICAL INNOVATION?

It was important for this paper to comprehend how companies view radical innovation. It was found, that in order to reap the benefits of radical innovation a company should consider what they define as radical innovation. If the general organization consider radical innovation as "new to the firm" instead of "new to the market", that does not suggest that they would attain the expected advantage of such development. The advantages of growth, long-term persistence, attaining or holding industry leadership are connected to radical innovation as in "new to the market". In the study it was found that the case companies define radical innovation as something new and challenging to their own organization. Not as theory suggests, that it would be something novel to the market. This discrepancy between theory and practice creates difficulties when discussing the outcome of radical innovation. If a company performs radical innovation as in "new to the company" it could of course get other kinds of benefits e.g. learning and dynamic capability building as described by Kristiansen and Gertsen (2015). If a company is aiming to become industry leader and grow, as Schilling (2013) refers to when discussing first-movers, the definition of radical innovation should rather be new to the market. Thus to organize for the FFE of radical innovation a company need to clearly map its objectives unitarily and align them with a relevant definition of radical innovation.

- A company should clearly map its objectives unitarily and align them with a relevant definition of radical innovation, in order for the employees to know what innovation direction the company is taking.

6.2. WHAT ARE THE ADVANTAGES AND DISADVANTAGES WITH RADICAL INNOVATION DEVELOPMENT?

It was clear that there is a strategic choice to be made whether to spend resources and time on radical innovation. Depending on the strategic direction and industry characteristics for case companies, the advantages and disadvantages have different relevance among the case companies. In fast-paced industries there were a tendency to focus on advantages with radical innovation, and for slower-paced industries, disadvantages gained greater attention. It seems that, depending on the strategic motives of the case companies engaging in radical innovation activities, the choice and design of such activities differ. Therefore, the findings regarding the

organizing of the FFE is relevant for companies that act within industries where the discussed advantages of: growth, long-term persistence, attaining or holding industry leadership, outweigh the disadvantages of; costly development, disruption from the core business, and the risk developing technology that is not demanded by the market (high failure rate). Thus it is concluded that radical innovation is connected to both advantages and disadvantages; and whether a company is focusing on the advantages or the disadvantages depends on the nature of its industry and its current position, as well as its desired future position within it. If managers evaluate the risk of falling behind in development as higher than the short term profits, radical innovation should be anticipated.

- Whether a company is focusing on the advantages or the disadvantages with radical innovation development depends on the nature of its industry and its current position, as well as its desired future position within it.

6.3. HOW TO ORGANIZE FOR THE FUZZY FRONT END OF RADICAL INNOVATION?

The third finding does not contain an answer as concrete as the previous two. In order to organize the FFE companies can use various methods. This is something that theory and the paper conclude. Defining the best practice is problematic since companies are in so very different contexts and have different strategic priorities to consider. Another problem is the lack of common understanding of the term radical innovation, which confuses the work of scholars and work by companies as discussed in previous paragraph. Hence, in this paper a solid answer to how one should organize the FFE is not provided. What is provided instead is the definition of a problem and inspiration to what companies should consider if they would like to improve the organizing of FFE of radical innovation.

An important discovery in this paper is the bottom-up information flow of radical ideas in the FFE process. The FFE starts at the individual who does advanced interpretation of the external environment. A problem seems to be that the distance between the company, individual and the environment is generally too vast, which implies that information and ideas do not flow as straight and undisturbed as required in order for radical innovation to be developed. The Fuzzy Front End Radical Innovation Landscape Model (2.5.1) provides a visualization of that problem. When companies introduce tools and activities at the FFE of radical innovation, the aim should be to decrease the distances between the three perspectives. Radical ideas are identified by individuals, through their understanding of the environment and market. Individuals need to be in close connection to the company, to be able to transfer information and new ideas. This is vital for the flow and development of radical innovation. In this paper it was found that the individual plays a central role for radical innovation and in order to organize the FFE, companies need to facilitate individual enablers and admit a greater flow for novel ideas within the company. To succeed with radical innovation at the FFE, this paper suggests that companies should work towards simplifying the flow of information and ideas from the environment to the individuals of the company, and from the individuals to the organizational level processes and functions. This strengthens the theories by Reid and De

Brentani (2004) who acknowledge the significance of the individual in order for the FFE process of radical ideas to be developed correctly.

Since all companies have a unique organizational setting, there do not seem to be any best practice on how to achieve an eased flow of radical innovation. However, the following trends were found among the case companies; facilitating externally focused business units that constantly dip into networks of universities, external R&D-centres and start-ups; pushing down the decision making power, while giving a general strategic direction to employees; and organizing a separate path for radical innovation development, such as an incubation unit (or an Innovation Garage). These approaches should be seen as inspiration to future efforts to organize the FFE of radical innovation. The outlining of model (Figure 2.5.1.) can support organizational decisions connected to the information flow at the FFE.

- In order to succeed with the FFE of radical innovation, a company should consider the flow of information and ideas. A more simplified and allowing flow will result in more novel ideas passing from the environment, the individual and finally to the organization.

The fourth and final finding was the recognition of the clear focus on the individual perspective, among the theoretical framework, experts, case companies and Volvo. To become more innovative at the FFE, the organization should facilitate an iterative and open environment in which radical innovation can grow. Common suggestions among the empirical data subjects are to increase the available time and resources to motivate employees to pursue radical innovation; give more time and resources to individuals to engage in projects they feel passion for; make individuals drive the FFE process of radical innovation rather than letting processes drive it.

- Empowering the individual to develop projects that she has passion for while also restricting her less, will most likely increase the radical innovation development within the whole organization.

In summary, this study has contributed to the existing literature and research on the definition of radical innovation and the FFE of radical innovation by having outlined some of the tools and activities practiced by Swedish Multinational Corporations together with input from field experts.

6.4. FUTURE RESEARCH

The aim of this paper was to provide a synopsis of how large companies today organize radical innovation development at the FFE. However, this paper has only scratched upon the surface of the research fields innovation and new product development.

It was argued that, The Fuzzy Front End Radical Innovation Landscape Model which was created by the authors to categorize and analyze the FFE activities at Volvo and the Case Companies, can be used to guide company managers when organizing the FFE of radical innovation. However, it would be interesting to make a longitudinal study analyzing its impact on innovation performance and how to organize in order to decrease the distance between environment, individual and organization.

The individual gained great attention in this paper and he/she was concluded as vital for radical innovation to be developed. It would be of great interest, to deepen the knowledge in how to empower individuals within such large companies and further explore the term intrapreneurship which was frequently mentioned by the case companies. Also, individuals seldom work individually, and it could therefore be interesting for future researchers to study how the relationships between individuals can affect the radical innovation development. Here one should also take into account the intersection of technology fields. People from different departments hold different perspectives of knowledge, and how individuals should work effectively together towards radical innovation is a topic that could supply important answers in the light of radical innovation development.

In this paper it was found that, from an organizational perspective, it is important to categorize and determine what kind of innovation a company should aim for. However, it would be interesting to perform a longitudinal case study at companies that actively avoid formalizing and categorizing innovation and compare the results with companies that do have a clear categorization and have outspoken radical innovation ambitions, to investigate the long term effects. Would the innovation-focused companies become more successful over time or will the bottom-up drive for radical innovation flourish in the actively disengaged organizations?

More interesting aspects and suggestions on what makes companies succeed with the FFE of radical innovation are yearned to be seen.

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APPENDIX 1. CONTACTS INVOLVED AT VOLVO

Department / Business Unit	Position of interviewee	Date	Interview Approach
Volvo Group Trucks Technology, ATR	**[V1] Former Director of Technology Strategy & Innovation**	22 nov. 2016	Face to Face
Volvo Group Trucks Technology, ATR	**[V2] Innovation Manager**	12 dec. 2016 – 8 may 2017	Face to Face
Volvo Group Trucks Technology, Q&CS	**[V3] Strategic Planner**	28 mar. 2017	Face to Face
Volvo Group Trucks Technology, ATR	**[V4] Emerging Technology Program Manager**	28 mar. 2017	Face to Face
Volvo Trucks	**[V5] Director of Environment & Innovation**	31 mar. 2017	Face to Face
Volvo Group Trucks Powertrain	**[V6] Software Leader & Software Engineer**	6 apr. 2017	Face to Face
Volvo Group Trucks Technology, ATR	**[V7] Director of Technology Strategy & Innovation**	6 apr. 2017	Face to Face
Volvo Group Trucks Technology, ATR	**[V8] Knowledge Management Specialist**	12 apr. 2017	Corridor chat Face to Face

APPENDIX 2. CONTACTS INVOLVED AT CASE COMPANIES

Case company	Position of interviewee	Date	Interview Approach
[C1] Packaging Company	Director of Development Strategy and Planning	1 mar. 2017	Audio Telephone
[C2] Technology and Security Company	Innovation Manager	2 mar. 2017	Face to Face
[C3] Home Appliances Company	Open Innovation Project Manager	3 mar. 2017	Audio Telephone
	Open Innovation Project Manager	3 mar. 2017	Audio Telephone
[C4] Automotive Company	Director of Corporate Innovation Office	6 mar. 2017	Face to Face
[C5] Bearings Company	President of Business and Product Development	9 mar. 2017	Face to Face
[C6] Construction Equipment Company	Director of Emerging Technologies	10 mar. 2017	Audio Telephone
[C7] Industry Tools and Machines Company	Manager Mechatronics Department, R&D	14 mar. 2017	Video Telephone
[C8] Communications Company	Change Leader	23 mar. 2017	Face to Face

NO WAY THAT WILL FLY! – ORGANIZING THE FUZZY FRONT END OF RADICAL INNOVATION
CARLEFALL & HEMBERG JANKEL

APPENDIX 3. EXPERTS INVOLVED

Expert number	Position of interviewee	Date	Interview Approach
[E1] Expert	Affiliated Professor at Centre for Business Innovation at Chalmers	13 mar. 2017	Audio Telephone
[E2] Expert	Senior Lecturer at the department of Innovation and Entrepreneurship at the University of Gothenburg	16 mar. 2017	Audio Telephone
[E3] Expert	PhD Innovation Management	30 mar. 2017	Audio Telephone

The interview guide below was sent out before the interviews were conducted in order for the interviewees to prepare for the questions asked. The guide was then later used as basis for the structure of the interviews.

Interview Guide
Master Thesis on Radical Innovation

Definitions
- *Radical innovation:* New market applied technology with the potential to offer unprecedented customer advantages, substantial cost reductions or the ability to create new business (Pisano, 2015; Slater et al., 2014).
- *Incremental innovation:* Minor and continuous improvements of existing products (Schilling, 2013).
- *The Fuzzy Front End:* The time of an activity prior to an organization's first screening of a new business or product idea, before any investments have been made (Reid & De Brentani, 2004).

1. Background
1. What is your position within your organization?
2. What is your involvement in innovation activities?

2. What is radical innovation?
1. What do you associate with the term radical innovation?
2. How is radical innovation defined by your organization?

3. Advantages and/or disadvantages the strategic implications of radical innovation
1. How is the strategy of your organization connected to radical innovation?
2. What do you see as the most important arguments for investing in radical innovation? *What are the financial benefits/costs from radical innovation?*
   a. Or not investing?
3. What are the results from the work with radical innovation in your company?
4. Do you consider your organization to be pro-active in radical innovation development?
5. Is your organization aiming to be first mover in any business area?
   . Why or why not?

4. Managing early stages of radical innovation activities (the fuzzy front end)
1. How are radical innovation ideas generated at your company? *Are ideas generated outside the company? Are managers mainly involved in supplying new ideas?*
2. What processes do you have in place to manage radical innovation? *E.g. what are the different stages and criteria?*
3. At the fuzzy front end of new product development, when potential radical innovations are at the idea-state, how would your company evaluate the ideas and select which ideas that gets further attention and funding?
   a. How is an idea defined as worth/not worth investing in?
      i. When in the development process is an idea defined this way?
      ii. Who should be involved in such a decision?
4. The fuzzy front end is inherent with a great degree of uncertainty. How does your organization manage that?
5. What are the success factors when developing radical innovation?

6. What kind of challenges have you met when engaging in radical innovation activities? (Please give an example).

5. Culture for radical innovation development
   1. If you were a product developer of radical products, what organizational support would you need to successfully perform/deliver in your job?
a. If you were a manager of radical products, what organizational support would you supply then?
   2. Who should be involved in the radical innovation development process?

6. Your personal view
   1. Do you have any other suggestions that could contribute in the work with radical innovation?
   2. Are there any topics/aspects that you feel we have missed when asking you about radical innovation?

We thank you for your participation.
If you have any questions regarding the interview do not hesitate to contact us.
Best regards Tobias Carlefall & Tao Hemberg Jankel
guscarleto@student.gu.se (xxxxxxxxxx) / taohembergjankel@gmail.com (xxxxxxxxx)

The interview guide below was sent out before the interviews were conducted in order for the interviewees to prepare for the questions asked. The guide was then later used as basis for the structure of the interviews.

Interview Guide
Master Thesis on Radical Innovation

Definitions
- *Radical innovation:* New market applied technology with the potential to offer unprecedented customer advantages, substantial cost reductions or the ability to create new business (Pisano, 2015; Slater et al., 2014).
- *Incremental innovation:* Minor and continuous improvements of existing products (Schilling, 2013).
- *The Fuzzy Front End:* The time of an activity prior to an organization's first screening of a new business or product idea, before any investments have been made (Reid & De Brentani, 2004).

1. Background
1. What is your academic/working role today?
2. What is your involvement in innovation activities?

2. What is radical innovation?
1. What do you associate with the term radical innovation?
2. How is radical innovation defined by you?

3. Advantages and/or disadvantages the strategic implications of radical innovation
1. How is the strategy of organizations connected to radical innovation?
2. What do you see as the most important arguments for investing in radical innovation? *What are the financial benefits/costs from radical innovation?*
a. Or not investing?
3. What are the results from the work with radical innovation?
4. Why should organizations aim at being first mover in any business area?
. Why or why not?

4. Managing early stages of radical innovation activities (the fuzzy front end)
1. How are radical innovation ideas generated?
2. What processes should be in place to manage radical innovation?*E.g. what are the different stages and criteria?*
3. At the fuzzy front end of new product development, when potential radical innovations are at the idea-state, how would you evaluate the ideas and select which ideas that gets further attention and funding?
a. How is an idea defined as worth/not worth investing in?
i. When in the development process should an idea be defined this way?
ii. Who should be involved in such a decision?
4. The fuzzy front end is inherent with a great degree of uncertainty. What is your view?
5. What are the success factors when developing radical innovation?
6. What kind of challenges have you met when engaging in radical innovation activities? (Please give an example).

5. Culture for radical innovation development
1. If you were a product developer of radical products, what organizational support

would you need to successfully perform/deliver in your job?
a.   If you were a manager of radical products, what organizational support would you supply then?
   2. Who should be involved in the radical innovation development process?

6. Your personal view
   1. Do you have any other suggestions that could contribute in the work with radical
      innovation?
   2. Are there any topics/aspects that you feel we have missed when asking you about
      radical innovation?

We thank you for your participation.
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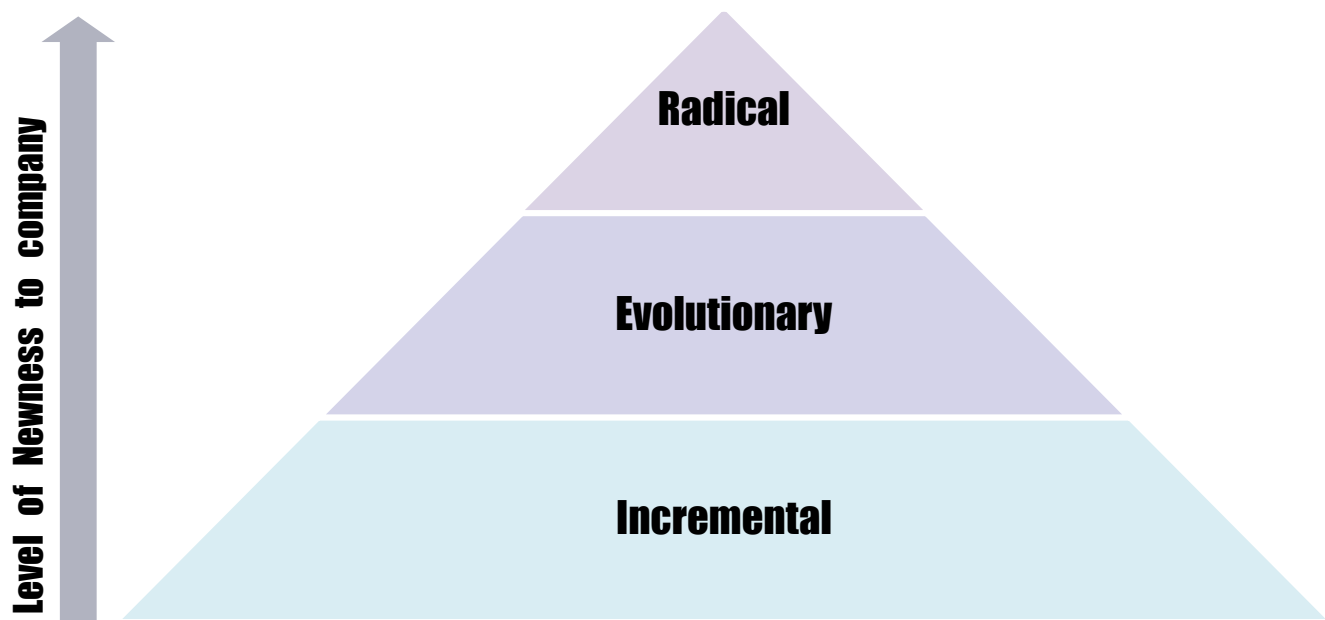
APPENDIX 6. INNOVATION CATEGORIZATION BY THE [C1] PACKAGING COMPANY

The table below was presented by the Director of Development Strategy and Planning, at the [C1] Packaging Company, as an example on how to categorize innovation. At the [C1] Packaging Company, one part of the innovation processes is to make a common definition of innovation categorizes, to be able to communicate and drive projects forward.

Innovation Type	Business Structure	Degree of Change	Method for Change
Type A **Sustaining Innovation (improve performance of our existing products or processes)**	Director of Development Strategy and Planning	Changes are made only to individual elements like new product, changed manufacturing methods or updated sales processes	Process for change/improvement exist, Stage-Gate, Continuous Improvement, Portfolio Management
Type B **Business Model Innovation (redefines the way we do business)**	Structure exist (sales, supply & development)	The structure and relationship between business model elements are redefined	Method for change ned to be defined each time. Guided by Kotter 8 step.
Type C **New Business Creation**	Structure must be created	Total	"Lean Startup" & "Learning Plan" Methodology

APPENDIX 7. INNOVATION CATEGORIZATION BY THE [C4] AUTOMOTIVE COMPANY

According to the Director of Corporate Innovation Office, at the [C4] Automotive Company, the company looks at four factors when categorizing the innovation level; technology, customer and market, organizational, and resources. If two or more factors are new or difficult to the [C4] Automotive Company the idea is radical, if one factor is new and difficult the idea is evolutionary, if none the idea is incremental.

Level of Newness to company

Radical

Evolutionary

Incremental

NO WAY THAT WILL FLY! – ORGANIZING THE FUZZY FRONT END OF RADICAL INNOVATION
CARLEFALL & HEMBERG JANKEL

APPENDIX 8. DEFINITIONS

Below are the different concepts that have been mentioned in the paper.

DEFINITION OF CONCEPTS
INTRAPRENEURSHIP

Moriano, Molero, Topa and Mangin (2011) stress that one strong possible solution to the current fast-changing atmosphere is finding intrapreneurs in companies. The substantiation of this suggestion is that organizations that support intrapreneurship have higher probability of being successful in terms of radical innovation capability, according to Rauch, Wiklund, Lumpkin and Frese (2009). Intrapreneurs are considered as individuals, who are proactive, highly risk taking, and entrepreneurial. Entrepreneurs exist outside larger companies, while those entrepreneurs that exist in larger companies are defined as intrapreneurs (Moriano et al., 2011). One can define intrapreneurs as intra-organizational revolutionaries who dare to clash with the status quo, and therefore can be the source of internal organizational friction, according to Bhatia and Khan (2013). Suggestively, a company that highly values formal processes would not prioritize an intrapreneurial culture. In order to create an intrapreneurial culture in a company, the company needs to consider what factors create motivation among the employees and leaders of that company, as stated by Moriano et al. (2011).

CROSS-FUNCTIONAL TEAMS

Today, the dominant idea among companies seem to be that organizing through fixed power hierarchies make the managing of groups very effective, as stated by Aime, Humphrey, DeRue and Paul (2014). What many of these companies should realize however, is that groups that practice collective decision making, are in addition, methods that can create very effective group dynamics and productivity. When groups split the responsibilities among themselves, that improves coordination and the inclination to cooperate. Slater, Mohr and Sengupta (2014) argue that since the end-goal of radical idea development are as undefined as they are, cross-functional teams are natural tools in order to face this type of idea development, where all types of skills are expected to be required in the process. When it comes to radical innovation development, there is a greater need for cross-functional interchange of notions, theories, information and other assets. A cross-functional team is most effective when the team members see themselves as one unit; working towards one same direction, Slater et al. (2014) clarifies.

AMBIDEXTERITY

As stated by O'Reilly III and Tushman (2014), ambidexterity is defined as the organization's capability of both looking at the past and into the future. If an organization is ambidextrous, it means that the organization manages to utilize the older and existing capabilities it already has, while at the same time it organizes for the unpredictable future. Ambidexterity can therefore be seen as taking less and more risk, simultaneously. According

to Mei, Laursen and Atuahene-Gima (2013), companies need to put emphasis on radical innovation but it should not be the entire focus. Because radical innovation development means that you run the risk of not capitalizing on costly and uncertain investments, copmanies need to continue develop the capabilities that they already have. A company's long-term existence depends on its ability to simultaneously pursue the searching activities for new ideas and concepts; and pursue the advancement of existing business capabilities (Raisch, Birkinshaw, Probst & Tushman, 2009).

INNOVATION WORKSHOPS

According to Polewsky and Will (2008), creativity is one of the main prerequisites in order for innovation to be developed in companies. Innovation workshops can help foster a positive and open culture towards creativity. Workshops are today designed in various ways, but usually consist of one introduction to the genre of the workshop and one or multiple creativity activities, where idea brainstorms and idea capturing is what is emphasized. Innovation workshops can emphasize different ideation processes depending on which phase the company is at. The company could for example be in a stage where one has just identified a possible area of interest or it could simply not have thought of any specific area of interest. When having identified the goal of an innovation workshop, the company can conduct ideation processes that improve the possibility of achieving that goal. The aspect of collaborative or individualistic innovation workshop activities is also needed consideration, Monticolo and Mihaita (2014) convey.

INNOVATION COACHES

Rousseau, Aubé and Tremblay (2013) stress that team motivation is dependent on the dynamics within the team, but also the support the team gets from the outside. Kubberoed and Hagen (2015) agree and state that mentoring can be viewed as a strong and essential part of the radical innovation development process, in order to increase the knowledge growth of the team. The function of the coach, according to Kubberoed and Hagen (2015) is to aid the team through constructive feed-back in order to maximize the probability of the team reaching the goal. In addition, the coach can ask questions about the functionalities of the team's radical idea in order to make them aware of what needs to be done in order to develop the idea even further and make it even more convincing (Kubberoad & Hagen, 2015).

OPEN INNOVATION METHODOLOGY

Chesbrough (2006) argues that open innovation is one of the largest reasons for companies to succeed with innovation. He argues that many companies have failed with their innovative development because they have had a too closed innovation development approach, which he calls a closed innovation paradigm. Chesbrough, Vanhaverbeke and West (2014) agree and state that the majority of researchers within innovation agree with the fact that knowledge relevant for innovation can exist as much outside a company as it can exist inside. West, Salter, Vanhaverbeke and Chesbrough (2014) explain how open innovation can be conducted in various ways. Two examples are; submitting internally developed suggestions in order to encourage discussion and inspire; and paying attention to the ideas of external actors and thus gain inspiration.

LEAN STARTUP METHODOLOGY

The assumption that Blank (2013) criticizes in the general approach of the construction of business plans is the idea 'that it's possible to figure out most of the unknowns of a business in advance, before you raise money and actually execute the idea". When Blank (2013) introduced the Lean Startup method appraised the fact that companies well too often research the ingredients of the business plan at a desk in isolation from the world. Blank (2013) stresses that only after one builds and launches a product can it be tested, and receive feed-back from potential customers. According to Ries (2011) the Lean Startup method suggests that one starts with building a prototype that can be customer tested. This should be followed by processes of measuring and learning. Conclusively, when knowledge has been obtained, that knowledge is then added to the existing knowledge and prototype and naturally the demanded improvements are developed. This whole process is then repeated repeatedly, until the customer demands fit with the company offered prototype/product (Ries, 2011).

INNOVATION HUBS

Leifer et al. (2001) stress that the characteristics of radical innovation are very different, compared to the ones of incremental innovation. Therefore some companies use innovation hubs, in order for the radical innovations to be able to grow outside the existing business development processes. According to Berger and Brem (2016) an innovation hub can be constructed in different ways, but some supporting elements are effective for any organization. Some of the supporting rudiments in order for the innovation hub to be effective; an innovation development process that is outside the normal incremental innovation development process; the existence of a strong barrier from bureaucratic distractions; practicing patience; freedom to experiment; and intrinsically motivated (intrapreneurs) staff (Berger & Brem, 2016).

STAGE-GATE SYSTEM

Cooper (1990) stresses that a Stage-Gate System is both a conceptual and operational model through which new an idea can be developed and lastly launched. It helps guide companies in managing new product development processes in order to improve effectiveness and efficiency of the product. The Stage-Gate System is dependent on strong and validated project selection processes, this is where the gates are (Cooper, Edgett & Kleinschmidt, 2002). Cooper et al. (2002) explains that companies generally have too many projects looking at the limited sources that are available and therefore "tough gates" should be implemented where scorecard methods should be used, in order to rate and prioritize projects. According to Cooper (1990), the Stage-Gate System consists of various Stage-Gate steps that consist of different levels of valuation pressure. It is at the Stages where the product or idea is developed in accordance with guidelines according to prior and future Gates. It is at the Gates where the decisions are made whether an idea or product should be further developed/financed, or not (Cooper, 1990).