Critical Factors for Fostering Radical Innovation

Performance Metrics for Improving the Radical Innovation Capability

Thesis Report

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Executive Summary

In the last two decades, the importance of innovation has increased within companies, because of expanding global trade, shortening of development processes, rapid technological change and commoditization of markets in the last two decennia. Therefore, firms are forced to find novel products, services or business solutions in order to survive in their competitive environments. Damen Holding B.V. is one of those companies recognizing the need for innovation in their business offerings. Innovation, defined as an invention in combination with its commercialization, is a mechanism to renew these offerings. Several types of innovation have been proposed in the past, but the main differences can be found between incremental and radical innovation.

Incremental innovation should be viewed as the step by step improving of business offerings and is typified by an exploitative character. Radical innovation on the other hand is more disruptive in its nature, and explorative competencies support this type of innovation. Nevertheless, radical innovation is defined in several ways in academic literature. The definition used in this thesis research is adopted from Norman and Verganti (2014), which describes the possibility to radically innovate over the axis of technological change or over the axis of perceived meaning change.

The need for radical innovation is different within every industry, but history has shown that firms that engaged in the radical type of innovation display above average performance and strongly increased their competitive position. Damen has shown to be very capable of incrementally innovating and therewith developing an extensive amount of vessel and vessel building solutions. However, they are aware that they need to stay ahead of competition and thus want to engage in radical innovation in a structural way. In the past Damen has indicated to be also capable of developing radical innovation according to the described definition. The most famous example is the standard building of ships, and further examples are the Axe bow design and Yacht Support vessels.

For Damen, as well as companies in general, it is beneficial to be able to predict and know how much innovation can be expected. Thus the controllability of radical outcomes would be an ideal state. First it is therefore necessary to have insights into which elements are specifically critical for Damen when aiming at radical outcomes. Thereafter a performance management mechanism has to be in place to control, guide and stimulate certain behaviours in these critical elements. The goal of this research is therefore to determine which performance metrics are most effective in stimulating the critical success factors for fostering radical innovations within Damen. Several sub-questions support the main research question in finding the answers. A literature framework is developed which extensively describes innovation and radical innovation, in order to avoid ambiguity in the used definitions. Further, it presents a body of knowledge on success factors for innovation in general and radical innovation specifically. It is followed by insights into performance management literature for innovation to show metric propositions and their usage in businesses.

The research approach used in this thesis is referred to as a mixed method strategy, which means it has a quantitative as well as a qualitative side. A questionnaire is developed for the quantitative part of the research, with the goal to determine which radical innovation success factors are most important for Damen. The constructs used in the questionnaire are based on the success factors as described in the

framework success, and are tested according to a seven point Likert scale. The qualitative part of the research is about comparing questionnaire results and identifying suitable performance metrics by interviewing several Damen employees of different hierarchical levels. Questions used in these interviews are also based on the in this thesis presented academic knowledge.

The resulting data from the questionnaire is analysed by comparing means and standard deviations, and applying an Analysis of variances (Anova) test to determine whether mean results are significant or not. The data of each individual factor is grouped into seven general management areas:

- Leadership
- Culture and climate
- Organisational characteristics
- Radical innovation process
- Discovery phase
- Incubation phase
- Acceleration phase.

Further, in the questionnaire statements about the current state at Damen are asked first, after which a future state is asked for on the same factor. The analysis of questionnaire data is also done on these two states, and on the difference (increase or decrease) between states. A similar three stage analysis approach is applied on each individual success factors, as presented in figure 3 (p.17). After conducting the interviews, the data is transcribed and subject to a content analysis. Data is coded according to similarity in answers and a general conclusion is derived for each question. Afterwards the results of the interviews are compared to the results found in the questionnaire.

The overall results indicate in general that the critical success factors leadership, radical innovation process, and discovery phase are important focus areas for Damen. Furthermore, the analysis into the individual factors implicate that all single factors, except for two, increase in mean scores when the current state is compared to the future state, which means all are perceived as important for radical innovation within Damen. One factor significantly stood out as most important for radical innovation within Damen, which is the single factor technology vision. The two negatively scoring factors are managers autonomy in renewing strategy and collaborations with partners. Next to the identified factors some implications can be made concerning metrics to stimulate these success factors. The following metrics specifically identified for Damen are proposed:

- An idea funnel metric for gathering and assessing ideas
- An innovation score and sales number metric for assessing the potential of ideas
- An idea follow up metric for tracking and stimulating radical developments
- A policy plan ‘spider’ benchmarking metric for benchmarking ideas against the technology vision
- A survey metric for assessment and stimulation of obeying the technology vision

Concluding, alignment of radical innovation efforts in general is essential for Damen. A process approach which focusses on the long term perspective with a clear technology vision needs to be defined within the organisation. The vision should guide employees engaging in radical innovation in the right direction. The radical innovation process needs to be clearly decomposed into, discovery, incubation, and acceleration phases, with extra attention on the discovery phase and the transition to the incubation phase.

Suitable metrics and performance incentives need to be integrated in the process to stimulate the right behaviour needed for radical outcomes in each phase. In general it is advised to institutionalize a management system to enable the creation of radical innovations on a continuous basis, thus measuring on a periodical basis. Such a system would help Damen as a company to structure and control processes and align radical innovation efforts. Metrics can provide financial control, but they can also direct and guide employee behaviour which is more important for radical innovation. Metrics should not be in place for punishment reasons or for increasing control over employees, rather they should be motivational and guiding efforts. As Simon et al. (2003) put it: “Stretching but not breaking the organization: motivating for radical results.” (p. 19).

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1. Introduction

1.1 Introduction into the Thesis Research

In the last two decennia, the importance of innovation has increased with the expanding globalization, the shortening of product life cycles, decreased development times, and rapid technological change (Janssen, Moeller, & Schlaefke, 2011). Markets are getting more and more commoditized in many countries and industries. Additionally, economic growth gets pressurized and some markets decline (Cooper, 2011) Businesses are therefore focusing on renewing their innovation strategies and processes, in order to overcome the issues with which they are confronted today (Richtnér, Brattström, Frishammar, Björk, & Magnusson, 2017). Innovations have the ability to change what a company offers in the shape of a product or service innovation. They can also change the way in which these offerings are created and delivered, often referred to as a process innovations (Bessant, Lamming, Noke, & Phillips, 2005).

Some argue that rather conservative innovation strategies as acquisitions, product development, product improvements and modifications only help to maintain the current market share. Firms that do not act in different or novel ways, are deemed to lose their part of the market. Therefore, it is essential for firms to renew their innovation processes and set this as a core business mechanism if they wish to stay competitive in todays and tomorrows market (Bessant et al., 2005; Cooper, 2011). Damen Holding B.V. (Damen) is a company recognizing the need for renewal and improvement of innovation strategies. This maritime oriented family firm has been offering a large number of vessels and vessel building solutions over the past decennia, and is aware it has to improve its products and solutions in order to stay ahead of competition. Innovations in products, services and processes have been an attribute to the success of Damen in the past. One of the most famous examples of innovation within Damen, especially know in the maritime sector, is when the company owner; Mr. Kommer Damen, introduced building standardized ships and building them to stock in the early 70's. This process innovation was revolutionary and changed the processing time of vessels dramatically. It provided Damen with an competitive edge over competition concerning quality and lead times, and was the main cause of the tremendous growth of the small shipyard (Damen Shipyards Group, 2018a).

Innovation being the invention in combination with its exploitation (Dewangan & Godse, 2014) has to receive even more senior leader attention today (Slater, Mohr & Sengupta, 2014). The departments concerned with innovation could evolve in similar ways as marketing and corporate strategy did, when they changed from an art to a process, and finally became their own functions (O'Conner & DeMartino, 2006). The often used approach of building continuous improvement capabilities and incremental improvements does not seem to have the wished for results. On the contrary, it is likely that it locks companies in a past perspective and prevents them from fully renewing business offerings, or enabling them to react to large technology or market changes (Tushman & Smith, 2002). Further, most firms investing in innovation activities have a rather short term focus. They tend to innovate on an incremental basis, where the focus is on the earlier mentioned improvements and modifications of business offerings with a limited longer term scope (O'Conner & DeMartino, 2006).

Thus, companies that want to stay or become truly competitive in a global market have to go beyond the incremental innovations (O'Conner & DeMartino, 2006). These kind of companies have to engage in radical innovation, where the offering is a so called creative destruction and breaking with

existing business or market competencies (Schumpeter, 1942). This type of innovation offers the ability to create new markets, provide first mover advantages, and set up new businesses or business models (Janssen et al., 2011; O'Conner & DeMartino, 2006; Reid, Roberts, & Moore, 2015). These also called, new to the world, or original new products and services can give the innovating firm an edge over competition with superior performance and stimulate its economic growth (Janssen et al., 2011; Reid et al., 2015). The discussion about whether or not large established firms can introduce such radical innovations are non-relevant. Since these innovations are in many cases a necessity for business continuation and thus key to their survival (O'Conner & Ayers, 2005).

Also Damen is recognizing the need for radical innovation and is aware that the risk of only innovating incrementally opens up the possibility for competition to keep up or take over market share. In the past Damen has showed to be capable to produce several radical innovations. Examples of these are the iconic Axe Bow design, the Yacht Support vessel and Damen Technical cooperation (DTC)[1]. The innovative ship bow design has been a technical novelty and enables ships to behave significantly different in rough seas. The Yacht Support vessel is a recombination of an offshore ship into a 'toys' supply vessel for super yachts. DTC on the other hand is a new business unit which renewed the way ships are being build. Normally this is done on the yards of Damen, but it this case the unit licenses out the design and builds the ship locally. Currently, Damen is investing even more resources into enabling internal process in such a way that they are able to develop radical innovations over and over again, and to explore technical and market possibilities with initiatives like genius hours and project Morpheus[2].

Nevertheless, management of these radical innovations is still a difficult part of the innovation spectrum and it is not just an outcome of business operations, which is also certainly true for Damen (Bessant et al., 2005). Currently, companies often see radical innovation as a "black art" (p. 37) and apply a hope based strategy in order to come to radical innovations (Turrell, as cited by Muller, Välikangas, & Merlyn, 2005). In many cases firms hope that given a right combination of resources, such as human brains, capital, and software or equipment will provide the ideas that have the potential to lead to break through innovations and business potential (Janssen et al., 2011). Nonetheless, some companies aim to make the process less ad hoc and more closely managed, because it is not sufficient for companies to introduce a radical innovation every ten years based on a fair share of luck (Janssen et al., 2011; Neely, Gregory, & Platts, 2005; O'Conner & Ayers, 2005). Accordingly, businesses are progressively analysing and measuring the processes and factors which could lead to radical innovations (Richtnér et al., 2017).

Notably academic literature provides quite an extensive list of success factors for innovation in general (Balachandra & Friar, 1997). These factors range from capabilities, such as internal/external knowledge development or application capability (Forés & Camisón, 2016), to specific management categories like inputs-, process-, output-, project-, portfolio management (Adams, Bessant, & Phelps, 2006) Yet, the amount of success factors for radical innovations in literature is rather limited. Some authors, like Cooper (2011) and Slater et al. (2014), do propose several elements which foster radical innovation capabilities. However, they all mention that the antecedents essential for radical innovation differ for each company

[1] See appendix A for an illustration of the vessels and DTC.
[2] See appendix B for more information about these initiatives.

and in each context. It is therefore crucial for Damen to know which elements are most critical and which factors should receive most management attention in order to foster radical innovation on a continuous basis. Richtnér et al. (2017) formulated it rather clear: “crux of effective innovation measurement” (p. 1) is to understand which elements in the innovation process are the limiting factor.

Once these critical factors are known it becomes important to properly manage them. The reasoning behind this is if a certain factor is enabling radical innovation for a firm, it is logical to monitor and stimulate this particular factor. Performance measurement and management systems are a way to do this monitoring an stimulating. They are often referred to as management control systems (Nilsson & Ritzen, 2014; Reid et al., 2015; Walker, Damanpour, & Devece, 2010). Two decades back, Cooper and Kleinschmidt (1995) already showed that top performing companies apply performance measurement systems for their Research and Development (R&D) function and therewith they highlighted the importance of performance management. An innovation survey report by the Boston Consultancy Group in 2010, also emphasizes firms need to examine their innovation performance management systems to reinforce the output of their innovation efforts (Andrew, Manget, Michael, Taylor, & Zablit, 2010). Still, radical innovation has not received the attention it needs in innovation performance management. Most of the efforts focus on R&D input and output measures, which are somewhat limited, and tend to not go beyond incremental innovation (Saunila, 2017a). Nevertheless, lately new types of performance management and measurement systems are receiving attention, because of faster changing technologies and business environments, and the importance awareness for radical innovation (Ukko, Hildén, Saunila, & Tikkamäki, 2017).

Measures such as key performance indicators or metrics play a key role in monitoring and stimulating performance within these performance management systems. Metrics enable management and employees to make timely decisions about which elements in the radical innovation process need extra resources or attention. In some cases metrics are seen as a limiting factor and restraining ‘free’ and creative behaviour, but when metrics are chosen well they can enhance the stimulation of these behaviours (Amabile, 1998; Hauser & Zettelmeyer, 1997). Radical innovation metrics are thus an critical part in the management of these innovations (Janssen et al., 2011). The way in which metrics are used and have been used in the past is still up for discussion. Chiesa, Coughlan, and Voss (1996) pointed out that most of the companies using metrics had rather simplistic metrics in place, such as annual R&D budget, patent count, percentages of sales numbers or ideas submitted, this is often still the case within companies (Reid et al., 2005). In contrast, Janssen et al. (2011) coin a more sophisticated approach to innovation metrics. They offer the term “information utilization” (p. 108), this expression refers to how metrics are used such that they provided timely information on which management decisions can be made. Guiding behaviour does not necessarily mean limiting, since guiding employees to be creative enhances this behaviour (Janssen et al., 2011). Research has been done on performance metrics for innovation, partly due to positive influences of metrics. However, the majority has focused on metrics for incremental innovations or focus on after product launch situations. Metrics for post launch or the ideation phase, in the context of radical innovation are rather scarce (Reid et al., 2015). Consequently, it is the challenge to identify metrics which are most suitable for each specific company by applying a holistic view on the innovation process (Birchall, Chanaron, Tovstiga, & Hillenbrand, 2011; Richtnér et al., 2017).

1.2 Damen Holding B.V.

The empirical foundation of this thesis research lies within the company Damen Holding B.V.[3]. Damen is a globally operating family owned ship development and building company. They provide novel ship designs in several niche markets, for instance high speed crafts, tugs and workboats, naval ships, offshore and dredging vessels, fishery ships and superyachts. Damen realizes an approximately 2 billion yearly turnover and an net result of approximately 5 million with its 52 group companies in 2017. In the Damen organisation each vessel category has its own business unit within the holding structure, and they are all supported by the central Research and Development department. From its origin Damen has been a company that recognized the need for innovative solutions in its products and processes, and still they invest in distinguishing from competition in a relatively conservative industry. Current focus is therefore on exploring even more innovative, and radical solutions for products and services which suit or exceed customer expectation. Damen brings along two main attributes that typify the organizational entity. Firstly, Damen is a family owned company which currently employs round about 10.000 people on 34 shipyards worldwide, and secondly they are operating in de maritime industry which presents its own characteristics (Damen Shipyards Group, 2018b).

1.3 Goal of the Thesis Research

Damen Holding B.V. is a company that is able to excel in innovating incrementally, and the resulting challenge for Damen is to further stimulate radical innovations. It became clear during initial semi-structured interviews with employees across several business units and with different hierarchical positions when defining the specific research challenge. The research goal could be formulated based on a combination of academic literature and the input by Damen employees. The overall goal of the research is to explore which critical factors, antecedents, have the highest potential to stimulate radical innovation within the Damen organisation. Once these factors are known the research aims to further determine which performance metrics could best be used within Damen to stimulate these critical factors. Therefore, the following research question is formulated:

> *Which innovation performance metrics are effective for a maritime/family owned research and manufacturing company in stimulating the critical success factors that foster radical innovations?*

The question is decomposed into several sub-questions that offer theoretical as well as empirical support to answer the research question.

Sub-questions:

1) *What is the literary definition of innovation and radical innovation?*
2) *Which success factors are defined in literature to stimulate radical innovations?*
3) *Which factors are critical for radical innovations within Damen?*
4) *How is performance management used in the context of (radical) innovation?*
5) *Which metrics support fostering radical innovation within Damen?*

[3] Damen Holding B.V. webpage: https://www.damen.com/

1.4 Theoretical and Practical Contribution

Literature covering the topic of innovation management, and more specific performance management and metrics is mostly based on high tech industries or companies with a pioneering role. It is therefore a risk to generalize this literature to the Damen setting and context (Koberg, Detienne & Heppard, 2003). Thus, the theoretical contribution of this research is to verify several theoretical constructs in the current Damen context. Furthermore, the research aims to enrich and test the theoretical frameworks proposed for fostering radical innovation, because success factors and insight for applying metrics for radical innovation are rather scares currently.

The practical contribution is concerned with the relevance of the study for Damen. The thesis research provides a better understanding in the way Damen is able to create radical innovations and the way in which they should be controlled in order to maximize the likelihood of innovating radically on a continuous base. As a result of this study Damen will gain a better understanding into what elements are critical for their radical innovation capability. Therewith, they are able to better stimulate and monitor its radical innovation opportunities. The study will thus be a tool to advance the knowledge concerning the radical innovation topic and provide suggestions how and where to improve current management practices.

1.5 Thesis Report Structure

The thesis has started with a brief introduction into the topic of radical innovation and performance metrics, and provided the main research question. Hereafter, the theoretical framework for this thesis is discussed in which the main constructs are defined and explained. The theoretical frame is necessary for providing an literary basis for the thesis research and thus enables to build on previous academic work. In the chapter the industry characteristics are explained, the literary definitions of innovation and radical innovation are elaborated on. The definitions are of importance for the thesis to secure the foundation on which this research is based and to avoid ambiguity. Next to the innovation definitions the framework focusses on literary antecedents for innovation and radical innovation. Thereafter, the frame provides insights into performance management and control to ensure proper understanding of performance measures and metrics. The literary section is followed by the method section in which it is explained how the literature is found, and which research approach is applied. In the results section the empirical evidence found with this research is presented and it constitutes out of two sections because of the research approach taken for this thesis. Firstly, the quantitative data of the questionnaire are discussed and analysed. Secondly, the qualitative results of the interviews are presented and interpreted. The results section is followed by the discussion in which the items found in the research are elaborated and the chapter draws preliminary conclusions. The thesis is finalized by the research conclusions, and is supplemented by the managerial implications, limitations, an academic contribution and further research implications.

2. Theoretical Framework

2.1 Industry Characteristics of the Case Company

Initially, in this chapter the two main characteristics of Damen Holding B.V. are briefly discussed, firstly Damen being a family owned firm and secondly the industry it operates in. Family firms constitute for a large share of the economy, in de OECD[4] countries 85% of the enterprises are family owned (Kraus, Pohjola, & Koponen, 2012). Thus, it is rather clear that family businesses play an important role in all economies. Although the importance of these firms, the way in which these companies innovate is lacking attention in management literature (De Massis, Frattini, & Lichtenthaler, 2015; Kraus et al., 2012). Until now family firms have often been described as being less entrepreneurial and innovative, and are being typified as conservative (Kraus et al., 2012). The difference between family and non-family firms is evident in their financial and ownership structure. According to De Massis et al. (2015) they also have contrasting approaches to product innovation and innovation process organization. Non-family firms tend to focus on incremental and radical innovation, applying cross functional teams with little hierarchy in a well-structured process. The family firms tends to direct most effort towards incremental innovations with a functional organization. Project leaders are given high amounts of autonomy in the typical description of a family firm by de Massis.

In addition, the maritime industry, also referred to as the 'blue economy', is a globally oriented industry and is characterized by many so called maritime clusters (Hassink & Shin, 2005). Pinto, Cruz, and Combe (2015) provide an extensive overview of the main clusters present in this industry, ranging from ports, inland shipping, coastal tourism to shipbuilding. Interesting to take into consideration is that Damen is offering vessel solutions in almost all of these industry clusters, which makes their product portfolio very wide in comparison to other conventional ship builders. Furthermore, the maritime industry and more specific the ship development and building sector are not typically used in management and innovation literature. Yet, a Canadian study has shown maritime firms are less engaged in product and process innovations, their innovations are mainly acquired through mergers and acquisitions. Main restrictions for innovation in this industry are thus high investment costs and regulations. Furthermore, maritime firms described in this study are loosely connected to other firms in the industry and they are to a lesser extend involved in innovation related collaborations (Doloreux & Melançon, 2008).

2.2 Innovation Explained and Defined

2.2.1 Definition of Innovation

Innovation is a dynamic, social and complex topic which finds itself at the cross roads of technical, economic, and political fields (Carayannis, Goletsis, & Grigoroudis, 2017). The concept of innovation is often fuzzy or ill-defined within businesses, as well as in academic literature (Saunila, 2017b). Due to this there tends to be a shortage of collective agreed upon definitions and frameworks, and the main reason for this lack is the precision of the used pure definition of innovation (Birchall et al., 2011). The definitions could also be ambiguous, because numerous disciplines and scholarly communities perform research on innovation (Garcia & Calatone, 2002). Thus, this section is aimed at providing a shared and common

[4] OECD stands for Organisation for Economic Co-operation and Development. Currently, the organization holds 35 member countries from around the world (OECD, 2017).

understanding and definition of the innovation concept in order to overcome conceptual discussions at a later stage.

Several variations of the innovation concept have been proposed, it takes shape as incremental, radical, discontinuous, really new, or modular, architectural, and improving innovation (Garcia & Calatone, 2002). The main difference between the types can be explained by the degree of novelty of the innovation (de Brentani, 2001). Nevertheless, all of these innovation types have some major commonality. At first, it is important to realize that an innovation is an invention in combination with the exploitation of this invention. Exploitation being the realization and commercialization of the invention. Without the exploitation part, the invention remains nothing more than a good idea (Dewangan & Godse, 2014; Garcia & Calatone, 2002). Secondly, one has to be aware that: "*The correct idea at the wrong time will fail*" (Norman & Verganti, 2014, p. 83). This stretches the importance or the right timing and proper marketing efforts when willing to innovate. Concluding, the internationally accepted definition that is also used for this research is provided by the OECD which states:

> *"An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations." (OECD, 2005)*[5]

2.2.2 Innovation Types and Degrees

Innovation is a phenomenon which can be defined and characterized in several ways. It is important to understand that innovation happens in more than products only, as is also made clear in the proposed OECD definition. Nevertheless, most literature tends to focus on innovations in products, services and processes (Oke, Burke, & Myers, 2007; Tidd, 2001). Management innovation has also received more attention lately, and business model innovations have become a more popular topic in current literature (Walker et al. 2010). The goal of business model innovation is to enlarge the market share by redefining the value proposition of the firm. Thus, how products and services can be offered in such a different way that it provides an competitive advantage (Markides, 2006; Osterwalder, Pigneur, & Tucci, 2005). Innovation in general is the interplay of market and technology newness and novelty, these factors determine the complexity or difficulty in order to realize the innovation (Balachandra & Friar, 1997). The concepts of incremental and radical innovation are often used in order to classify the degree of newness of the innovation. They are in some way representing either side of the innovation spectrum (de Brentani, 2001). In between the innovation types architectural innovation and component innovation can be found. The first one being the innovations in the composition of components, and the second being the innovations in the components themselves (Henderson & Clark, 1990).

Moreover, incremental innovation is mostly concerned with smaller (incremental) improvements, refinements or reinforcements in more mature stages of the product life cycle (Forés & Camisón, 2016). Firms engaging in these innovations have an often exploitative focus (Chang, Chang, Chi, Chen, & Deng, 2012). Contrastingly, radical innovation is more disruptive and renewing, mainly present in the early

[5] The OECD definition is somewhat old and is of a non-academic source, nonetheless this definition is still used by the OECD organization and is also in line with literature today.

stages of life cycles (Garcia & Calatone, 2002). The radical innovation has as a result that it fundamentally changes the offering, process or structure of the firm (Forés & Camisón, 2016). These firms tend to undertake more explorative efforts in their business approach (Chang et al., 2012). Norman and Verganti (2014) provide an illustrative metaphor to make the differences between incremental and radical innovation even clearer: *"Incremental innovation tries to reach the highest point on the current hill, radical innovation seeks the highest hill."* (p. 79). Still the earlier brought up degree of newness, also called innovativeness, is still a relative concept. A deviation in newness has to be made between new to the customer, new to the company, new to the industry, or new to the world (Garcia & Calatone, 2002). It could thus happen that a radical innovation in one industry is rather incremental for another industry. Accordingly, it is important to understand how incremental differs from radical innovation in order to understand the firms innovation capability (Slater et al., 2014). An important first point on which they could be divided, which is also implicitly included in the mentioned metaphor, are the process differences between the two ends of innovation. Incremental innovation is often a more linear process and it is therefore easier to track progress and predict the outcomes. The process which brings radical innovations is typically non-linear and often long. It is characterized by uncertainties, risks, setbacks, needs lots of effort to evolve and often initiatives fail (Garcia & Calatone, 2002; Oke et al., 2007; Pihlajamaa, 2017).

2.2.3 Radical Innovation Defined

In order to be able to further deviate between the two main types of innovation, or any other kind of innovation, it is essential to clearly define radical innovation. The more disruptive kind of innovation is defined in various different ways in literature, and definitions are often ambiguous (O'Connor & Ayers, 2005). To illustrate, radical innovation has many 'names', such as: creative destruction, really new innovation, disruptive innovation, discontinuous innovation, and explorative innovation (de Brentani, 2001; Garcia & Calatone, 2002; Markides, 2006; Schumpeter, 1942; de Visser & Faems, 2015). The definitions of radical innovation vary as much as the names do.

Schumpeter (1942) is one of the first to define radical innovation. He is the one bringing forward the term creative destruction, which describes the commercialization of radical new technology at the expense of established firms. In other early literature in line with Schumpeter, radical innovation is defined as competence destroying (Tushman & Anderson, 1986). Other authors refer to radical innovation when they speak about novel and unique inventions which have an impact on the technological future. They should have the ability to create breakthroughs in a product group or technology (de Brentani, 2001; Dahlin & Behrens, 2005). According to Garcia and Calatone (2002) radical innovations include new technology which creates new markets. They add that the radical innovation could happen at the macro as well as on the micro level, but radical innovations on the macro level automatically influence the micro level. Customers and producers are strongly affected by radical innovation on the macro level, because the new value proposition disrupts the behaviour of these customers and the newly created markets affect the competences of established firms.

Nevertheless, the radical innovation could arise is several ways which fundamentally differ from each other. The disruption could be based on a radical new business model, technology, product, service, process, or management approach. They therefore have different impacts on both customers and producers (Markides, 2006). Notably, Kaulio, Thorén, and Rohrbeck (2017) distinguish between radical business model innovation and radical technology innovation in their work on double ambidexterity. They

do assume that either one of them could happen to be radical or both. A rather general definition which does include most of the previous work is recently proposed by Pihlajamaa (2017). In this definition he includes the novelty elements of technologies, the essence of new market structure and he added the importance of a paradigm shift. Meaning people may perceive the offering of the radical innovation differently compared to the perception they had towards the offering replaced by the radical innovation.

The definition which will be leading throughout the following of this thesis is proposed by Norman and Verganti (2014). The frame they propose is including most of the elements mentioned by previous authors on the topic of radical innovation and provides a holistic view on radical innovation. The proposed dimensions in the frame are based on changes in technology and changes in meaning, see figure 1. The "radical technology-driven innovation" (p. 89) leads to a technology push towards the market, thus being a major change in the technological status (Norman & Verganti, 2014). An example of this could be the introduction of the colour television. On the other hand there is the "radical meaning-driven innovation" (p. 89), which changes the meaning we give to certain technologies or applications (Norman & Verganti, 2014). The Swatch watch is a nice example of this type of radical innovation, where the functional watch becomes a fashionable item. In a certain way the radical meaning innovation has strong similarities with what we become to know as business model innovation, since it is also incorporating already existing capabilities but applying them differently. At last, when both types of radical innovation occur Norman and Verganti (2014) speak about a technology epiphany, which is in line with the thinking of Schumpeter (1942) and his creative destruction. These are the rare innovative moments in history such as the introduction of the steam powered engine, computers and the internet.

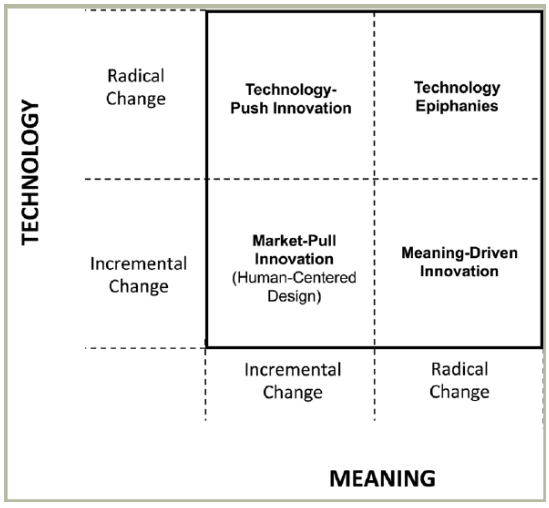

Figure 1. The two dimensions and four types of innovation. Reprinted from "Incremental and radical innovation: Design research vs. technology and meaning change." by D. A. Norman, and R. Verganti (2014). *Design issues*, *30*(1), p. 89.

2.3 Critical Factors for Innovation

2.3.1 Sources of Innovation

Innovation in general is often initiated within firms or by collaborations between businesses, and knowledge institutes (Pihlajamaa, 2017). Studies have shown that the innovation development patterns do differ across sectors in the service and manufacturing industries (Forsman, 2011). Even within these sectors businesses differ in their innovative behaviour. A classification on the innovativeness of firms has been proposed, which groups firms on their willingness to invest and their capability to innovate. The classification ranges from a non-innovator who is in an immature state or an innovator by chance to a mature routine innovator (De Carvalho, de Carvalho, Duclos, & Stankowitz, 2017). The variety in the classifications shows the diverse basis on which innovation is grounded within companies. Nevertheless, there are sources for innovation which more or less are presented within each company. Examples of these could be the rise of new markets or technologies, new regulations or deregulations, disasters or other extraordinary events (Bessant et al., 2005). All of these examples could be a reason for a business to innovate. Often the source of innovations can be found in the externa; environment of the company, this became also somewhat clear from the examples mentioned by Bessant et al. (2005). In many cases innovations are developed in combination with what is presented externally and how it is interpreted by the innovating firm internally (Brentani & Reid, 2012). Marketing or (new) business development frequently are the internal business functions searching and proposing opportunities to innovate. In other cases the source of innovation could be more directed from within, and is pushed by a central R&D function, or specific R&D units such as new product development (NPD) teams. These R&D and NPD teams are repeatedly charged with introducing game-changing technologies or applications, in often knowledge intensive high-tech or niche markets (O'Connor & Ayers, 2005).

Additionally, mentioned business functions are often concerned with the front end of the innovation, also called fuzzy front end (FFE) of innovation. The term fuzzy front end is used for the early stages of the innovation process in which new ideas are developed and propositions and concepts are developed and planned (Brentani & Reid, 2012; Kock, Heising, & Gemünden, 2015). In this stage a firm often develops, learns, and therewith gains knowledge and understanding by trial and error, since the radical innovation process is fuzzy and not linear. Further, factors such as technical developments and social networks are regularly in play and determine the process and outcome of the innovation efforts (Bessant et al., 2005; Norman & Verganti, 2014). Incumbent firms could also innovate by leveraging innovative ideas of start-ups, they therewith avoid the fuzzy front end and acquire this through the knowledge of the start-up. The acquiring firm could use its business development function as a scouting mechanism to find ideas and the capital of the firm itself could serve as venture capital to accelerate the idea into a business proposition. This process is often referred to as incubation capabilities of an incumbent firm (Markides, 2006)

However, there are also businesses that use another source for their innovative capability. An example and somewhat lesser known way to innovate is via lead users, people who are external to the innovating firm that provide insights in their needs and behaviours. This source of innovation can be insightful and helpful when firms are willing to innovate radically, because this user group presents demand characteristics ahead of the current markets or technologies (von Hippel, 1986). In some cases experienced people are hired and are set with the task to hack the system or test the product the business

is willing to offer to the market. In this way the product or service is beta tested and the firm is able to improve the final product before introduction (Verganti, 2008). Furthermore, the source of radical innovation is often an initiative of individuals within the firm and developed by small teams. In some cases radical innovations were just interesting thing to try and pushed by a limited number of individuals, as was the case with for example Facebook and Twitter (Brentani & Reid, 2012; Norman & Verganti, 2014). Contrastingly, incremental innovation typically finds its origin at the top of a firm in its strategic plan and is planned top-down, or it is the result of the interactions between the company and its customers (Pihlajamaa, 2017).

2.3.2 Factors Critical for Incremental Innovation and Innovation in General

Innovation has been an well described topic for years and therewith authors have spent much effort in understanding the phenomenon. Also today the debate on the topic which factors are leading in innovation management continues. These key success factors (KSF) or key performance areas (KPA) are quite similar to the better known key performance indicators (KPI). These KSF's or KPA's are essential attributes, capabilities, competences or activities which are most critical to the in this case innovation process, at a certain point in time. (Ferreira & Otley, 2009; Spanò, Sarto, Caldarelli, & Viganò, 2016) To be clear, it is essential to understand that incremental and radical innovation are mutual enhancing each other. They are coexisting in innovative firms, nevertheless they do have several different success factors (McCarthy & Gordon, 2011; O'Connor & Ayes, 2005). Thus to be successful in both it is crucial to have an understanding of the critical success factors for both innovation types (Birchall et al., 2011). In the following chapter first the critical factors for incremental innovation and innovation in general are described.

Already before the year 2000 several authors extensively described success factors to enhance the innovation process and its outcomes. For example Chiesa, Coughlan, and Voss (1996) provide insights on four core processes which according to them are important for management to monitor. These processes are the generation of concepts, development of products, acquisition of technology and process innovation. Additionally, Balachandra and Friar (1997) described 72 factors that contribute to innovation in general. They sub-divided the factors in market-, technology,- organisational-, and environmental related factors. Montoya-Weiss and Calantone (1994) provide another 17 factors contributing to project level success grouped into four categories, strategic, development process, market environment, and organisational factors.

The context in which the development of the innovation takes place is quite essential. The nature of the innovation, the nature of the market, the nature of the technology, and the nature of the firm do affect the factors that are critical and it thus influences the success (Balachandra & Friar, 1997). Concerned with the nature of the innovation a 'Tier' approach is proposed in which Tier 1 efforts are focused on basic research and technology development. Tier 2 projects have more focus on matching existing technology with organisational competences, and Tier 3 concerns about projects with a shorter term focus and more immediate needs (Hauser & Zettelmeyer, 1997). The last mentioned tier is mostly the domain of incremental innovations. Even if there would be a set of factors suitable for all tier levels, they would still be influenced by the context of the innovation, thus a factor for success in one situation could limit innovation efforts in the other (Balachandra & Friar, 1997).

It is rather evident that a misfit arises when one would focus on success factors with the wrong scope or based on the wrong natural assumption. Therefore it is crucial for businesses to clearly define the innovation strategy at the start before undertaking any innovation effort. The developed strategy has to be communicated thoroughly within the organisation and visionary leaders should be present to provided managerial focus in the innovation process (Cooper, 1999; Reid et al., 2015; McCarthy & Gordon, 2011). Management has the role to provided boundaries within which innovation is allowed to take place. Business leaders should clearly provide a (technology) vision which is motivating and inspiring employees. Lower level management has that task to translate this vision into measurable outputs which are controllable (Birchall et al., 2011; Tushman & Smith, 2002). Nevertheless, executives still need to participate and show accountability since it contributes to improved performance in innovation (Saunila, 2016). In addition, managers have to be aware of emerging strategies in contrast to their proposed planned strategies. These emerging strategies, that rise from external as well as internal developments, could successfully contribute to the innovation capabilities of a company (Kopmann, Kock, Killen, & Gemünden, 2017). Concluding, only when a proper strategy and vision are in place employees are able to know what is expected, and what the space is in which they are supposed and allowed to operate and innovate (Ferreira & Otley, 2009).

Furthermore, the essence of innovation projects, as well as any other kind of project, is to do the right project in the right way. It is thus first critical for the management of innovations to select and decide which projects are the right ones before even considering the proper execution. Portfolio management is a method for such monitoring and selecting of projects which should, and should not be executed. Further, a portfolio approach also provides a clear direction for the innovation efforts and is there with a practical elaboration on the proposed strategy and vision of the firm (Costantino, Di Gravio, & Nonino, 2015). The approach could support in the balancing of planned and emerged strategy implementation (Kopmann et al., 2017). Portfolio management is also effective in the field of business model innovation, the portfolio allows for a well-balanced range of business models and could determine which models are outdated or are absent in the business spectrum. Project portfolio management (PPM) is thus an critical factor for fostering innovation efforts and provides well-defined business and innovation direction (Kaulio et al., 2017; Killen, Hunt, & Kleinschmidt, 2008).

Next to these high level organisational success factors there are other elements on individual and project team level which could make a significant contribution (Pihlajamaa, 2017). To follow the innovation process order, we start with the front end of innovation. In this stage of the process individuals and teams search and propose ideas. It is therefore important to have proper organisational conditions under which sufficient ideas are generated. Things such as adequate time spent on up front investigations, a clear early product or service definition and tough decisions moments are needed to streamline the ideation phase (Cooper & Kleinschmidt, 1995; Kock et al., 2015). In general the critical elements of the ideation process are basically comprised out of “the stimulation, identification, selection and implementation of ideas”(Nilsson & Ritzen, 2014, p. 192). Forés & Camisón (2016) identified several other elements which contribute to proper implementation of knowledge. They advocate in the first place that the level of internal knowledge creation needs to be sufficiently high, only than an organisation is able to absorb external knowledge. Firms need to have, depending on the industry, a certain amount of specialist

scientist who are able to absorb and translate specific, technological, developments into propositions or applications (Forés & Camisón, 2016; Hung, 2017). Other factors such as the acquisition and assimilation are essentials in order to identify and incorporate the generated and absorbed knowledge (Forés & Camisón, 2016; Saunila, Pekkola, & Ukko, 2014). Thus the capacity of the organisation to learn is critical in the ideation phase, as well as in later stages. The ideation and innovation process can be streamlined by fostering this organisational learning and reflecting on the process and decisions made. The performance of a company should increase by applying such reflective practices and learning (Chiesa & Frattini, 2007; Ukko et al., 2017). Therefore, trial and error learning, which is a good source for incremental innovation, is a critical part for innovation. Often ideas are not directly implementable and need many adjustments and refinements before they can be commercialized (Kaulio et al., 2017). Therefore, the level of analytical processing of individuals in innovation teams is mentioned to stimulate success within projects, where intuition effects of the teams depend on the nature of the innovation (de Visser et al., 2014).

Additionally, there are several other critical elements which could play a pivotal role for innovation in general. One thing would be the interaction of the firm with its environment. Companies that frequently interact with their customers, suppliers, competitors and other industries show better innovative performance (Saunila et al., 2014). Thus the network effects of a firm are an important factor in its capability to innovate. Companies that operate in dense social and business networks are able to leverage and incorporate external knowledge better (Hung, 2017). A dense network could also contribute to improved business reputations, or vice versa business reputations strengthen the network. More important, the network enhances the linkages and interactions between firms, and when suitable network boundary functions are in place, the company is able to benefit from knowledge spill overs. These network boundary functions are often referred to as gate keeper functions and should be fulfilled by experts in the field in order to identify and incorporate relevant knowledge (de Brentani, 2001; Hauser & Zettelmeyer, 1997; Hung, 2017; Spano et al., 2016; Tidd, 2001). Hauser and Zettelmeyer (1997) present the term “research tourism” (p. 32) which strongly relates to the external searching behaviour of employees. A risk of this research tourism is the negative phenomenon often called ‘not invented here’ behaviour, which means people in a firm are not willing to adopt certain knowledge because it is not generated in their own organisation. This attitude is mainly caused by the application of wrong metrics by which teams and individuals are evaluated. When they are not incentivized or rewarded for internal and external research exploitations they will withhold from this behaviour and are not willing to consider inputs of other sources than their own (Hauser & Zettelmeyer, 1997).

2.3.3 Critical Success Factors for Radical Innovation

Radical innovation cannot be fully justified as a capability in itself, rather it is composed out of several elements which do interact with one and other, and are also critical by themselves. These elements might sometimes seem contrasting and counterproductive, this is mainly the result of the often coexistence of radical and incremental innovation within one firm (Slater et al., 2014; O’Connor & DeMartino, 2006). The before mentioned critical factors for incremental innovation and innovation in general are in most cases true in situations which are relatively stable. However, when discontinuities such as market-, technology- or political change arise, additional or different critical factors should receive more attention (Bessant et

al., 2005). The following framework, see figure 2, is developed based on the later described literature. The overview indicates the general factors with are of importance for radical innovation. Later in the text each of the seven performance areas is further elaborated and the individual success factors are explained, as summarized in figure 3.

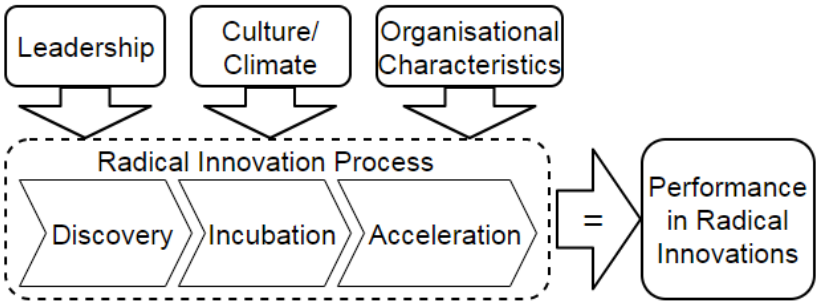

Figure 2: Success factors framework and internal relations indication for enabling radical innovation performance.[6]

The somewhat limited amount of literature on success factors for radical innovation agree on the point that leadership is an essential factor. Leadership is said to be vital for radical innovations and radical efforts fail without executive support and stimulation, even when the right processes are installed and critical factors are monitored (de Brentani, 2001; Cooper, 1999, Pihlajamaa, 2017; Slater et al., 2014). Employees are only able to properly direct and focus their intentions when the top management of a firm is able to provide a vision what it wants to reach in the (near) future. The vision offers an early direction, especially in the front end of innovation. It indicates in which technologies and markets a business wants to radically innovate, and it should incorporate strategy directions about which business opportunities or areas have priority (Cooper, 2011; Reid et al., 2015). Business leaders should also demonstrate passion in their management, and they have to provide psychological support and encouragement. Additionally, it is critical that radical development teams are protected from short term distractions and that they are equipped with sufficient resources (Slater et al., 2014). Pihlajamaa (2017) identified that radical innovation also needs strategic priority within businesses, since it increases the awareness and purposefulness of the innovation efforts. A company is able to increase its innovation capabilities by recruiting and developing highly skilled employees with a radical innovation focus, and providing them with the necessary central positions, autonomy, and appropriate performance metrics. Certain autonomy among managers in renewing product portfolio's or strategies enables flexibility, and their approach should not be risk averse (Cooper, 2011; Kock et al., 2015; Pihlajamaa, 2017; Slater et al., 2014).

Thus radical innovation starts with senior management accountability and commitment, and is enhanced by an open and creative entrepreneurial business climate. The company culture and business climate also effects management approaches and shapes the leaders themselves, and vice versa (de Brentani, 2001; Cooper 1999). An entrepreneurial climate should be stimulated and supported by sharing past success stories and providing transparency in radical innovation activities. Open communication of innovation activities and results are crucial for fostering the right business environment. The business culture demands a specific orientation, whether it is a customer, competitor or technology orientation in order to have people within the radical innovation process with similar mind-sets and enabling them to

[6] The framework is based on knowledge presented by the authors mentioned in this sub-chapter, however this particular overview is an own illustration.

have an entrepreneurial focus on specific business opportunities (de Brentani, 2001; Pihlajamaa, 2017; Slater et al., 2014). Therewith, for radical innovation activities it is encouraged to have an external focus and to scout for opportunities outside of the firm . When engaging in external sourcing it is essential to be aware of competitors, and market and technology developments (Cooper, 2011; Slater et al., 2014). The innovating firm therefore has to focus on learning and incorporate learning from failures (de Brentani, 2001; Pihlajamaa, 2017). A certain amount of flexibility is thus needed and the company needs to be able to make ad hoc decisions, which could even mean sacrificing current sales or market share (Slater et al., 2014).

The specific organisational characteristics are another key performance area for radical innovation performance, that is affected by leadership as well as by the cultural elements. The initial most obvious organisational element critical for radical innovation is the company structure. Companies that are able to balance between a structural and an organic structure have according to literature the best chance to radically innovate. An often applied mechanism for this structural balancing is the cross functional team, which has a positive effect on explorative behaviours and results. The probability of radical results is further increased when incremental and radical innovation projects are separated in the organisation (Cooper, 2011; Pihlajamaa, 2017; Slater et al., 2014). A critical side note to these separated project teams is that they have to rotate there members once in a while to avoid the so called ivory tower effect (Cooper, 2011). The level of bureaucracy with which these teams have to deal is said to have an effect on the innovative outcome, where less bureaucracy is contributing to higher radical performance (Pihlajamaa, 2017). Nevertheless, performance management is an essential, and radical innovation project teams have to be rewarded, or at a minimum recognized for their contributions (Cooper, 2011; Pihlajamaa, 2017). Radical innovation performance is increased when these teams or other organisational functions interact with external knowledge sources, such as universities, industries, or other business network interpreters as also earlier mentioned (Slater et al., 2014; Verganti, 2008). According to Forés & Camisón (2016) a critical organisational factor for radical innovation is the recombination of external sourced information and knowledge with internal developments. In order to be able to internalize this knowledge in the organisation, it is necessary to stimulate the development of skills and knowledge of the people who have to interpret or further develop ideas and technologies into radical innovations (O'Connor & DeMartino, 2006).

Developments in radical innovation projects and initiatives can be viewed as a process with several process steps along the way (Cooper, 2011; O'Connor & Ayers, 2005). As Cooper (2011) puts it: "Just because these projects are imaginative and bold is no reason to throw discipline out of the window." (p.2). It is therefore critical that the radical innovation process has a systematic ideation to product or service launch approach, which is able to iterate and thus is flexible (O'Conner & DeMartino, 2006; Slater et al., 2014). Further, essential in this process is the presence of a dedicated radical innovation groups which are driven by product or service champions and control the total process (Cooper, 2011; Slater et al., 2014). These process managers could guide and stir the radical innovation process with measures for several stages (Slater et al., 2014). O'Connor and Ayers (2005) propose three radical innovation capabilities or stages which should lead to better performance. They define discovery, incubation and acceleration capabilities as subsequent critical steps to get from single ideas to radical innovations. Each capability in

itself has several critical factors which contributes to its success, these are further explained in the following paragraphs.

Idea management does have the biggest impact on the success of radical innovations according to Cooper (1999), but it cannot be viewed as a self-supporting success factor. It is a critical part of the discovery capability where a firm needs to create, recognize, and elaborate on big ideas (O'Connor & Ayers, 2005). Therefore, an effective and proactive idea generation system has to be in place, often an ideation portfolio management approach is applied in innovative firms. Businesses that support the general innovation portfolio with a clear (technology) vision show higher performance in the front end of innovation (Cooper, 2011; Kock et al., 2015; Reid et al., 2015). Further, employees are enhanced and motivated to radically innovate when idea submissions are rewarded and when they receive freedom to further develop ideas. They therewith have to chance to distance themselves to a certain degree from the often shorter term perspectives (Cooper, 2011).

The incubation capability is concerned with evolving ideas in to specific business proposition. Thus in this capability is it essential to thoroughly understand the market and available technology domains (O'Connor & Ayers, 2005). Since radical innovation needs proper guidance and leadership support it is critical to develop business cases for each proposition. These cases enable fact based decision making and therewith decrease the risks and complexities associated with radical innovation to a certain extent. They are also closely related to the point made for incremental innovation, about performing up front due diligence (Cooper, 2011). On the other hand, a critical factor of radical success is allowing individuals concerned with innovation to perform their own initiated projects, often called 'pet' projects, unofficial projects, or skunk works. Employees are stimulated and allowed to show innovative behaviour because they get a certain amount of freedom in their thinking and work, this should enable them to pursue more radical ideas (Cooper, 2011). However, an institutionalized mechanism within the organisation is a prerequisite for being able to rapidly combine, apply and distribute developed radical initiatives. These mechanisms are often referred to as incubators or corporate venturing initiatives, but their essence is similar in that they can quickly shift on newly presented knowledge and inputs (Cooper, 2011; Forés & Camisón, 2016; O'Connor & Ayers, 2005).

Acceleration is the last phase in the radical innovation process according to O'Connor & Ayers (2005), this last capability is concerned with ramping up the innovation until the point that it could support itself as a market and/or business segment. In the acceleration capability the main focus is on the right marketing efforts, thus critical factors are the market launch strategy and correct marketing mix. Entry timing and a well bundled product/service offering increases the commercial success of a radical new offering (O'Connor & Ayers, 2005; Pihlajamaa, 2017; Slater et al., 2014). Furthermore, having a clear and well defined focus on which specific technical and commercial ideas fit the current company market strategy enables radical success (Cooper, 2011). The likely success of these radical innovations is further increased when sufficient scale up funding from the business is available (O'Connor & Ayers, 2005).

Category	Leadership	Culture/ Climate of the Business	Organisational Characteristics	Radical Innovation Process	Discovery Phase	Incubation Phase	Acceleration Phase
Single Success Factors per Category	Strategic priority for radical innovation (RI) [3];[8]	Outside the business solution searching [3];[10]	Separation incremental / radical innovation activities [3];[8];[10]	Applying iterative innovation process [7];[10]	Idea development vision [3];[5];[9]	Using innovation hubs (incubators/ corporate venturing) [6]	Scale up funding for radical innovations [6]
	Manager autonomy in renewing strategy/product portfolio [2];[8]	Open communication and transparency in RI activities [1];[8]	Collaborating with external partners for innovation [4];[10];[11]	Applying RI process measures [10]	Idea portfolio for guiding ideation [5]	Stimulation personal/ unofficial projects [3]	Consideration of introduction timing [10]
	Visionary/passionate leaders active for innovation [10]	Sharing of past innovation success stories [8]	Skills and talent development of innovation teams [7]	Dedicated groups for total RI process [3]	Reward/recognition for idea submission [3]	Business case development for technology/ business ideas [3]	Bundling of innovations for increasing market impact [10]
	Senior executive stimulation of radical innovation [1];[2];[8];[10]	Entrepreneurial minded employees [3];[10]	Applying cross-functional teams [3];[8];[10]	Systematic and disciplined idea-to-market process [3];[6];[10]	Applying idea generation systems/ initiatives [3];[6]	Internal knowledge creation/ acquisition stimulation [4]	Deploying marketing efforts for radical offering [3];[10]
	Barrier breaking, risk and innovation promoting managers [5];[10]	Organisational learning focus [10]	Low bureaucracy in innovation projects [8]		General portfolio management for guiding innovation [5]	Preforming up front homework before initiating projects [2];[3]	Clear market launch strategy [3];[8];[10]
	Management attributing sufficient resources toward RI [10]	Creative and open business environment [1]	Project team recognition for success [3];[8]				Focus on technical/commercial ideas fitting company product-market strategy [3]
	Executive vision on technology and market development [3];[9]	Competitor awareness in radical developments [10]	Evolving organisational and team structures [10]				
	RI protected by management from short-term pressures [10]	Allowing leaning from failures [1];[8]					
		Willingness to sacrifice sales for radical opportunities [10]					

[1] de Brentani, 2001; [2] Cooper, 1999; [3] Cooper, 2011; [4] Forés & Camisón, 2016; [5] Kock et al., 2015; [6] O'Connor & Ayers, 2005; [7] O'Connor & DeMartino, 2006; [8] Pihlajamaa, 2017; [9] Reid et al., 2015 ; [10] Slater et al., 2014; [11] Verganti, 2008

Figure 3: Overview of critical success factors for radical innovation.

There are quite some factors which are critical when a company is willing to innovate radically, however the innovation process is in some cases still influenced by serendipitous events. Nevertheless, Vallery-Radot once mentioned: "Chance favours the prepared mind" (p. 220), indicating that when firms have processes in place that are able to institutionalize and process radical innovation adequately it will give them the upper hand (Vallery-Radot, as cited in Abetti, 2000). In figure 3 an overview is presented of all radical innovation enabling success factors as described before. They are grouped according to the literature from which they were extracted. The essence for innovative businesses is to be aware and develop management systems which enable radical innovation in a structural way by focusing on the antecedents which are most applicable for their specific context. The innovation performance

management structure has to be designed in alignment with the factors which are critical for a specific firm (Jansen et al., 2011; O'Connor & Ayers, 2005; Reid et al., 2015).

2.4 Innovation Performance Management and Measurement

2.4.1 Performance Management and Measurement in the Innovation Context

For many years key performance indicators (KPI's) have been used by businesses to monitor, control and stimulate the performance. Performance management systems (PMS) are in general frameworks of KPI's which allow for the controlling of activities and behaviour (Broadbent & Laughlin, 2009). These performance management systems have evolved during the last century. They started off as productivity management systems, changed into budgetary control mechanisms, shifted to integrated performance measurement, and later towards integrated performance management systems (Bititci, Garengo, Dörfler, & Nudurupati, 2012). In earlier literature these performance management systems are often called management control systems (Anthony, as cited by, Ferreira & Otley, 2009). Today, the performance management systems frequently focus on business level decision making and enabling auditing of a firm to make sure the company policy is executed well (Birchall et al., 2011). Performance management is viewed as an important element of the governance structure of a firm and it is frequently discussed in literature, however the PMS phenomenon is infrequently defined (Neely et al., 2005). According to Neely et al. (2005) performance management "Literally is the process of quantifying action, where measurement is the process of quantification and action leads to performance." (p. 1228). The performance management system thus has as a goal to achieve certain ends with a particular set of means by monitoring specific actions (Broadbent & Laughlin, 2009). Some authors argue that performance measurement is related more to outputs and results, where capability measurement is related more to inputs and processes (Calik & Bardudeen, 2016). Furthermore, performance management includes more than mere monitoring the performance, it also is about planning and setting expectations, capability development and rewarding good performance (Broadbent & Laughlin, 2009). In the end a performance management system is a composition of multiple measures which are critical for a particular business function (Neely et al., 2005). Thus, the essence of performance management systems is to provide a holistic view on the progress made and define clear organisational goals, targets and indicators that enable the firm to pursue a certain strategic direction, such as improving radical innovation capabilities. The tendency is however that firms focus on specific control areas which on the short term are most profitable, which is contra dictionary focus when willing to develop innovations for the longer term (Ferreira & Otley, 2009; Walker et al., 2010).

Innovation could be viewed as one such strategic focus area for performance management. In general innovation performance measures are applied at three levels; governmental, industry and firm level. At the governmental level the emphasis is on policy making, and on the industry level measurement is concerned with effectiveness comparisons and benchmarking between firms. On the firm level the focus is mainly on the overall performance and the effectiveness of the R&D function concerning innovations (Birchall et al., 2011). Moreover, performance management in the context of innovation within businesses starts with measuring the innovativeness capability of a particular firm. Despite the importance of PMS it remains difficult and under-exposed within businesses how to define and measure their innovation

activities and capabilities (Calik & Bardueen, 2016). Adams et al. (2006) also observed that the measurement of innovation for management purposes is not performed on a routine basis. Therewith, performance management tends to be used in an insufficient way, where it is utilized as an traditional management control tool instead of a learning and reflection tool for supporting the organisation. Despite organisational learning is essential for innovation and it could be stimulated by applying the right performance management systems, it still does not receive the attention needed in businesses (Kerssens-Van Drongelen & Bilderbeek, 1999; Saunila et al., 2014). Often innovation performance measures are applied to reflect upon the outcomes of innovation efforts, which is a rather limited application by firms (Forés & Camisón, 2016; Neely & Al Najjar, 2006). Literature shows that innovation performance should be measured and managed on a wider basis than mere input, processes and output. Items such as ideation, strategy, market and customers, learning and knowledge management, and culture and leadership are critical additions for PMS (Saunila, 2017c; Adams et al., 2006). The work by Simons developed the 'four levers of control' (p. 244) in which he defines four control systems categories for PMS which have different characteristics (Simons, as cited by, McCarthy & Gordon, 2011). These four levers are defined as follows:

- Beliefs system
- Interactive system
- Boundary system
- Diagnostic system

The last two are concerned with exploitative (incremental) innovation activities and are used as a feedback control mechanism, whereas the first two should be applied for explorative (radical) innovation and are used for feedforward control. The beliefs control system is about guiding and sharing general company beliefs in order to stimulate the creative process for innovations, especially the radical and explorative innovations (Ferreira & Otley, 2009; McCarthy & Gordon, 2011).

Accordingly, the chosen strategic controls and measures determine what innovative results are derived from the resources available and efforts applied for innovation. In recent years several authors have proposed frameworks for performance management in innovation. Ferreira and Otley (2009) are a well cited example of authors who propose an innovation PMS. They proposed a management framework in which they start with the mission and vision of a firm in a certain culture and context, and it results in a specific rewards system. In their work they define 12 questions which are supposed to help businesses to come to the most suitable management system. A strong point in their approach is that the purpose of the frame work is clear and utilized measures are in line with the business strategy. PMS could thus serve different roles for each business and therefore Chiesa and Frattini (2007) indicate differences in performance management purposes. According to them, the PMS could be a mechanism to support decision making, or enhance performance in R&D. The PMS could be motivational and incentivizing, stimulate the organisational learning, increase communication and coordination, or it could reduce risks. Therefore, having a certain focus and balancing the different business attributes is critical for each business. A well-known performance management framework in business literature enabling this focusing and balancing of multiple control areas is the balanced score card by Kaplan and Norton (2000). They are one of the firsts to approach business management by applying multiple measures across several business

areas such as operations, finance, customers, and organisational capacities. The major strength of this approach is that the balanced scorecard links the business strategy to certain performance measures (Otley, 1999).

Additionally, PMS could help businesses to be prepared to react to external uncertainties, no matter the kind of business or the context in which innovation take place. Especially, the earlier mentioned interactive system by Simons could support in learning and reacting to emerging ideas or strategies which is closely related to the way radical innovations arise. The diagnostic role and interactive use of a PMS is what is critical for business to be able to react to its environment (Ferreira & Otley, 2009). Also strategic controls at portfolio level, also called a dynamic portfolio capabilities, have the ability to sense and reconfigure based on externalities when necessary (Kopmann et al., 2017). In general, a firm has to monitor a wide variety of performance categories to be able to quickly respond and reconfigure based on newly presented inputs and externalities (Saunila, 2017c). Nevertheless, it does start with defining purposes and objectives a company wants to reach with its innovative efforts (Ferreira & Otley, 2009). Thereafter, specific measures can be developed and performance frameworks can be applied for the innovation process to support and/or stimulate innovative outcomes (Soosay & Chapman, 2006).

2.4.2 Performance Measures and Metrics for Innovation

Measures play a critical role in performance management systems, without measurement points the systems would not be able to reflect on the actual innovation process (Broadbent & Laughlin, 2009; Jansen et al., 2011). A typical Dutch example of the importance of performance measures can be found in speed ice skating. During each round the race the skaters get time information about their completed lap plus an indication whether they should increase or decrease the skating speed in order to be able to finish the race and achieve the time needed to win. This application clearly indicates the guiding and motivational elements of measures for the top athletes, plus the decision making aspect of the coach who determines whether or not the skater should increase or decrease speed (Ambler, as cited by Reid et al., 2015). The important point which has to be noted in the ice skating metaphor is the difference between the lap times and the total time of the race[7]. These times show the difference between what is called in literature a measure and a metric. The measure is the total time as measured after finishing the race and the metrics are the lap times provided to the skater. Thus the difference between a measure and a metric is that metrics are 'leading' measures, as well referred to as leading KPI's. Metrics indicate the progress made at a certain point in time, but effort could change the final measurement result (Saunila, 2017c; Spano et al., 2015). Another well-known example of a metric could be the downloading bar visible on computers, it also indicates the progress made at a certain point but the downloading time could still alter due to your internet speed. Literature puts metrics in the ex-ante, and measures in the ex-post performance measurement category (Broadbent & Laughlin, 2009):

- Before end of innovation process (ex-ante): Leading KPI's = Metrics
- After finalizing innovation process (ex-post): Lagging KPI's = Measures.

The link between critical success factors and metrics in de case of ice skating is the following. Many factors contribute to the speed of the ice skater, such as ice temperature, air pressure, sharpness of skates, body

[7] The total time of an speed ice skating race is the sum of all laps to complete a particular distance.

posture and many more. However, most important is the energy used by the ice skater and when all other elements remain the same this is the most critical elements, it might even be linear related to the speed. Thus, when one would measure speed in each round, which is time over a certain distance, the result is that the amount of used energy becomes known in the form of a metric. The monitoring of these time metrics can than stimulate the skater to increase or decrease energy usage in the next round in order to achieve the best possible race time.

The same about measures and metrics holds thus true for innovation within firms, and there is a difference in performance management approach when a firm is monitoring measures or metrics. In many cases firms, and also governments, monitor measures which allows them to tell how well a business, sector or industry has performed in its innovation efforts at the end of the measurement period. The resulting problem then of course is that the people responsible for innovation are not able to alter their approach or direction in order to redirect capabilities and positively influence the outcome, figure 4 provides a simple overview of the usages of measures and metrics. Academic literature on R&D and innovation management presents quite an extensive number of measures which should provide insights in the innovation process, however the number of metrics for innovation are less available (Adams et al., 2006, Ferreira & Otley, 2009).

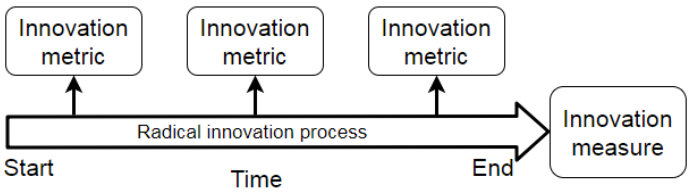

Figure 4: Graphical overview of the utilization of measures and metrics in radical innovation process

2.4.3 Utilization of Performance Metrics

The essence of performance management systems and metrics is not only about which metrics to apply, rather also how to utilize them. Firstly, measurement should be done on a continuous basis, and should thus not be sporadic phenomenon within a firm, which is also somewhat in the nature of metrics. The once in a while monitoring or measuring is often due to the fact that measurement in the past was used as a controlling mechanism where at certain date the numbers were gathered to present the past quartile/yearly (financial) statements (Nilsson & Ritzen, 2014). Secondly, businesses have to define their contextual environment in which they are willing to institute performance metrics, in the case of this thesis the context is radical innovation. Several internal as well as external contextual elements could block the success of the performance measurement for radical innovation. For example internal company politics and employee behaviour plays an important role in the acceptance and use of the proposed metrics. Therefore, proper communication and commitment of top managers about why it is important to use metrics for innovation, and with what goal, is essential (Chiesa & Frattini, 2007; Kerssens-van Drongelen & Bilderbeek, 1999; Nilsson & Ritzen, 2014). Metrics in certain business areas, such as R&D or product development, could even become part of senior managements incentives scheme to show their involvement and commitment (Cooper, 2011). Also regularly evaluation by internal customers of R&D activities, and the departments in general, seems to support better performance, in contrast to the evaluation solely by R&D managers (Kerssens-van Drongelen, 1999).

Metrics are used to guide decision making and are often applied for functions which are recognized as being critical, or for innovation processes that require more attention at a specific point in time. Moreover, they should also be institutionalized to monitor and stimulate those attributes that are critical for the innovation process or activities for a certain firm (Cooper & Edgett, 2008; Richtnér et al., 2017). In order to thrive as a company in radical innovations more attention is needed to these specific functions or areas that contribute to innovation. Therefore metrics could be applied to monitor, evaluate, and redirect business efforts on these KPA's (Hauser & Zettelmeyer, 1997). Some argue that measurement of activities, especially in innovative and creative activities, is restricting the creativeness of employees (Amabile, 1998). Others say that metrics certainly are a proper mechanism to stimulate the right decision making and action taking according to a pre-determined strategy. It would however be a mistake to apply similar metrics for different functions or processes, each needs a specific set of performance metrics (Birchall et al., 2011; Hauser & Zettelmeyer, 1997; Saunila et al., 2014). Consequently, managers should apply a comprehensive set of metrics which can be changed during the innovation process according to specific needs or critical issues. Best performing businesses already make use of metrics which vary according to the innovation phase in which the firm finds itself. Thus, the measurement instrument should be dynamic and reviewed frequently, still the metrics have to be in line with the pre-defined technology vision and strategy (Muller et al., 2005; Saunila, 2017a). Even in the early stages (fuzzy front end) of innovation metrics play an important role to gain commitment and to evaluate progress, however the common performance management tools are mostly not suitable for this phase (Reid et al., 2015). Further it is advised to avoid metrics with complex measurement procedures. A manageable number (eight to ten) of them should be applied, due to the limited time and control span of managers. These metrics could consist out of financial as well as non-financial measures, this depends on the specific situation. Generally speaking financial metrics tend to be somewhat insufficient for innovation processes, because the direct effect of an innovation on revenue and sales numbers is lacking in time, and is therefore difficult to predict during the innovation process itself (Birchall et al., 2011; Jansen et al., 2011; Muller et al., 2005). Managers and leaders should prevent measuring everything that can be measured, this will in the end result in an information overflow and decision inertia (Muller et al., 2005).

Often metrics are a mechanism to reward the behaviour of employees, whether it is for their own performance incentives or to guide their developments and innovation efforts. It is therefore wise to include these employees in the development of the measurement procedures and metrics selection, when people are included they might feel more committed and take ownership. In addition, the measurement should take place frequently, preferably one, two or three times per month and employees should be rewarded accordingly (Chiesa & Frattini, 2007; Kerssens-van Drongelen, 1999; Nilsson & Ritzen, 2014; Saunila, 2017c). Especially for radical innovation efforts the iterative learning of the organisation and its employees is key, this should therefore also be reflected in the metrics applied (Ukko et al., 2017). Saunila (2017c) therefore proposes to not refer to innovation measurement rather to innovation evaluation, this because it could positively stimulate the communication across different departmental levels, which is often a discussion subject.

Summarized, metrics have to enable performance planning instead of reviewing, and they should provide answers to why certain aspects in the innovation process do not function in the way they should

(Birchall et al., 2011). Nevertheless, metrics can fulfil several functions as mentioned before. They can create routines, trigger management, enable action, operate as a reflection mechanism and guide behaviour (Nilsson & Ritzen, 2014). In sum meaningful for metrics and their right use, is measuring the critical areas of the innovation process, and they should be clear and simple to understand. This requires them to not depend on difficult data sources or be complex to compute. Most important, metrics have to be actionable, they have to reflect items in the innovation process which can be influenced by the person responsible, and need to be in line with the strategic innovation intent of the firm (Birchall et al., 2011; Nilsson & Ritzen, 2014).

3. Method

3.1 Research Approach

The thesis research applies a mix method research approach to explore which of the success factors and therewith performance metrics are effective for fostering radical innovation within Damen. A mix method design is one that integrates qualitative and quantitative research, and which synthesizes the intellectual and practical elements of both (Bryman & Bell, 2011; Johnson, Onwuegbuzie, & Turner, 2007). Every research design has its strengths and weaknesses, also the mix method design. Despite this, the research design is chosen because it has the ability to provide a more complete and comprehensive picture of the situation studied (Johnson & Onwuegbuzie, 2004; Oke, 2007). The method is suitable for this research since it quantifies general opinion within Damen, and it is able to provide a full image of the company with its qualitative part. Furthermore, the "development" (p. 260) mixed method purpose is used because of its informing character and the increased validity of constructs applied in a later stage, which is practical since limited theoretical constructs exist on radical innovation success factors or antecedents (Greene, Caracelli, & Graham, 1989).

McCarthy & Gordon (2011) mention the appropriateness of surveying employees in order to find out which elements are driving them in their R&D organization. In this study the quantitative method ranks the critical success factors for radical innovation based on a self-completion questionnaire. Thereafter, the appropriate metrics and usages are identified with a qualitative in-depth interview approach. Triangulation is used in the interview to cross check the critical factors which turned out to be significant during the quantitative part of the study. The research approach is graphically displayed in figure 5.

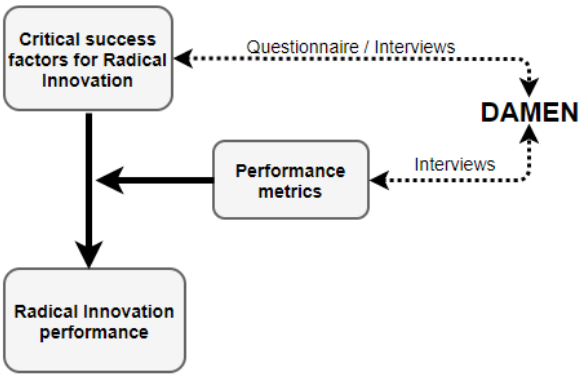

Figure 5: Research approach framework

3.2 Survey Strategy

The study deals with primary data, because the questionnaire is conducted within Damen during the research itself. The self-completion questionnaire is based on the theoretical constructs presented in the previous theory chapter 2.3.3. Constructs are mainly based on the Slater et al. (2014), Cooper (2011), and Reid et al. (2015) frameworks and contributions of several other authors, see figure 3 for the overview. Using theory to create measures for the questionnaire ensures the basic face validity (Bryman & Bell, 2011; Kalton & Schuman, 1982). For every single success construct a statement is representative, which has to be ranked on a seven point Likert scale (fully agree to fully disagree). For each statement two time states are asked, first the respondents are asked to rate the current state, this provides a benchmark. Secondly, they are asked to rate the future envisioned state. The intention of this approach is to avoid average answering, meaning respondents indicate all success factors are more or less important. The questions are formulated in such a way that they force respondents to answer them for the specific Damen situation. Judging whether or not the success factors are in general important is avoided by the question structure. Furthermore, the statements will be randomly ordered to avoid bias forming and minimizing the possibility to 'game' answers during the questionnaire. A multiple-indicator measurement approach avoids the reliance on a single indicator concerning the grouped factors. Additionally, the respondents are asked to rank the seven success factors on which they intuitively think Damen could best improve its radical innovation performance. The aim is to get a clear picture of construct importance (Bryman & Bell, 2011; 't Hart, van Dijk, de Goede, Jansen, & Teunissen, 1996).

The self-completion questionnaire is filled out through Qualtrics[8] online survey software and is transmitted through the Damen email to respondents. Employees most likely to encounter (radical) innovations within Damen are selected for the sample of the questionnaire, which is done in consultation with the innovation program manager. The number of selected respondents is limited compared to the total number of employees, however the number is fairly large when compared with the total amount of employees contributing to (radical) innovation. A cover letter is included in the email to the employees which explains the goal of the questionnaire, and clarifies that there are not right or wrong answers, and complete honesty is the best possible answer. Anonymously filling out the questionnaire is possible to avoid no response bias, but respondents can add their contact information if they want to receive the questionnaire results later on. The questionnaire itself is pre-tested among several knowledgeable Damen employees that judged the statements on their validity towards their intended meaning, as well as on their formulation and wording mistakes, see appendix C for the full questionnaire (Bryman & Bell, 2011; 't Hart et al., 1996).

3.3 Interview Strategy

The interview strategy applied in this study is of the semi-structured kind, this to be able to get into detail about specific topics but at the same time leave space for the respondents to elaborate on issues they think are important (Bryman & Bell, 2011). An interview guide is created containing questions to be asked, which is based on the theoretical concepts elaborated on in chapter 2.4, as mentioned before to ensure validity (Kalton & Schuman, 1982). Furthermore, the interview questions are developed in collaboration

[8] Qualtrics is an online survey software tool available for University of Twente students which enables respondents to complete the questionnaire via an web link, see appendix D for an overview example.

with the thesis supervisors and the interview is submitted to a test run. The interview guide including questions can be found in appendix F.

During the interviews the interviewees are firstly asked about their view on radical innovation to set a benchmark for further answers given in a later stage of the interview. Secondly, they are asked about which elements would refrain radical innovation from happening with in Damen. Thirdly, the concepts of innovation and radical innovation are explained, by the use of several slides. Fourthly, questionnaire results are briefly presented and the opinion of the interviewees are asked. Fifthly, the concept of measures and metrics is explained and several questions follow about how this could best be done for the success factors which turned out most significantly important in the questionnaire. In the final open question the interviewees can provide further insights or opinions about the current situation and the research itself.

In total five Damen employees are interviewed for approximately 45 minutes. The choice is made to interview employees from different hierarchical levels within Damen, this because it provides a richer and wider view in the results and it eliminates functional bias to a certain extend. The group of interviewees consists out of an engineer, a manager, an operational and non-operational director and an executive board member. The selection is done in consultation with the innovation program manager in order to select employees who deal with radical innovation, or have decision authority over the process[9]. Every interview is recorded and transcribed for analysis purposes (Bryman & Bell, 2011).

3.4 Data Analyses Method

Two types of data analysis are needed in order to analyse all the data gathered in this study. The quantitative data resulting from the questionnaire is subject to statistical data analysis, and the interview data is analysed with a content analysis approach. The general success factors under investigation in the questionnaire data are composed out of multiple single success factors, which are rated on a seven point Likert-scale. Thus, the data can be analysed at an interval measurement scale. The analysis of means and standard deviations is the first step, after which a more comprehensive analysis of variance test (Anova) determines the relative importance of factors, based on their significance levels (Boone & Boone, 2012; Bryman & Bell, 2011; Norman, 2010). Multiple Anova's are performed on the data to determine which factor(s) is most important for Damen. Figure 6 shows the iterative Anova approach used for determining the significance of high or low scoring factor. Each factor has a mean score and standard deviation which is the basis of the Anova analysis. In the first run all factors are compared with each other and the result is an certain chance value, p-value. When this p-value is below an significance level of 0.05 it means at least one factor is significantly different from the group. The following step is to re-run the Anova excluding the highest or lowest factor mean, which is most probable different from the group. By excluding a factor each time and then rerunning the Anova it becomes clear which factors are significantly different from the group.

[9] The Damen Innovation program manager is also the first company supervisor of the project, Solco Reijnders.

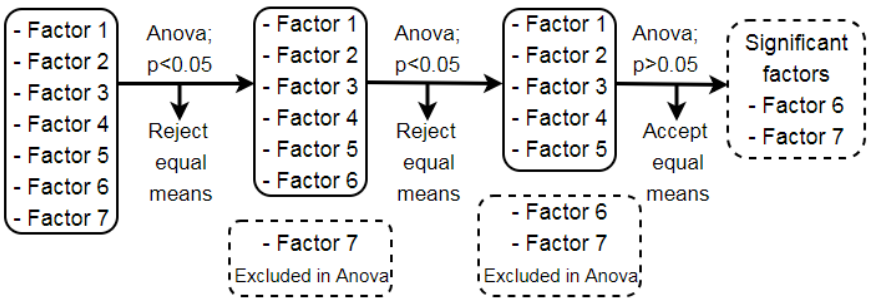

Figure 6: Iterative factor excluding Anova analysis method

In the analysis the single factors are grouped into the seven general factors, in accordance with the theory they are extracted from see in figure 2 and 3. The result is seven items constituting out of several single factors as shown in figure 3. An Anova analysis is done on:

- Current state mean and standard deviation results
- Future state mean and standard deviation results
- Difference between states, increase or decrease of mean value for the success factor(s)

The result of this analysis are insights into which general management area(s) Damen has to focus in order to improve its radical innovation performance. Thereafter, the single factors are analysed, also based on iterative approach as well as on the three mentioned states, to identify which of these single antecedents are most important. At last, all Anova's are performed again, however in this case the analysis focusses on differences in results between business units and hierarchical levels. These grouped analysis have to determine whether or not differences exist in the grouped results.

The interview data is transcribed and subject to a qualitative content analysis and is analysed deductively. Further, an open coding approach with the 14 steps as described by Burnard (1991) is applied. This coding method is well suited to analyse and understand the multifaceted phenomenon under study (Bryman & Bell, 2011; Elo & Kyngäs, 2008). In a certain way this approach resembles the literature matrix approach often used by university students to produce literature reviews, where per items of interest the information of every interviewee is compared and judged on similarities and dis-similarities. Conclusions can be drawn per items. Lastly, the results of the questionnaire and interviews are subjected to cross comparison to determine whether or not the results present similar or different views, as well as to assess and find reasons for the quantitative found data.

3.5 Research Biases

Every research has to deal with biases and the aim of a certain research design is to minimize the effects of these biases. Also this research is confronted with several types and it is explained how these bias effects are minimized. Every questionnaire has to deal with the self-completion bias, to assess this effect respondents are asked how innovative they would rate themselves, and Damen as a company. It is to make sure the sample of the questionnaire is not skewed to either side, and it therewith ensures the people contributing to the research can be assumed a normal population (Bryman & Bell, 2011).

In addition, this research deals with a sample selection bias since not the whole population is tested in the questionnaire and interviews. The selection bias is part of the sampling bias and is specifically

concerned with the respondents selected for a research (Bryman & Bell, 2011). In this thesis research the respondents for the questionnaire are selected based on their contribution or probability to contribute to innovation within Damen. Selecting these employees avoids random sampling effects and increases the relevance of the answers provided. The selecting of employees is done in consultation with the innovation program manager, and is also partly based on the initial interviews which gave insights into the Damen organisation. In the end the larger part of the employees who deal with innovations are selected for the questionnaire sample. On the other hand, the interviewees are chosen based on their functional levels and are most likely to be confronted with or contribute to radical innovations. These employees are thus selected based on the same criteria as with the questionnaires, and additionally the hierarchical spread is added after consultation of the university supervisor.

Furthermore, there are several response biases which have to be taken into account, these are especially present in Likert scale questionnaires (Furnham, 1986). At first, one has to avoid question order bias in both the questionnaires and the interviews. In the questionnaire used for this research the bias risk is dealt with by randomizing questionnaire questions. In the interview the questions are chosen in such a way that no information from the interviewer is provided prior to the moment the interviewee has given an answer about a certain topic. Additionally, questions are ordered in a tactical way such that the interviewee is not influenced by the topics asked in the questions before (Bryman & Bell, 2011). A second bias important to reduce is extreme responding, thus disturbances of the data results in the questionnaire by respondents who answer only in extremes (Furnham, 1986). In the data analysis it is checked whether or not this occurred and extreme items have been eliminated from the data set. Then there is also the social desirability bias which to some extent is in line with the previous bias, but in this case respondents provide answers which they think are best accepted in society or the company. Or they try to please the experimenter with their answers. The questionnaire is therefore completed anonymously, and only at the end respondents could indicated if they would want to make their identity known by adding their contact information, in order to partly avoid this bias type. At the start it is also made clear to respondents that the questionnaire is not developed to judge or rate performance. Respondents are asked to fill out the questionnaire intuitively, meaning there are no ‘ right’ or ‘ wrong’ answers to the questions presented. Also the interviews deal with the same kind of bias too, therefore the interviews are anonymized to avoid social desirable answers of the respondent (Bryman & Bell, 2011; ‘t Hart et al., 1996). Nevertheless, this bias is hard to control due to the topics discussed and the recording of the interviews for analysis purposes.

The last bias which is controlled in the research is the acquiescence bias, typically mentioned as the “yea-saying” bias (Arndt & Crane, 1975, p. 218). This bias is extremely important for this research since many success factors are tested in the questionnaire which could lead to all factors being to some extend equally important. To avoid these kinds of results, respondents are forced into rating a current state, as well as a future state. Because of this difference of time frames the respondents are able to give their opinion on the present situation and then indicated whether or not this should be different. The result is more variance in means scores, and a clearer deviation between an objective rating of the present and a subjective rating for the future. Special care is taken in the wording used in the two states, since one does not want to force people to indicate certain items to be more important than other just because of the wording used (Bryman & Bell, 2011; Furnham, 1986; Kalton & Schuman, 1982).

4. Results and Data Analysis

4.1 Quantitative Results of the Questionnaire

4.1.1 Descriptive Statistics on the Sample

In total the questionnaire is send to 160 Damen employees. Of the 84 responses 34 are excluded due to incompletion, extreme answering and unrealistic processing time. The remaining 50 valid responses contribute to a 31.3% responses rate. The sample constitutes out of 86% males and 14% females. The dominant educational level of the sample is University masters level (66%), further the sample includes hbo (20%), PhD (6%), and high school, mbo, university bachelor count for the remainder percentage[10]. The research department is mostly present in the sample (34%), development contributes 12%, High Speed Craft (HSC) adds 18%, Tugs and Workboats (10%), and the remaining percentage is a mix of eight other departments[11]. Furthermore, the sample is for 66% represented by respondents at a hierarchical level of employee, the other 34% identified themselves as managers. In total the respondents in the sample have been working on average for 10.5 years since leaving their education. On average the respondents have been working for Damen for 6.4, and the mean time operational in the maritime industry, excluding years at Damen, is 5.6 years.

The questions that aim at determining the sentiment towards innovation and radical innovation among the respondents in the sample indicate the following. On the question if respondents agree or disagree on the definition of radical innovation, similar as described in this thesis (chapter 2.2.3), 72% agrees, 6% disagrees, and 11% is undecided. In addition, respondents rate themselves not innovative (2%), somewhat innovative (46%), innovative (36%), and very innovative (16%). To the question how relevant radical innovations are for Damen respondents indicate; somewhat important (22%), important (54%), and very important (24%). Lastly, employees indicate that Damen is not good at all in radical innovation for 8%, a not good rating receives 22%, somewhat not good (18%), not good / not bad (20%), somewhat good (28%), good only 4%, and very good 0%.

4.1.2 Results General Success Factors Analysis

The first step in the data analysis is determining which of the seven general success factors, as described in the theory (chapter 2.3.3), are most important for Damen when willing to innovate radically. Three separate analysis of variances (Anova) have been conducted on the grouped factors questionnaire data[12]. One for the current state, the future state and the difference between these two states.

Current state analysis

The overall mean of the seven current state success factors is 3.96 with an average standard deviation of 0.766. An Anova on the seven factors indicates that there are one or more means which are significantly different to the others in the group at an alpha level of 0.05 (df = 6, F = 6.063 > F-Critical (Crit) = 2.125,

[10] Hbo (bachelor of applied science) and mbo (intermediate vocational education) are Dutch educational levels.

[11] Remaining departments: Damen Technical Cooperation (2%), Civil & Green (2%), Business development (2%), IT (2%), M&A (2%), iPMO (4%), other (6%).

[12] A Likert scale is used in the questionnaire ranging from 1 till 7, with 1 being fully disagree and 7 being fully agree.

and p = 0.000 < 0.05)[13]. When the leadership factor (M = 3.71) and the process factor (M = 3.53) are removed from the group the remaining factors show no significant difference in means (df = 4, F = 2.230 < F-Crit = 2.408, and p = 0.066 > 0.05), meaning that these two factors are significantly different, and lower, than the others in the group. An analysis on only the leadership and process factors together showed no significant differences between the two (df = 1, F = 0.972 < F-Crit = 3.938, and p = 0.326 > 0.05).

Future state analysis

The overall mean of the seven future state success factors is 5.38 with an average standard deviation of 0.677. An Anova on these seven factors shows that there is no significant difference between the factor means (df = 6, F = 1.086 < F-Crit = 2.125, and p = 0.370 > 0.05).

Difference between current and future state analysis

The overall mean for the differences between the two states means of the seven factors is 1.41 with an average standard deviation of 0.998. The Anova on all seven mean differences shows that there are one or more factors which significantly differ from the remaining factors (df = 6, F = 4.971 > F-Crit = 2.125, and p = 0.00 < 0.05). Further analysis indicated that the factors leadership (M = 1.62), process (M = 1.81) and discovery (M = 1.66) have significantly higher increase scores than the remaining factors, as is the result of subtracting them from group under analysis (df = 3, F = 1.034 < F-Crit = 2.651, and p = 0.379 > 0.05). Between the three higher scoring factors no significant difference is found in there means (df = 2, F = 0.409 < F-Crit = 3.058, and p = 0.665 > 0.05).

An analysis on the differences between states of seven success factors combined with a deviation in business units, Research and Development and the remaining business units, provides slightly different results. An Anova on the R&D department data shows that without the leadership (M = 1.6) and process factor (M = 1.73), the remaining means are not significantly different (df = 4, F = 1.756 < F-Crit = 2.454, and p = 0.143 > 0.05). The significantly different factors leadership and process do not differ significant from each other (df = 1, F = 0.143 < F-Crit = 4.062, and p = 0.707 > 0.05). The Anova on the remainder business units indicates that the factors leadership (M = 2.07), process (M = 1.88) and discovery (M = 1.87) are significantly higher based on their means. When these three factor are retracted from the analysis the remaining means show no significant difference (df = 3, F = 2.194 < F-Crit = 2.692, and p = 0.093 > 0.05). The three factors themselves do not significantly differ from each other (df = 2, F = 0.267 < F-Crit = 3.114, and p = 0.766 > 0.05).

A similar analysis is done on the differences between the hierarchical level of the respondents, employee compared to manager level. The Anova on the seven factor differences shows that for the manager level there is no significant difference between the means. However, the employee level Anova indicates that the means of the factors leadership, process and discovery are significantly higher than the other factor means, when they are excluded the Anova result is insignificant (df = 6, F = 0.392 < F-Crit =

[13] The analysis is statistically significant when the F value is higher than the F-Critical value, which means the p-value (chance value) is smaller than the significance level of alpha = 0.05, and therewith it is assumed that one or more means are different from the group under analysis. The df value stand for the degrees of freedom under analysis, which is the number of means under investigation minus one.

2.675, and p = 0.759 > 0.05). Table 1 presents an summary overview of the results of the Anova's as described in this section.

General Factor Categories Anova Results	
Current state	Leadership and Radical innovation (RI) process factor significantly lower than group, no significant difference between the two factors
Future state	No significant differences between factors
Difference between states	Leadership, RI process and Discovery significantly larger increases than group, no significant difference between the three factors
Departmental separation:	
Difference between states	R&D: Leadership and Process significant larger increases
	Remainder units: Leadership, Process and Discovery significant larger increases
Hierarchical separation:	
Difference between states	Manager level: No significant differences in means
	Employee level: Leadership, Process and Discovery significant larger increases

**Significant at an alpha level of 0.05*

Table 1: Summary overview of Anova results of general success factor categories

Critical success factor ranking

In the last part of the questionnaire respondents were asked to rank the seven general success factors from highest priority for radical innovation to the lowest. The results of the ranking show that the leadership factor is ranked the highest by the studied sample (43%) and culture is ranked at a second place (cumulatively 36%). The other factors are logically ranked lower and do not show large differences. Their order does thus depends on the kind of analysis used, therefore the results are not further elaborated on in this section.

4.1.3 Results Single Success Factors Analysis

In addition to the analysis performed on the general factors, which are a grouping of several single factors, an Anova is performed on the single factors themselves. Here also the two states and the difference between the two is taken into account. The Anova determines whether or not significantly high and low scores are present.

In the current situation responses on the single factors, only one significant result is present. The factor 'willing to sacrifice sales for radical innovation opportunities' scores significantly lower than the other factors. When this factor is excluded from the bottom ten lowest mean scores, the Anova shows no significant differences in the remaining means (df = 8, F = 1.291 < F-Crit = 1.899, and p = 0.239 > 0.05)[14]. The analysis also determines that there is no difference statistically among the highest scoring factor means in the current state. The analysis of variances on the single factors in the future state resulted in

[14] For analysis purposes the lowest and highest ten single factors are compared in the Anova's to determine any extreme high or low scores, since these are most relevant for this study.

no significant higher or lower factor means (lower means: df = 8, F = 1.766 < F-Crit = 1.899, and p = 0.072 > 0.05; higher means: df = 9, F = 1.242 < F-Crit = 1.899, and p = 0.267 > 0.05).

Analysing the single factor means of the difference between states resulted in three factors standing out. At first it has to be noted that all single factors increased their mean scores when going from current to future state, except for two. These items are 'business unit managers having autonomy in renewing their product portfolio and strategy' and 'Damen relying on its partners (suppliers, research institutes, universities etc.) to innovate'. Only the first, managers autonomy, is significantly lower than the other mean scores. This factor exclude from the group provides no significant differences in means (df = 8, F = 1.262 < F-Crit = 1.959, and p = 0.262 > 0.05). When the sample is separated according to hierarchical level (employee/manager) and on business unit categories,[15] the significance changes. In this situation only the 'employees' group and the R&D business units give a significantly lower score for the autonomy factor (M = -0.45, M = -1.00). The 'managers' group rates the autonomy factor also as negative but not significantly, and they indicate the partner factor as positive (M = 0.65). Concerning the business unit group HSC and Tugs, they do not rate any factor as negative, and the remainder supporting business units rate the autonomy and partner factors as zero (no change). On the contrary , the R&D business unit is rating the a third factor as negative, which is the 'focus on technical and commercial ideas that fit the Damen product/market strategy' (M = -0.30).

The data presents one single factor as scoring the highest overall, which is the factor 'top management providing a market/technology vision'. It increases from a current mean score of M = 2.8 to a future M = 6.1. When the factor is included in the Anova, the result is that at least one mean is significantly different (df = 9, F = 2.446 > F-Crit = 1.899, and p = 0.010 < 0.05), when the factor is excluded there are no significantly different means remaining (df = 8, F = 0.494 < F-Crit = 1.959, and p = 0.860 > 0.05). Thus, the result is that this factor for the whole sample is significantly higher than the other factor means in the questionnaire. When using the same categorization as just before, the results show that the vision factor is significant for the HSC and Tugs group categorization (df = 8, F = 1.089 < F-Crit = 2.013, and p = 0.375 > 0.05). All other categories do rate the vision factor the highest, but these results are not statistically significant. Also table 2 provides a summary overview of the results found with the above described Anova's.

[15] Second separation is in three categories; Research and Development, High Speed Craft and Tugs & Workboats (operational units), and the remainder supporting business units.

Single Success Factors Anova Results	
Current state	Willing to scrifice sales scores significanly lower than group
Future state	No significantly higher or lower scoring factors than group
Difference between states	Manager autonomy in renewing strategy scores negative and significantly lower than group
	Relying on partners to innovate scores negative, but not significant
	Top management providing market/ technology vision scores significantly highest
Departmental separation:	
Difference between states	Only R&D units scores autonomy as significantly lower, they also rate relying on partners and focus on technical/ commercial ideas fitting Damen product/ market strategy as negative
	HSC and Tugs rate vision as significantly highest increase, all others also but not significantly
Hierarchical separation:	
Difference between states	Employee level scores autonomy asnegative and significantly lower Manager level scores autonomy as negative, but it is not significant
	Manager and Employee level rate vision factor as highest incease but not significantly

**Significant at an alpha level of 0.05*

Table 2: Summary overview of Anova results of single success factors

4.1.4 Questionnaire Comment Section

The questionnaire is supplemented with a comment section at the end where respondents could add notes, insights or opinions as they wished. Out of the 50 respondents on the questionnaire, 16 of them left an end comment referring to specific items or general comments on the research. Of these comments eight are in some sense referring to a proper vision implementation or adequate radical innovation direction. Comments such as: 'Damen needs a clear possible outcome for the radical innovations', 'One single and strong voice at the top', 'It is all about a clear vision on your own business and the role that innovation should have to accomplish this.', 'We need more focus on what we are actually going to radically innovate', and 'The board should have a vision on where to go and why to go there' (Anonymous questionnaire comments, July 2018).

4.2 Qualitative Interview Results

The remainder of the empirical study constituted out of five conducted interviews with employees across different hierarchical levels. In the following text the interview results are presented and summarized. An overview of the codified interviews can be found in appendix F and the full interview transcripts are available upon request[16]. The results are structured according to the interview guide, available in appendix E.

[16] Note: Interviews have been held in the native language of the interviewer and interviewees, which in this case is the Dutch language.

Question 1: Opinion of the interviewee towards (radical) innovation

The general believe among the interviewees it that radical innovation is essential for the further existence of Damen as a company. “I think it is a necessity to innovate” (Interviewee 1, personal communication, August 29, 2018)[17]. Furthermore, all indicate that Damen as an organisation is good at innovating incrementally, however radical innovations are still a challenge. “We are very good in innovating incrementally, but we make ourselves vulnerable because we spend too little attention on radical innovation” (Interviewee 2, personal communication, August 29, 2018). Damen views itself in some sense as a SME, which is flexible, but therewith it is not always able to renew itself in its thoughts and beliefs.

Question 2: Roadblocks for radical innovation within Damen

Interviewees all mention a lack of vision or strategy, being a roadblock for radical innovation especially. “I think that there must be one voice at C-level. The CEO needs to fully support it [radical innovation], and in the end one person needs to be responsible for the innovation trajectory.” (Interviewee 4, personal communication, September 5, 2018). Further, what is also implicit in the words just mentioned before, the innovation trajectory, is the way the radical innovation process is organized and structured. Four out of the five interviewees mention that the radical innovation process needs to be more strictly organized and could even be separated from the current business. “For radical innovation you just need a somewhat other organisation, and somewhat different people” (Interviewee 2, personal communication, 28 August, 2018). Also other interviewees mention the point about the employees currently operating in the organisation. They note that many people have grown towards higher positions in the organisation over the years, which might come with certain limitations and could also lead to some conservatism. In three interviews the interviewees indicate that different, or people from outside might be of help to stimulate radical innovations within Damen. Nevertheless, this point is sensitive since the collaboration with suppliers has some room for improvement. “We don’t know exactly what it should do in practice, thus little feedback, but we also didn’t sit down together [with the supplier]” (Interviewee 5, personal communication, 6 September, 2018). The distance between Damen and its suppliers and customers concerning radical innovation is also indicated as a roadblock for radical innovation. “You have to have very intimate knowledge about the business model side of that customer, of every activity that he executes and of the technical solutions that he needs for that” (Interviewee 2, personal communication, 28 August, 2018). A last barrier for radical innovations mentioned is the current focus on decreasing cost prizes and the tendency to development after the point it has been sold. “[People live] in the issues of the day, that they are sucked in the operations.” (Interviewee 3, personal communication, 3 September, 2018).

Question 3: Opinion on the questionnaire results

For none of the interviewees the results are very surprising. When discussing the single critical success factor vision the interviewed employees see this as an improvement area too. One person mentions that there is indeed a general need for direction in radical innovations, and the board is acknowledging this but they show to little intention. “We want to be innovative, but this is insufficiently made apparent in

[17] All quotes used, out of the transcribed interviews, in this section are as precisely as possible translated from Dutch to British English.

deeds." (Interviewee 4, personal communication, 5 September, 2018). On the other hand, this vision item is to some extent given back to the business units by others, and they are asked "who are your customers and what do they want" (Interviewee 3, personal communication, 3 September, 2018). Nonetheless, each interviewee does confirm the fact that vision on technology and the market could be improved and especially technology development is being mentioned as a critical part in this. In the past Damen operated in a joint effort of product development and sales. Currently, this is in some sense still the case and therewith technology is somewhat under exposed. "Technology is a bit overlooked within Damen" (Interviewee 2, personal communication, 29 August, 2018). The choice has to be made whether or not Damen is, and will be, a technology driven company in the future. "I think we are now at the tipping point [of becoming a technology company or not]" (interviewee 4, personal communication, 5 September, 2018). At this moment the people are inclined to skip or rush challenging technological developments since these are mainly cost drivers for the organisation.

Furthermore, the opinions of the interviewees concerning the point about partnerships with external partners to create or develop radical innovations are quite similar to each other, there are however some minor differences. It is mentioned that some people within Damen have doubts about suppliers abilities. "At first, I think that once in a while the belief is there that within Damen we can do things smarter and better, and therewith cheaper." (Interviewee 5, personal communication, 6 September, 2018). The others mention that collaboration with knowledge institutes and universities is essential, but it should not be a one sided dependency on these institutes. Further, since projects within Damen get more and more complex the management of suppliers get more important. "[It means] that you certainly have to be very intelligent in integrating all these systems" (Interviewee 2, personal communication, 29 August, 2018).

In addition, the single factor autonomy is viewed in similar ways, and interviewees can understand why questionnaire respondents responded like they did. They add that managers do need a lot of autonomy, but it should be in line with the vision of top management. "I can imagine that people now find that there is too much freedom, that is what is called entrepreneurship, that everybody can do as he likes." (Interviewee 4, personal communication, 5 September, 2018).

Finally, the last point which is discussed by several interviewees is the general factor of the discovery phase. The questionnaire had showed that this point turned out to be significantly important, however some nuance has been introduce since interviewees mention that to their insights the incubation phase might be more important. "I thought that the 'problem' would be more in the incubation phase" (Interviewee 1, personal communication, 29 August, 2018). It is even called "the biggest bottle neck" for the radical innovation process (Interviewee 5, personal communication, 6 September, 2018). Specifically the issue should be in the transition between the discovery and incubation phase according to two interviewees.

Question 4: How performance in innovation is assessed

On this question interviewees indicated that performance in innovation is not assessed companywide. On business unit level, or product level, it might be possible to retrieve past performance data. Within the R&D department key performance indicators are used but these are currently not specifically addressed towards innovation or radical innovation.

Question 5: How a metric can be utilized in such a way that reflects a technology/market vision

In the answers on this question less consensus can be found among the interviewees, this is surely part of the nature of the question. Several metric ideas are proposed to 'measure' the effectiveness of a vision. Propositions as using spiders, a management assessment tool, to assess each new idea and see if it is in line with the trajectory of the spider. Other metric ideas are how much budget is allocated towards (radical) innovation, and how much is used over a certain time period. Or a metric focussing on "follow ups of radical innovation initiatives" (Interviewee 2, personal communication, 29 August, 2018). Another idea, which is partly borrowed of a company which Damen visited lately with its managing directors, is an innovation score which determines the innovation sales. The innovation sales number is determining the success of past innovation. Further, this metric should enable the possibility to "clearly make choices on what money has to be invested" (Interviewee 4, personal communication, 5 September, 2018). Interviewees indicate that it is essential to define points of attention or themes which than could be coupled to concrete project goals or targets. In general the intrinsic motivation is not an issue among, especially R&D employees, but the general direction is something that can be stimulated or guided with a vision metric.

Question 6: How to utilize a metric for the discovery phase

Multiple interviewees propose the idea of measuring the used genius hours[18] as a metric, "are you 10% of your time really busy with creative thinking" (Interviewee 3, personal communication, 3 September, 2018). "A result obligation is difficult, you want specifically that they [employees] freewheel, that they can act non-committal" (Interviewee 3, personal communication, 3 September, 2018). However, others mention that the operational pressure is limiting the use of these genius hours and it is difficult to "be genius for two hours, and then not anymore" (Interviewee 4, personal communication, 5 September, 2018). It might be difficult to use such an initiative within the current exploitation organisation. "Unless you really subtract people and put them in a different setting, I doubt if this would succeed" (Interviewee 4, personal communication, 5 September, 2018). The Research department became, partly for this reason, better protected for daily distractions.

A metric indicated by interviewee 2 is the ratio between proposed ideas in the Morpheus[19] campaign and the ideas that get developed further. Thus another metric could be the number of Morpheus campaigns held each time period. Assuming that more campaigns deliver more ideas. In line with this thinking it is also proposed to use an idea funnel metric, similar to the sales funnel currently used within Damen. Such a metric would enable an innovation manager to assess whether or not sufficient ideas are generated and at which level these are.

Question 7: How to utilize a metric for the radical innovation process

Several metrics have been proposed which are somewhat in line with metrics mentioned for the discovery phase. Items such as how much projects resulted from the Morpheus campaign, or certain percentages

[18] Damen has been using an initiative called 'genius hours', which are hours that employees in the R&D department have free time to experiment with what every they think is necessary, in other words; free creative hours.

[19] Morpheus is an I,D&R tool, or campaign, within Damen which is aimed at collecting and developing ideas company wide.

of hours, or budgets allocated to radical innovation. In general three out of the five interviewees responded explicitly to this question and all off them see metrics as a useful tool to improve the radical innovation process. “I think that each piece, discovery, incubation, acceleration is possible to measure. How many ideas are available, how much unique ideas are there, and which percentage passes on from one phase to the other phase.” (Interviewee 5, personal communication, 6 September, 2018). Thus, number of ideas, lead times or used hours would be suitable for improving the process according to the interviewees. According to interviewee 4 it is however essential to be able to quickly sort between proposed ideas in order to secure the quality of ideas.

Question 8: How to use metrics such that they function as learning/reflection tools

The responses to this question are varying strongly, but are however complementary to each other. At first, it is mentioned that no new metrics should be forced upon employees, “punishing works counterproductive” (Interviewee 3, personal communication, 3 September, 2018). Further, it is somewhat questioned whether or not metrics will have direct effect on the organisation since working with metrics, or KPI’s is quite new for employees within Damen. Interviewee 5 supplements this thought with his idea that it has to start with proper communication about how Damen will use metrics and for what reason.
Furthermore, in the Morpheus campaign the whole company is asked to participate and give input, whether or not this is good is questioned. One interviewee mentions that it could be a danger to include everyone in the innovation process, and not everybody needs to be innovative. Also employees which are very efficient are crucial too, but the likelihood that these people are innovative is smaller. In the campaign many ideas are proposed which are in some sense already running, being executed, somewhere else in the organisation. Additionally, there are some issues concerning the double boss effects when employees are contributing towards innovations. At last, three out of five interviewees indicate that metrics should not only ‘control’ employees, but they should also be used on board level. Therewith the board would show their commitment and responsibility towards (radical) innovation as well.

5. Discussion

The study results provide several significant insights into which critical areas should receive further management attention in order to foster radical innovations within Damen. Specifically, the critical success factors leadership, radical innovation process, and discovery turned out to be most important focus areas. In general all but two single factors showed to be of importance for radical innovation within Damen. The single factors managers autonomy and collaborations with partners were the two items scoring negatively. On the other hand, the single factor vision on technology was found essential for stimulating radical innovation within Damen. Logically, it was first necessary to define these factors for Damen before providing a mechanism which enables the management of its performance, which is discussed at the end of this chapter.

Firstly, this thesis research at Damen Holding B.V. shows radical innovation is seen as an essential for the future survival of a maritime oriented family firm. Damen has shown in the past to be capable of creating radical innovations along the technology, as well as the market axis, of Norman and Verganti (2014). Nevertheless, the resulting issue of stimulating the next radical innovations remains present for Damen.

Literature on radical innovation has presented several success factors for radical innovation, see chapter 2.3.3. However, the challenge is to determine which are most applicable to stimulate in a certain business, since these constructs are context dependent.

Damen operates in the maritime industry, and is a family owned firm. Awareness of these company characteristics when proposing management implications is critical. In this case Damen has grown as a strong sales oriented organisation towards a large product development company with a very extensive product portfolio. In the future Damen might even grow further towards a technology developing oriented firm. Nevertheless, the fact that Damen is still to some extent sales oriented became evident during the interviews and is also implicit in the negative responses in the questionnaire on willingness to sacrifice sales for radical opportunities. Damen is much in line with the reporting of de Massis et al. (2015) on family and non-family firms. They mention that family firms mostly focus on incrementally innovating, incrementally introducing new products to the market, and providing managers with high levels of autonomy in often functional organizations, which is all to a certain extent true in the case of Damen. Additionally, they report that family firms take more risks and entrepreneurship by individuals is stimulated. On the other hand, non-family firms focus on both incremental and radical innovation, where they rely on cross-functional teams and managers are given limited autonomy and decisions authority. In hindsight, Damen has the tendency to still view itself in some sense as an small and medium sized enterprise, which enables its flexibility and allows entrepreneurial behaviour.

Radical Innovation Leadership

Leadership is one of the three management categories which showed to be of significant importance for the radical innovation capability of Damen. Most of the significance can be explained by respondents which find themselves at employee level, this might be logical since they are influenced mostly by leadership. Leadership turning out to be critical for radical innovations is not very surprising. Leadership is often mentioned to be important in general management practices, but in this case the attributes within the general leadership factor are specifically aimed at radical innovation. Further, it is quite logical that leadership is significant, since it can be viewed as an initial enabler for change within an organisation. Currently, Damen is making first steps towards structurally institutionalizing radical innovation capabilities in the firm, and this firstly needs management awareness and support to succeed. Strong leadership is often mentioned by scholars, and sufficient commitment, support, and involvement of company leaders are said to be critical for radical innovation (O'Connor & DeMartino, 2006; Simon, McKeough, Ayers, Rinehart, & Alexia, 2003; Slater et al., 2014).

Furthermore, the analysis into the single success factors resulted into two items being more important in the group. Firstly, the factor top management vision on market and technology, part of company leadership, is seen as most important for radical innovations within Damen. Vision, often referred to as strategic intent, is looking at the longer term perspective and emphasizing direction (Kelley, as cited by Slater, 2014). It should be clear for a business and its people what to do and where to go. A well-constructed and communicated vision could provide such direction, and should incorporate some sense of urgency towards employees and business leaders. Currently, it is not always the case for radical innovation efforts within Damen. Especially the technology vision is to a certain extent fuzzy, and could be better supported by defining certain strategic themes, technologies or business areas to focus on

(Cooper, 2011). Within Damen technology is to a certain extent somewhat overlooked and it might be the cause of a poor vision, or it is the result of the old vision.

Moreover, a well-defined vision is essential, since especially employees in entrepreneurial oriented firms such as Damen, have to commit and follow a single compelling vision. Therefore it is of importance to create and implement one that will be adopted (Reid et al., 2014). The top management is not only responsible for developing a clear vision. Certainly with radical innovation the technological possibilities are often in the minds of the innovators and therewith not always explicitly available for (top) managers. Communication about these possibilities or the inclusion of radical innovators in developing the vision might be helpful in creating a vision which will be followed (Reid et al., 2014). Nevertheless, radical innovation starts at the top of a firm, and business leaders have to act as visionaries and mentors to stimulate the initiative and processes (de Brentani, 2001; Slater et al., 2014). Thus, having a well-defined technology vision is an enabler for radical innovation performance within firms. It could however also be the case that this vision is directly related to the performance of a business and therefore the following proposition is made:

The accuracy of the top management vision on the role of technology is directly and positively related to a firm its radical innovation performance.

The second significant leadership factor is the autonomy managers have in renewing their product strategy. The research showed the factor to be negative, meaning that managers should receive less autonomy within the Damen organisation. Currently, it is important to note that managers already have high levels autonomy. The factor is not fully surprising since autonomy is strongly related to the single compelling vision. If a business has a strong vision it allows for less fluctuation within the strategy. One could in some sense say that managers have to stick more to the predefined plan, and should receive less freedom in operating as they think suitable, often referred to as entrepreneurship. It does not mean that managers should become followers, they have to be transformational in their characteristics. Meaning they have to focus on the longer term perspective and inspire followers, but also need to be critical and make clear go/no-go decisions based on the corporate goals (Cooper, 2011; Reid et al., 2014). A specific leadership behaviour deemed suitable for this task is called stewardship, where the leader has a focus on "long-term welfare" (p. 2) of a firm and acts subjugative (Dominguez-Escrig, Mallen-Broch, Lapiedra-Alcami, & Chiva-Gomez, 2018).

Radical Innovation Process

Currently, Damen does not have a structured and clearly defined radical innovation process and the research indicates this is an issue for its radical innovation capability. If the process would be clearly structured and formalized it should provide a significant contribution towards the success of radical innovation, especially in the early stages (Kock et al., 2015). As Cooper (2011) said, the results of radical innovation might be bold and imaginative, this is not a reason for not having a disciplined approach. Interviewees strongly recognize this point and mention that Damen has to be more strictly organized on its radical innovation process. They even mention separating radical innovation from the running business might be necessary, in line with literature (Cooper, 2011, Slater et al., 2014). Further, the research showed that improvements can be made on collaboration with partners, such as suppliers, universities, knowledge

institutes and customers. In the past Damen has grown as a joint effort of sales and the product groups, but now this might be a cause of the limited external collaboration. Currently, Damen still has the tendency to be internally focused when it comes to innovation and this limits the possibilities (Cooper, 2011). Furthermore, interviewees indicate that intimate knowledge of customers would stimulate the radical innovation process for Damen, this relation also applies for the collaboration with suppliers. A co-creation approach is said to be very effective for developing innovative solutions, and enables faster learning with and from partners (Bessant et al., 2005). All interviewees agree on this point, but add relationships should be mutual enhancing and not based on a single sided dependency from the side of Damen. Collaborations with partners is also essential when the complexity of technology increases. Since Damen is increasingly aiming a more complex technological developments, it becomes critical to grow as a company towards an competent integrator, and thus collaborator within an innovation network (Ritala & Huizingh, 2014).

Discovery Phase for Radical Innovation

Additionally, the discovery phase is the last focus area in need of more management attention. Integral in the radical innovation process, the discovery phase is where ideas and opportunities are proposed and gathered in order to be further developed. From the questionnaire the discovery phase turned out to be significantly important, the results did however differ per business unit. During the interviews some more nuance was proposed and interviewees indicated that the bottle neck might be more towards the incubation phase or the transition between discovery and incubation. Arguments are that many ideas are brought up or initiated, and employees within Damen possess a high level of entrepreneurial behaviour, but it does not directly result into innovations. O'Conner and Ayers (2005), the first to propose the three phases, also indicated that the transition between phases is indeed crucial. For Damen it could also be the case that ideas or initiatives do not get formal treatment and therewith keep floating in the organisation. Literature showed that companies which have institutionalized ideation portfolios or strategies are more successful in developing radical innovations and therefore make a better transition between phases (Kock et al., 2015; Reid et al., 2014).

Damen has introduced such an initiative called Morpheus, an I,D&R tool[20], which is specifically aimed at finding opportunities within the company and fully developing them. However, Morpheus is currently more a once in a while recurring initiative or campaign than a process, this makes the radical innovation process ad hoc and emerging ideas after the campaign remain untreated. Morpheus would have the ability to overcome the presented radical innovation process issues as well as the discovery phase issues. It would then be necessary to institutionalize Morpheus as a process tool where each step, discovery, incubation and acceleration are integrated. There are however doubts among managers whether or not everyone has to be included in Morpheus. Plus commitment of employees is still an issue because of the rewarding system currently applied. A second initiative discussed before are the Genius hours, these free time hours could stimulate the idea discovery phase too. However, it is necessary to provide more guidance in these hours. An idea portfolio approach or strong technological development strategies could provide such guidance (Kock et al., 2015).

[20] Ideation, Development & Research tool

Hence, aligning radical innovation efforts in general is essential for Damen. A process approach which focusses on the longer term perspective with a clear technology vision stimulates employees that engage in radical innovation in the right direction. The process needs to be clearly decomposed into, discovery, incubation, and acceleration phases, and proper metrics and performance incentives should stimulate the right behaviour needed for radical outcomes (Broadbent & Laughlin, 2009; Cooper, 2011; Hauser & Zettelmeyer, 1997; O'Connor & Ayers, 2005). Additionally, part of the process is that innovation management is integrated within the current management systems, and it should be part of the strategic management agenda to meet its full potential (Barsch, Capozzi, & Davidson, 2008).

Performance Metrics for Radical Innovation

Key performance indicators and metrics, within management systems, have been used to monitor, control and stimulate the performance of the items being measured by businesses for many years. In this research the metrics which are useful for fostering radical innovation within Damen are discussed. Metrics, being leading measures, or leading KPI's, are only treated in the interviews, this makes the results rather subjective in character. Nevertheless, several high placed managers have provided their views and therewith some propositions can be done concerning metrics and their use. Since the critical factors discussed before are in some sense complementary to each other, it is difficult to make a clear cut distinction between metrics specifically for each category. Essential is to remember that a firm should not excel in one critical area or factor, rather it should balance all critical factors at a similar level (O'Connor & DeMartino, 2006; Slater et al., 2014). Thus, the proposed metrics cover in some cases multiple critical areas.

There are several metrics proposed for the factor technology vision. One of such is using the Damen policy plan 'spiders' as an assessment tool. These are a graphical illustration of the developments a business unit is aiming for in a certain time period. Thus, monitoring the appropriates of idea developments in accordance with these 'spiders' could incorporate the corporate technology vision. Another proposition much in line with the previous one would be to use an survey metric. Such a metric will periodically survey whether or not for example employees apply the technology vision, whether they agree with the vision and if they see it as suitable for Damen. This approach scouts the general and thus assesses how well the vision is used and understood. An easier metric or approach to stimulate employees to apply a certain vision is to financially stimulate key projects in line with this vision. The resource allocation indicates commitment and frames developments in a certain direction.

Furthermore, several radical innovation process and discovery phase metrics are suggested. One of the most comprehensive ones is the innovation score metric. This metric, based on the knowledge of an innovative strategic partner of Damen, is developed to determine the possible success of ideas or initiatives before they are executed. The potential of an idea is determined via a calculation and is internally benchmarked. If an idea scores sufficiently high it is placed in the radical innovation category and is subjected to an acceleration program. Other supplementary metrics for the discovery phase could take shape as idea funnel metrics, which keep track of the amount of ideas. Quickly sorting between proposed ideas guides innovative efforts in an early stage. Similarly, an idea follow up metric could be applied, for each radical process step, discovery, incubation, acceleration. Or the number of ideas in progress can be tracked to determine success. These might be extremely helpful for managing the

(ideation) portfolio, and makes it possible to time developments and entry timing (Kock et al., 2015). Metrics proposed specifically aimed at the Morpheus and Genius hours initiative are hours spent, number of engaged employees, and budget allocated.

In general it is advised to institutionalize a management system to enable the creation of radical innovations on a continuous basis, meaning also measuring on a periodical basis (O'Connor & Ayers, 2005). Such a system would help Damen as a company to structure the current processes and align radical innovation efforts. Metrics can provide financial control, but more important for radical innovation, they can direct and guide employee behaviour (Barsh et al., 2008). Interviewees do indicated metrics should not be in place for punishment reasons or for increasing control over employees, which paralyzes people, rather they should be motivational and guiding. As Simon et al. (2003) put it: "Stretching but not breaking the organization: motivating for radical results." (p. 19).

6. Conclusions

The study has enlarged the understanding about radical innovation for Damen. In general, Damen displays several family firm characteristics, which contributed to the current size of the company, but some of these characteristics oppose the ones which are necessary for radical innovation. The research showed that the in literature defined critical success factors are almost all of importance for radical innovation within Damen. It is especially explored and identified which specific factors are most critical and will need further attention in order to maximize the radical innovation capability of Damen. Main focus of management should be on structuring and organizing the radical innovation process to an extent that it can (re)produce radical innovations over and over again. Radical innovations might be bold and imaginative, still a process structure would allow for better performance and control. Therein special attention is needed on the discovery phase, and the transition to the incubation phase. Essential, especially for Damen, is to be aware that innovations are often the results of extensive collaborations within each of these phases.

Moreover, the factor leadership turned out to be an important focus area for management, and specifically the factor technology vision resulted to be crucial for Damen. A single compelling vision on core technological developments is an essential enabler for radical innovation performance, according to literature as well as the majority of surveyed employees. Therewith managers should be able to operate autonomous, but within the limits of the defined vision. Critical factors summarized, effective radical innovation starts with top management vision, and is the result of an creative, open and entrepreneurial process with managers who have a balanced amount of autonomy.

Lastly, defining which specific metrics are useful remains difficult to answer, and currently it can only be preliminarily concluded which metrics would foster radical innovation for Damen. It is partly due to the performance management system of Damen which is currently not dependent on metrics. Nevertheless, metrics have been proposed and the general intent about how to utilize these metrics is made clear. In order to effectively stimulate the emphasized critical factors, attention is needed on the further development of the proposed metrics specifically suitable for these performance areas.

6.1 Managerial Implications

Several managerial implications resulted from studying the innovation literature and Damen as a company. Businesses willing to increase their innovation capability first need to define what in their opinion is innovation. Often there is not a strict consensus on what can be called an incremental innovation, what is a radical innovation, and what is just an improvement. The result is that employees are not on the same page, which is not surprising, since radical innovation in literature is ambiguously defined too. Therefore, it is impossible to actually control innovative behaviour in a positive way, when these definitions are not clear within organisations and it also becomes impossible to determine the success of developed innovations.

Furthermore, extensive attention is needed on the development of a radical innovation technology vision. It is advised to construct such a vision in collaboration with employees from several hierarchical levels, this in order to included multiple views and to increase the successful adoption of this vision among employees. Proper balance in the vision is needed on market and technological developments, and it should be in line with the general company strategy.

Radical innovation is often associated with start-ups, creative and autonomous firms, but literature and this research showed that a process approach is most sufficient for radical developments on a continuous basis. Therefore, the radical innovation process has to be analysed more in depth and specific process oriented changes are required to be able to organize for radical innovations. It recommended to rotate employees operating in the radical innovation process once in a while to avoid, ivory tower or status behaviour. Further it can be useful to include external partners or people in the radical innovation process to make paradigm shifts possible, or to supply expert knowledge on specific topics, such as innovation process design or creativity stimulation in established firms.

Nonetheless, sufficient rewarding and acknowledging of employees participating in the radical innovation process is necessary, next to designing an innovation process and allocating resources. Thus, proper rewarding of efforts are needed to stimulate innovative behaviour, and protection from operational pressures are points of attention. However, it is necessary to make a distinction between efficient and innovative employees. Companies do not survive on innovation alone, they need to be operational efficient too. Therefore, not each employee needs to act innovative, and when someone is not innovative it does not mean they are not operating well in their job. The same holds true for the different kinds of innovation, incremental and radical. The organisation has to balance between the two, the ambidextrous organisation. As Norman and Verganti (2014) mentioned, incremental innovation is climbing a hill, where radical innovation is seeking the highest high. Organisations need people who are good in hill climbing, as well as people excelling in searching for high hills. The message is to not solely focus on radical innovations, but to find a balance between incremental, radical and efficiency activities and reward accordingly.

Lastly, leadership has a major contribution towards innovation in general as well as for radical innovation. For the last innovation type specific leaders have to be appointed, it is advised to choose leaders which possess high levels of stewardship and ones who are subjugative. These in some sense transformational leaders should be facilitating and not disturbing the radical innovation process, and need to possess a long term perspective in their management approach. They have to be assisted by top

management commitment and support, and in addition appropriate metrics have to be integrated to guide and stimulate efforts. A great and successful example from business is the metric introduced by the CEO of P&G, Alan Lafley. He introduced that 50% in the R&D capacity needed to come from outside their own organisation. The vision behind this metric was to improve the open innovation culture within P&G. Similarly metrics should be developed for each business willing to radically innovate.

6.2 Damen Specific Managerial Implications

Firstly it is crucial for Damen to define a corporate vision on technologies to pursue and to develop as a company. Without this vision most of the initiatives in (radical) innovations remain to a certain extent 'shots in the dark' and reduce the opportunities for alignment within Damen. The vision will give Damen employees a common understanding of the general goal the company is aiming for and clearly shows which business activities have priority. Such a single compelling vision also leaves less room for managers to adjust their own business strategy as they wish. Often this is referred to as entrepreneurship, but within larger companies such as Damen this attitude might generate confusion and misalignments between internal, as well as external, business operations. Critical also for this vision, as well with any other innovation activity within Damen, is a common understanding and definition of innovation and radical innovation. Damen has to decide what is incremental innovation and what is radical innovation, otherwise it is not possible to direct business resources specifically on either exploitation or exploration.

Secondly, a process structure has to be installed that is capable of processing innovations and specifically radical innovations within Damen. The process orientation has to include the discovery, incubation and acceleration phases in order to succeed. The Morpheus campaign is a well suited initiative to be further developed into such an innovation process. It already has senior and company wide attention, and with proper adjustments Morpheus could grow into a ideation hub, a test and development hub, and acceleration hub. In developing a process approach special attention is needed on the discovery phase and its transition to the incubation phase. Thus collecting ideas internally as well as externally, processing them and rewarding contributions are key elements. Technology vision plays a role in the discovery phase too, since proper vision increases suitable idea input.

Thirdly, suitable performance metrics have to be institutionalized within Damen. These metrics should guide and stimulate employees to behave in a radical innovation fostering way. Specifically metrics should be attribute to the critical items mentioned before. The corporate technology vision might be controlled by applying a survey metric for assessing and stimulating employees to obey to the defined vision. Another vision metric might be a benchmarking metric which assesses ideas or initiatives in accordance with the policy plans of business units. Critical side note is here, the policy plans themselves need to be in alignment with the technology vision. Metrics for the radical innovation process and discovery phase are the following:

- An idea funnel metric for gathering and assessing ideas in the early stage
- An innovation score and sales number metric for assessing the potential of ideas
- An idea follow up metric for tracking and stimulating radical developments

In the end Damen needs to approach the phenomenon of radical innovation in a structural way with a strong and clear vision. The proposed metrics are a first step to structurally measuring and guiding efforts, and they also show insight into past performance, 'meten is weten'[21].

6.3 Academic Contribution

Since this research is confined to the setting of a family owned maritime business, it is difficult to generalize results to other industries. Nevertheless, several businesses in other industries are for sure in the same developmental state concerning their radical innovation capability, therefore some contributions to the general business literature can be made.

At first, radical innovation is often seen as a creative and 'free' capability which is difficult to manage, or should not be controlled. However, the results of this research show it is possible to view this capability as a process, it is even advised to do so. Having a radical innovation process with phases, such as the ones proposed by O'Conner and Ayers (2005), increases the possibility to control and manage radical outcomes, and it decrease the serendipitous effects and coincidence. Thus, this research is providing an empirical example of the usefulness of a process approach for radical innovation with several phases.

Furthermore, having a proper vision is not new within the business literature, but reporting on the strong effect of vision in the context of radical innovation could be increased. Academic research on technology driven companies in general should contribute more attention towards technology vision and its effects. A vision enables the alignment of efforts for radical innovations and supports employees in their explorative efforts. It also creates a common understanding of the strategic long term goal of the business. Therewith it supports the team effort of a company in developing radical new offerings and creates creative thinking boundaries.

Additionally, the research also showed having high amounts of autonomy in management does not directly contribute to better performance in radical innovations. The assumption is that there is a certain saturation point, which means that an increase of autonomy does not increase the performance and might even deteriorate it. The considered literature for this thesis does not report on this effect and further research could determine when this saturation point is research for specific businesses or industries.

6.4 Research Limitations

Each research study has several limitations which hardly or cannot be avoided. This research for example is confined to the single empirical setting of Damen and is it therefore difficult to generalize the results across the entire maritime industry or family businesses in general. Moreover, the sample in the questionnaire is relatively small, thus differences between each business unit could not be fully explained yet. The respondents in the sample have been selected on their contribution to (radical) innovations. It is however still difficult to assess whether respondents answers are specifically targeted on radical innovation or the business in general. A control mechanism is applied in the questionnaire, nonetheless it

[21] 'Meten is weten' is a Dutch engineering saying, meaning measuring is knowing.

cannot be determined fully whether respondents answered to the specific setting. Further, it is to some extent assumed that respondents know what is good for radical innovation within Damen, but there is a probability that they might misjudge it. The questionnaire is therefore constructed in such a way that respondents can provide an as objective possible answer, but ruling out the possibility of subjectivity remains difficult. The language skill of the respondents is not judged as a limitation for this study, first Dutch people are well skilled in the English language and foreign employees naturally speak proper English within Damen. Secondly, the questionnaire is developed in such that difficult or business terms have been replace by easier expressions.

Furthermore, the current literary definition(s) of radical innovation is seen as a limitation for this study. The concept itself is to some extend ambiguously defined in literature which makes it difficult to adopted each and every critical factor cited. Besides the extent of literature on critical success factors for radical innovation is rather limited, and especially metrics for radical innovation are scarcely describe in previous academic work. Further, a similar ambiguous understanding of radical innovation within Damen is present, thus respondents might be influenced by this in answering to the questionnaire questions. The same holds true for the management control system within Damen, since currently no measures are applied for the innovation process or its outcomes. It is difficult to test and determine which metrics might be most suitable. More specifically targeted metrics could have resulted from this research, if an initial performance measurement system would have been in place.

6.5 Further Research Focus

Initially it might be of great contribution when in depth research would contribute to a single compelling definition for radical innovation. A common agreed upon definition is essential for aligning all future research on the topic and to avoid ambiguous results. Currently, many definitions are present and it would strongly contribute to future research when radical innovation has a single literary definition.

Additionally, more research is needed in order to get a better understanding of the critical factors for specifically radical innovations, to verify results and cross compare in similar as well as different industries. Such research might broaden the understanding of critical success factors in general and for specific settings, and it could provide insights in the importance attributed to these factors.

Concerning top management vision, it is helpful to research how a technology vision for radical innovation could be developed and institutionalized within businesses. Especially the practicalities of how to do it remains an essential next steps for businesses and academics. Further research efforts could also determine to what extent autonomy of managers or employees is contributing to better performance in radical innovation. The assumption is that there is an saturation point to the amount of autonomy provided to managers, and it might be of business interest to determine which level is sufficient.

Specifically, further research could also be done into the three radical innovation phases, discovery, incubation, acceleration. Identifying which elements or processes are supporting radical outcomes in these phases. As well as offering insights into the challenges and opportunities when transitioning from

one phase to the next. Metrics for supporting and controlling the performance in these phases could also be broadened, in order to make the entire process more manageable.

Lastly, metrics for radical innovation remain a general research topic which needs academic attention. It is often mentioned that metrics for incremental innovation should be different than those for radical innovation. It remains somewhat unclear how this deviation should look like and which specific metrics foster radical innovation for businesses. Further research could thus explore which specific metrics business could apply for their critical radical innovation factors, how these are utilized and who has managerial control over them.

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Appendices

Appendix A: Illustrations of Radical Innovation Track Record within Damen

Fast Crew Supplier (FCS) Vessel – Sea Axe bow design[22]

This vessel has an innovative ship bow design which enables it to maintain high speeds in strong winds and heavy sea conditions. The bow of the ship is shaped in such a way that it pierces waves and does not arise above the water surface, this increases the sail capabilities of the vessel. The axe shaped bow is displayed below.

Yacht Support Vessel – 6911 Game Changer[23]

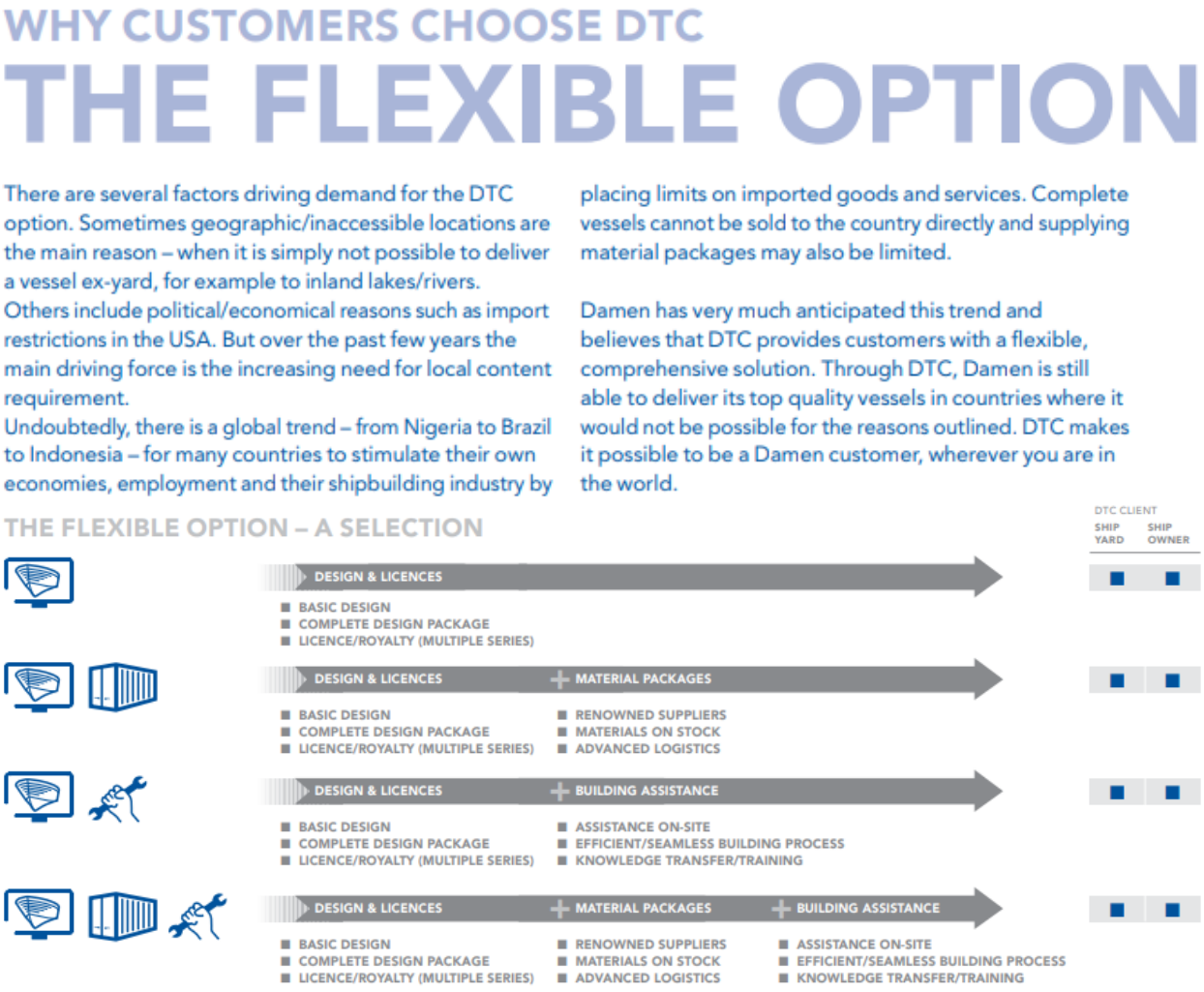
The Yacht Support vessel products are a whole new shipping category. These support vessels are developed to supply 'toys', such as speed boats, RIB's, jet skis, submarines and helicopters, to super yachts. In conventional yachting the super yachts got bigger and bigger to bring and store all these 'toys', but this Yacht Support vessel takes over this role and sails along with the super yacht. Therefore, this vessel is a great example of using existing technology and placing it in a totally different context, because the support vessel is largely based on the same design and construction as the FCS.

[22] https://products.damen.com/en/search?q=fcs

[23] http://www.yacht-support.nl/yacht-support/fleet/fleet/

Damen Technical Cooperation (DTC)[24]

The DTC department is a relatively new unit within Damen and focuses on local shipbuilding in cases of local content legislation or inaccessible waters. In conventional shipbuilding vessels are purchased by the client and build on Damen shipyards. However, DTC created a new market for local building of vessel. The text and graphical display further elaborate on the approach and options.



[24] https://www.damen.com/en/services/local-construction/dtc-think-global-act-local

Appendix B: Innovation Initiatives within Damen

Genius hours

The genius hours approach is partly based on the idea of google where employees receive free time to try creative things. This same approach is stimulated within the R&D department of Damen, where employees have two hours per week free time to experiment with ideas they have or projects that they want to try.

Morpheus[25]

The Morpheus I,D&R initiative aimed at scouting ideas internally in the Damen company, and differentiating and selecting the best among them. Thereafter, these selected ideas are subject to an acceleration program in order to fully develop them. Every employee within Damen is able to supply idea input in the Morpheus campaign. After the gathering, the ideas are judged on their novelty and applicability for Damen by several knowledgeable Damen employees. The result is a selected group of ideas which are presented to a development board, constituting of board members and other high place managers. The people determine if an idea is good enough to be subject to an acceleration program, accompanied with the needed funding.

[25] https://magazine.damen.com/innovation/building-the-dream/
https://www.youtube.com/watch?time_continue=164&v=cYjgJ3ETvdU (Morpheus promotion video)

Appendix C: Radical Innovation Critical Factors Questionnaire[26]

Information

The goal of this questionnaire is to assess the innovation mode at Damen and to figure out which elements best work for Damen when focusing on radical innovation. When completing the questionnaire, trust on your instincts and remember that there is no right or wrong answer. Furthermore, the data provided by you is not distributed outside of Damen and will not be used to assess employee/your performance. Therefore, the data are anonymized and randomized which makes it impossible to trace personal responses.

By clicking 'Ok' you give permission to use the your answers in this research. [OK]
By proceeding you give permission to use your answers in this research.

Basic information

- Male/female [Two options]
- Age [Number]
- Educational level [Dropdown] (High school; mbo; hbo; WO bachelor; WO Master; PhD.)
- Working for business unit [Dropdown] (HSC, R, D, Tugs, DTC , Civil/Green, business dev., Services, IT, etc.)
- Functional level [Dropdown] (Intern; Employee; Manager; MT; MD; Executive)
- Functional years at Damen [Number]
- Working years in a family firm and/or maritime industry (excl. Damen) [Number]
- Functional years after leaving School/University [Number]

Questionnaire guide

In order to set a benchmark for all participants of this questionnaire a definition for innovation and radical innovation is provided.

An *innovation* = an *idea* + the *commercialization/ implementation* of this idea, and innovations not necessarily need to be technological. Innovations can be new or significantly improved products, services, processes, management methods, marketing methods, or organisational methods. Therefore, the impact of an innovation can be very different as it is applicable for numerous situation. However, the two ends of the spectrum are set at incremental and radical innovation. Incremental innovation is the step by step improvement of products/ services/ processes/ management and tends to focus on the shorter term perspective.

Contrastingly, radical innovation is characterized by disruptive changes in product/ services/ processes/ management and can be radical for a business, industry, or to the world. Radical innovation can be driven by either technological change or meaning change. The technology aspect focuses on disruptive new technological options. On the other hand, the meaning aspect relates to new ways in which technologies or ways of doing things are perceived (what meaning people give to a technology and its application).

- Do you understand the radical innovation definition? [Yes/No]
- Do you agree with the definition? [Yes/No/Not sure]

[26] The version as presented here is only the text used to develop the questionnaire. The distributed version is made with Qualtrics survey software.

- How relevant are radical innovations for Damen [Scale]
  - Not important/somewhat important/important/very important

- How good can we radically innovate at Damen? [Dropdown]
  - Not good at all
  - Not good
  - Somewhat not good
  - Not good / not bad
  - Somewhat good
  - Good
  - Very good

- How innovative do you perceive yourself? [Dropdown]
  - Not innovative
  - Somewhat innovative
  - Innovative
  - Very innovative

Statements

Following are several statements concerning radical innovation aspects for Damen. Indicate for each statement to what extent you agree or disagree. Every time, you are asked to indicate your opinion for the current situation and then how you view the future situation.

Fully agree (FA)/ Agree (A)/ Somewhat agree (SA)/ Neutral (N)/ Somewhat Disagree (SD)/ Disagree (D)/ Fully disagree (FD)

1. Currently, radical innovation has a strategic priority at Damen
2. In the future, radical innovation needs more strategic priority at Damen

3. Currently, radical and incremental innovation are separated activities at Damen
4. In the future, radical and incremental innovation activities have to be separated more at Damen

5. Currently, business unit managers have the autonomy to renew their product portfolio's and strategy
6. In the future, managers should get more autonomy in renewing their product portfolio's and strategy

7. Currently, people mainly search for solutions outside of Damen when it comes to innovation
8. In the future, people should search for solutions more outside of Damen when it comes to innovation

9. Currently, Damen uses radical innovation hubs, such as incubators and/or corporate venturing
10. In the future, Damen has to use radical innovation hubs, such as incubators and/or corporate venturing more often

11. Damen has dedicated radical innovation groups
12. Damen increasingly needs dedicated radical innovation groups in the future

13. Currently, a technology vision is used to guide innovative technology/business ideas

14. In the future, a technology vision has to be used more to guide innovative technology/business ideas

15. Currently, visionary and passionate leaders are active in the innovation process at Damen
16. In the future, more visionary and passionate leaders have to be active in the innovation process at Damen

17. Damen relies on its partners (suppliers, customers, research institutes, universities, lead users) to innovate at this moment
18. Damen should rely more on its partners (suppliers, customers, research institutes, universities, lead users) to innovate in the future

19. Sufficient funding is available for scaling up innovations
20. In the future, more funding is necessary for scaling up innovations

21. Currently, people within Damen receive skills and talent development training for innovation purposes
22. In the future, people within Damen have to receive more skills and talent development training for innovation purposes

23. Currently, senior executives stimulate radical innovation at Damen
24. In the future, senior executives need to stimulate radical innovation more at Damen

25. Currently, open communication and transparency in innovation activities is normal at Damen
26. In the future, open communication and transparency in innovation activities have to become normal at Damen

27. Currently, introduction timing of the radical new products/services is considered
28. In the future, introduction timing of the radical new products/services has to be considered more

29. Currently, innovation project teams are cross-functional
30. In the future, innovation project teams are have to be more cross-functional

31. Currently, Damen has managers with barrier removing, risk promoting, and innovation encouraging characteristics
32. In the future, Damen needs more managers with barrier removing, risk promoting, and innovation encouraging characteristics

33. Currently, past radical innovation success stories are emphasized and shared within Damen
34. In the future, past radical innovation success stories should be emphasized and shared more within Damen

35. Innovations are bundled/combined to increase market impact currently
36. Innovations have to be bundled/combined more to increase market impact in the future

37. Personal projects and/or unofficial projects are stimulated within Damen
38. Personal projects and/or unofficial projects have to be stimulated more within Damen in the future

39. Currently, an idea portfolio is used to keep track and guide ideation
40. In the future, an idea portfolio has to be used more to keep track and guide ideation

41. Innovation projects are too bureaucratic at this moment
42. Innovation projects have to become less bureaucratic in the future

43. Currently, Damen employees are entrepreneurial minded
44. In the future, Damen employees need to be more entrepreneurial minded

45. Currently, Damen has a focus on organisational learning
46. In the future, Damen needs to focus more on organisational learning

47. Currently, Damen has an open and creative internal environment
48. In the future, Damen needs an more open and creative internal environment

49. Currently, idea submissions are rewarded and/or recognized
50. In the future, idea submissions have to be rewarded and/or recognized more

51. Currently, proper marketing efforts are deployed to make customers and the market familiar with the radical new offering
52. In the future, more marketing efforts have to be deployed to make customers and the market familiar with the radical new offering

53. A clear market launch strategy is applied for innovations at this moment
54. A more clear market launch strategy has to be applied for innovations in the future

55. Damen creates business cases for technology/business ideas
56. Damen has to create business cases for technology/business ideas more often in the future

57. Currently, internal knowledge creation is stimulated in order to be combined with external knowledge
58. In the future, internal knowledge creation has to be stimulated more in order to be combined with external knowledge

59. Currently, Damen applies measures across the full innovation process
60. In the future, Damen has to increasingly apply measures across the full innovation process

61. Currently, radical innovation projects and/or initiatives have sufficient resources
62. In the future, radical innovation projects and/or initiatives need more resources

63. Existing and potential competitors are assessed in the innovation process
64. Existing and potential competitors should be assessed more often in the future

65. Up front 'homework' is done before going into details of innovations at this moment
66. In the future, more up front 'homework' has to be done before going into details of innovations

67. Currently, top management provides a future market and/or technology vision
68. In the future, top management should provide a more clear future market and/or technology vision

69. Currently, idea generation systems or initiatives are used to find innovative ideas
70. In the future, idea generation systems or initiatives have to be used more to find innovative ideas

71. Portfolio management is applied for guiding innovation initiatives currently
72. Portfolio management has to be applied more for guiding innovation initiatives in the future

73. Currently, Damen focusses on strong technical and commercial ideas that fit the Damen product-market strategy
74. In the future, Damen has to focus more on strong technical and commercial ideas that fit the Damen product-market strategy

75. Currently, Damen applies an iterative innovation processes with intermediate goals
76. In the future, Damen has to increasingly apply an iterative innovation processes with intermediate goals

77. A systematic and disciplined idea-to-market process is used for innovations currently
78. In the future, a more systematic and disciplined idea-to-market process needs to be used innovations

79. Currently, project teams are rewarded/recognized/acknowledged for innovative achievements
80. In the future, project teams have to be rewarded/recognized/acknowledged more for innovative achievements

81. Currently, organisational and team structures are allowed to evolve during the innovation process phases
82. In the future, organisational and team structures have to be allowed to evolve more during the innovation process phases

83. Currently, learning from failures is normal at Damen
84. In the future, learning from failures has to become more normal at Damen

85. Damen is willing to sacrifice sales for radical innovation opportunities currently
86. Damen has to be more willing to sacrifice sales for radical innovation opportunities in the future

87. Currently, radical innovation projects are protected from short-term pressures and distractions
88. In the future, radical innovation projects need more protection from short-term pressures and distractions

Critical success factor ranking

Now you are provided with several success factors for radical innovation. If you were in charge of (performance) management within Damen, which one would you select to be most important and which to be least important? Order the following factors, 1 being most important and 7 being least important, according to you own insights and intuition.

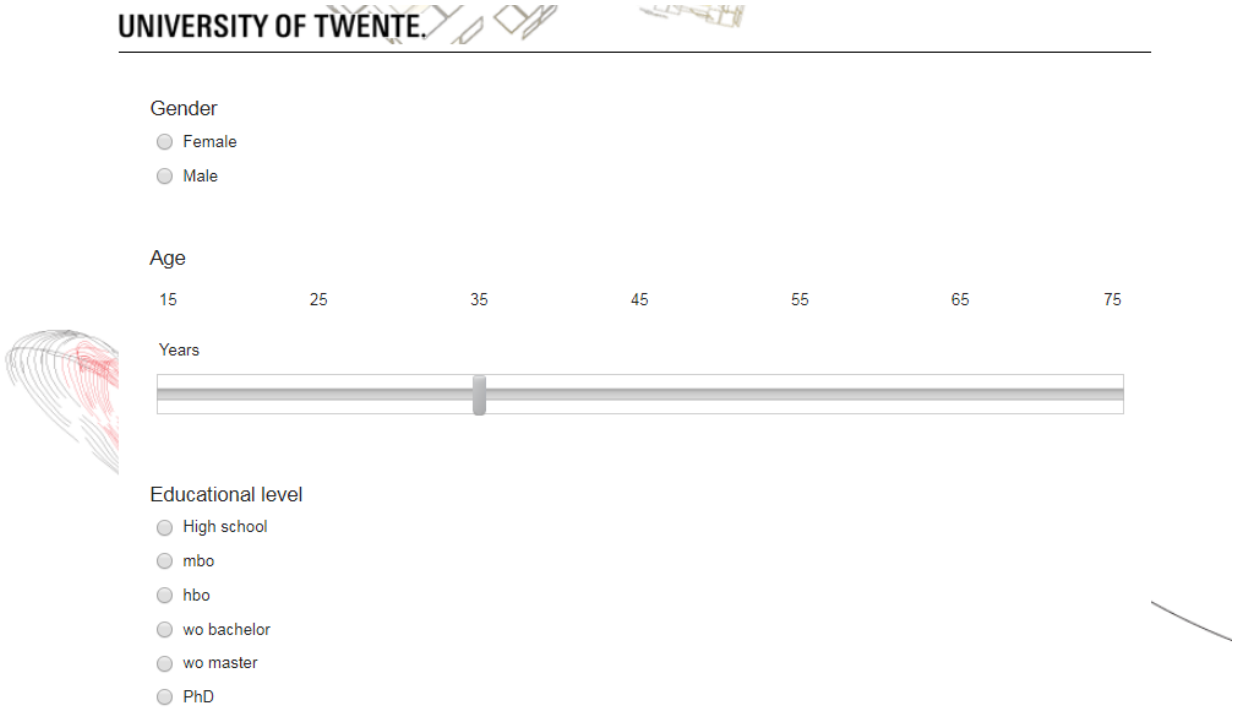
- Executive/Senior/Operational Leadership [....]
- Company culture/climate [....]
- Organisational characteristics (structure, cooperation's, etc.) [....]

- Radical innovation process [....]
- Discovery (creation and recognition of ideas) [....]
- Incubation (Implementation and experimentation with ideas) [....]
- Acceleration (Commercialization of ideas) [....]

If you have any comments or notes on how you think radical innovation is best stimulated please leave them here.
[Text box]

Thank you for completing the questionnaire! If you want to receive the results of the questionnaire or the full research please leave your email address here.
[Text box]

Appendix D: Example Questionnaire in Qualtrics



Appendix E: Interview Guide

Interview guide NL

Introductie voor de participant:

Beschrijf kort wie je bent (Uni etc.) en wat je onderzoekt, en wat je hoopt te vinden met het onderzoek.

Het onderzoek heeft twee trappen:

- Het identificeren van kritische succes factoren voor radicale innovatie
- Definiëren welke performance metrics (Metriek) radicale innovatie kunnen stimuleren

Het doel van dit en de komende interviews is om te verifiëren of de factoren die ik heb gevonden ook juist worden bevonden. Veder hoop ik met dit gesprek naar voren te krijgen hoe we de factoren zouden kunnen meten en hoe het meten plaatsen zou moeten vinden.

Interview structuur en vragen:

- Leg de definities van innovatie en radicale innovatie uit als benchmark
- Q1: Hoe kijkt u momenteel tegen innovatie en radicale innovatie aan binnen Damen?
- Q2: Wat zijn naar uw mening roadblocks voor radicale innovatie binnen Damen?
    - SQ: Zijn deze roadblocks hetzelfde voor incrementele innovatie?
- Noem de 7 kritische factoren uit de literatuur en presenteer de resultaten van de questionnaire.
- Q3: Wat is je mening over de resultaten? Verrassen ze?
- Q4: Hoe wordt innovatie performance op dit moment gemeten? (bij gehouden?)
- Leg uit wat een metric is en hoe hij verschilt van een measure. Vertel dat een metric kan worden gebruikt in een brede zin en dat hij niet specifiek voor een individu is.
- Q5: Hoe kunnen we een metric toepassen voor radicale innovatie zodat hij de bedrijfs-markt en/of technologie visie reflecteert en tot actie leidt? *(Quartile survey)*
- Q5: Hoe kunnen we Discovery meten op zo'n manier dat het tot meer radicale ideeën leidt? *(Genius hours)*
- Q7: Hoe kunnen we RI Process meten op zo'n manier dat het tot een gestroomlijnder proces leidt? *(Morpheus budget)*
- Q6: Hoe kunnen we deze metrics binnen Damen gebruiken zodat ze als leer/ reflecties tool kunnen worden gebruikt?
- Q Open vraag: Heeft u nog opmerking over dit interview of over het onderzoek?
- Bedankt voor de tijd!

Interview guide EN

Introduction to interviewee:

Briefly describe the research that I am doing and what I am hoping to get out of it.

The research is twofold:

- Identifying critical success factors for radical innovation
- Defining which performance metrics can contribute to better performance

Goal of this interview is to verify the factors found in the previous part of the research. Further, the end result of this conversation is to get a better insight into how these factors could best be controlled and stimulated.

Interview structure and questions:

- Explain the literary definitions of Innovation and Radical innovation to set a benchmark
- Q1: How do you view innovation and radical innovation within Damen currently?
- Q2: What in your opinion are current road blocks for radical innovation within Damen?
    - SQ: Are these roadblocks similar for incremental innovation?
- Mention the 7 critical factors and briefly present an overview of the questionnaire results
- Q3: What is your opinion on the results?
- Q4: How is performance in radical innovation currently assessed?
- Explain briefly what a metric is and how it differs to a measure. Add that metrics can be used in their broadest form and don't necessarily need to be on the individual level.
- Q5: How can we measure; Leadership, Radical Innovation Process, and Discovery in such a way that it leads to action?
- Q6: How could we utilize these metrics such that it acts as a learning and reflection tool?
- Q7: How could we utilize a metric such that it reflects the company's market/technology vision or strategic intent? (How could it be a guiding mechanism?)
- *Q8: (Who would 'grade' the metric? Peer to peer (collaboration), managers, employees?)*
- Q_Open end question: Do you have any final remarks on this interview or research?
- Thank the interviewee and finish the conversation

Appendix F: Interview Analysis Sheet

	(1)	(2)	(3)	(4)	(5)
Q1: Hoe kijkt u momenteel tegen innovatie en radicale innovatie aan binnen Damen?	Innovatie (ook radicale) is een necessity maar vaak vanuit de oude gedachte gehandeld	We zijn erg goed in incrementele innovatie, maar besteden weinig aandacht aan radicale innovatie	Innovatie is essentieel voor het voort bestaan van Damen. Innovatie is gewoon keihard nodig om voorop te kunnen blijven lopen. Damen staat zeker nog open voor radicale innovaties als die zich presenteren.	Damen innoveert weinig tot niet radicaal. Innovatie en product ontwikkeling als separate activiteiten zien.	Damen is erg ondernemend, opereren nog steeds als een klein flexibel bedrijf, met MKB insteek. Sterk in incrementee innoveren, maar blijven achter in radicale innovaties.
Q2: Wat zijn naar uw mening road blocks voor radicale innovatie binnen Damen?	Visie nodig om daaruit nieuw ideeën te genereren. Veel mensen met door gegroeide posities, handelen op hun vele ervaring, maar kan ook voor belemmeringen zorgen. Externen zouden hierbij kunnen helpen.	Gebrek aan strategie. Geneigd opportunistisch te reageren op kansen in de markt. Willen reageren op de wil van iedere klant. Te veel focus op het halen van lage kosten. De mate van customer intimicy. 'Quality up cost price down' zorgt voor sterke focus op efficiency, dit staat haaks op nodige explorative houding die nodig is voor RI. Zekere mate een andere organisatie en mensen nodig.	Innovatie is niet altijd even strak georganiseerd of gestructureerd. 'Ja maar doen we altijd zo, geen budget' Waan van de dag, in operatie gezogen. Conservatisme, kat uit de boom kijken. Mensen die out of the box kunnen denken en een strategische stip op de horizon hebben.	Damen vind het lastig om zich naar RI te organiseren, moet misschien los staan van bestaande structuur. Teveel discussies en praten, te weinig inhoudelijk doen. Op board niveau meer aandacht nodig. RI beschermen van bestaande business, anders wordt het gekilled of naar binnen trekken. Op C-level one voice. CEO keihard ondersteunen, en 1 iemand verantwoordelijk voor innovatie traject. Eigenaarschap en sponsorschap cruciaal.	De manier van georganiseerd zijn belemmerd RI. RI heeft ook een andere ontwikkel strategie nodig dan nu. Nu veel marketen, producten en diversitei dus complex. Leren onvoldoende van fouten. Geen helder beeld van de praktische toepassingen en weinig teru koppeling. Samen werken met leveranciers matig van kwaliteit. Niet altijd duidelijk waar op ingezet moet worden, blijft vaag en geen duidelijke lijn. Pas als iets verkocht is wordt er gerent.
Sub_Q: Zijn deze road blocks hetzelfde voor incrementele innovatie?	Voor radicale visie toch nog meer van belang	--	--	Ja, en snel schakelen, mislukkingen accepteren en weer door.	
Q3: Wat is je mening over de resultaten? Verrassen ze?	Niet echt. Dacht dat incubation meer het 'probleem' zou zijn. Manager heeft autonomie nodig, maar niet teveel, moet wel in lijn zijn met top management visie.	Het niet hebben van een single compelling vision verrast me niet, bleek ook uit Damen 2025, daar is geen visie uit gekomen. Technologie is een beetje een ondergeschoven kindje, erg sales georiënteerd, en mentaliteit van we kopen het wel in. Capaciteit van de organisatie is voornamelijk de reden voor onvoldoende snelle research, budget is aanwezig. Aansturing van toeleveranciers is belangrijk, gaat niet altijd goed omdat we onvoldoende kennis hebben. Projecten worden groter en complexer, dus het integreren van systemen steeds belangrijker, meer kennis voor nodig.	Samenwerken met kennis instituten en universiteiten is belangrijk. Resultaten verrassen niet, bevestiging van vermoeden. Op het punt van vision, die legt hij ook terug naar de business units, 'wie zijn je klanten en wat willen ze'. Je kunt ook vraag creëren bij de klant. Product ontwikkeling lang samenspel van product groep en verkoop geweest.	Externe contacten verbaasd hem ook, Damen zou meer moeten samenwerken, maar geen enkelzijdige afhankelijkheid. Kan zich voorstellen dat er nu teveel vrijheid is, noemen ze nu ondernemerschap; 'dat iedereen maar lekker doet waar hij zin in heeft.' Terwijl er behoefte is aan algehele richting en visie, waarbinnen mensen mogen opereren (Voor noemen visie punt). Visie punt; Ja herkenbaar, we willen innovatief zijn, maar dat blijkt onvoldoende ergens uit. Zijn we technologie gedreven als bedrijf? Nu op het kantelpunt.	Misschien moet R&D opener zijn in het laten zien wat kan en gedaan wordt. Discovery gaat best wel goed, alleen de incubation fase gaat minder, hoe ga je van discovery naar incubation is naar mijn mening de grootste bottle neck. We weten met wie we moeten samenwerken en welke stappen we moeten zetten, maar wordt niet concreet gezegd; ontwikkel het maar door, tot lego modules, producten. Als Damen willen we graag alle tussenstappen overslaan, die kosten geld. In zeker mate wantrouwen naar leveranciers. Ook de overtuiging dat we binnen Damen dingen zelf slimmer, beter en goedkoper kunnen. Voorbeelc falen meerdere leveranciers, misschien moet je op gegeven moment in de spiegel kijken. Autonomie: We missen binnen R&D toch wel de visie op tech o
Q4: Hoe wordt innovatie performance op dit moment gemeten? (bij gehouden?)	Per afdeling beetje bijgehouden wat voor ideeën er zijn. Overzicht van alle investeringen en het resultaat is er niet.	Eigenlijk niet goed. Lastig om te bepalen wat de bijdrage van een innovatie is aan het succes.	Niet. Damen heeft geen strak innovatie proces. Bij DSM mensen in de board met verantwoordelijkheid voor innovatie. Gebruiken innovative sales, en toegevoegde waarde innovatie metrics.	Niet, ik denk dat we daar niet echt zicht op hebben. Op product niveau wellicht te achterhalen, maar product ontwikkeling is iets anders dan innovatie.	Ja, wordt dat gemeten? Niet? Persoonlijke/team KPI's binnen R&D, zijn gemakkelijk te halen. Niemand ligt er echt van wakker.
Q5: Hoe kunnen we een metric toepassen voor radicale innovatie zodat hij de bedrijfs- markt en/of technologie visie reflecteert en tot actie leidt? (Quartile survey)	Iedere afdeling gebruikt spiders die zouden we kunnen gebruiken. Iedere nieuw idee zou tegen het licht van die spider kunnen worden gehouden.	Drie vragen kun je doen. RI budget, en in hoeverre die gebruikt is als metric. Hoeveel follow ups zijn er aan RI-initiatieven. Pijpdelen voorbeeld-> team samen met toeleverancier ontwikkeld.	Voorstander van het van buiten halen van kennis. Daarvoor een denk raam, en denk niveau nodig. Idee van KPI's om dit te organiseren nieuw, maar mooi idee. Je moet je altijd openstellen voor andere meningen. Nieuwe ogen, hulp van buiten, hoeveel klankborden? Sommige mensen blijven hun hele leven ontdekken, anderen raken verzadigd, meerder types binnen een bedrijf.	Hoeveel van onze omzet spenderen we aan innovatie. DSM: Heeft soort ranking, innovatie score, hoger score succesvollere innovatie, groter deel innovation sales. Hebben ook four square, met red box, daar ga je als bedrijf op inzetten. Innovatie is niet iedereen met een leuk idee budget geven, maar heel duidelijk keuzes maken waar zetten we op in.	Projectdoelen meetbaar maken. Lastig. Alles binnen Damen multi-interpretabel. Als er duidelijkere speerpunten zijn, mogelijk om daar concrete doelen aan te hangen. Intrinsieke motivatie is wel aanwezig, soms wel handig om concretere stappen plan te maken.
Q6: Hoe kunnen we Discovery meten op zo'n manier dat het tot meer radicale ideeën leidt? (Genius hours)	Genius hours is een goed initiatief, zouden we meer moeten doen. Metric om tussentijds bij te houden hoeveel gebruikt zijn.	Het aantal ideeën dat je ophaalt en het aantal ideeën waar je wat mee gaat doen. Morpheus 7/240 ratio. Morpheus campagnes runnen, challege definiëren voor BU. Ideeënbus lijkt op zwartgat. Morpheus gekoppeld aan bootcamp. Metric; de meer Morpheus campagnes er worden uitgevoerd de meer ideeën. Morpheus is een proces, I,D&R tool-speciaal voor gedurfdere ideeën. (Wordt er een richting gegeven in de ideeën, kan een visie erin verwerkt worden?)	Een resultaat verplichting is moeilijk, je wil freewheelen promoten (J. Misschien proces verplichting?) Je krijgt wat je beloond. Metric; 10% van je tijd aan vrijblijvend denken besteden. Input genius hours, niet beloond. Budget discipline niet groot. (Idee J.: genius hours linken aan Morpheus)	Genius hours: Het lijkt me super lastig om te zeggen, je kunt niet even twee uur geniaal gaan zitten zijn. Je zou eigenlijk net zoals bij sales een sales funnel kunnen meten. Lastig om binnen een bestaande organisatie explore en exploit naast elkaar te hebben. Misschien mensen wel apart zetten van bestaande organisatie. Hoe verander je nu de cultuur zodat mensen vrijer denken en out of the box denken.	Genius hours worden goed gestimuleerd, werkt redelijk maar de productie druk heeft invloed op die uren en de D departement. Research is beter beschermd, maar krijgen soms ook wel vragen vanuit de business.
Q7: Hoe kunnen we RI Process meten op zo'n manier dat het tot een gestroomlijnder proces leidt? (Morpheus budget)	--	--	Morpheus; Vijf projecten opgeleverd die door gaan? 1-2% uren aan RI projecten besteed. 1-2% totale kosten aan innovatie besteed? Voorstander van het proces scherpen neer zetten, nog te veel freewheelen. Morpheus gelinked aan René (niet helemaal duidelijk). 100mil in startups bij DSM voorbeeld.	Hoeveelheid ideeën die de stappen door maken, uren, doorloop tijd gebruikt. Top projecten leiden misschien wel tot jaloezie. Morpheus was een oproep aan iedereen, maar moet iedereen wel innovatief zijn? Gevaar situatie waarin iedereen innovatief moet zijn. Efficiëntie en innovatie gaan niet samen, dus iemand die niet innovatie is niet per se minder. Moeten niet het een boven het ander stellen.	Ik den kwel in die fasering, discovery, incubation, acceleration zouden prima te meten zijn. Hoeveel ideeën zijn er, welke uniek, welke komen ervan door? Misschien onderdeel building the future, met innovatie fuik. Morpheus: Goed om iedereen aan het denken te zetten, ook goed hele bedrijf te betrekken. Wel 70-80% ideeën liepen a ergens binnen Damen. 'Er loopt al iets, kunnen we die kennis terug geven, in ieder geval, sluit daar even aan en kijk wat ermee kan.'

Q6: Hoe kunnen we deze metrics binnen Damen gebruiken zodat ze als leer/ reflecties tool kunnen worden gebruikt?	Geen nieuwe metrics opleggen, maar mensen zelf laten identificeren wat vaq belang is. Net zoals bij wielrennen, watt meting.	Belangrijk hoeveel in RI wordt geïnvesteerd, dit geeft ook aan hoe belangrijk het wordt gevonden. Morpheus 100% gefinancierd uit de holding. RI juist aan de board gekoppeld. Board wordt ook afgerekend op hun RI input. Board is erbij betrokken zodat follow ups ook een kans krijgen en capaciteit vrij te spelen is. Mensen die deel nemen aan Morpheus grote kans dat ze problemen krijgen met de lijn manager, puntje van aandacht. J. Beoordeling van Morpheus project overruled lijnmanager beoordeling, meer incentive om mee te doen.	Successen vieren, afstraffen werkt verlammend. Hoe zou metric als reflectie tool kunnen werken -> JW: Gewoon toegang geven tot de hoogste niveaus. (Is dit wel goed, hierdoor misschien nog meer autonomous gedrag?)	Het lastige van metrics meetbaar maken, hoe hang je een waarde aan het creative proces, ideeën, wanneer telen ze. Snelle schifting om de kwaliteit te borgen, verhouding oorspronkelijke ideeën/goede ideeën. Strategische thema's definiëren en daar dan aan koppelen hoeveel innovaties/ideeën ontstaan.	Ik denk dat het primair begint met hoe communiceer je het en hoe ga jer ermee om.
Q_Open vraag: Heeft u nog opmerking over dit interview of over het onderzoek?	Goed dat gedeeltelijk gekwantificeerd is wat in de hoofden van veel mensen leefde.	Belangrijk onderwerp, zoveel metric hebben we niet. Ik denk dat het nog steeds erg goed is.	Ontzettend belangrijk onderwerp	We zijn geen DSM, en voor hen is het ook een proces geweest naar waar ze nu zijn. Wat blijft hangen, focus, keuzes maken, en meten sturen leidt tot meer resultaat. Leiderschap moet het uitdragen en een key sponsor, van groot belang. Ander bedrijf heeft bepaalde innovaties helemaal apart gezet, eigen PMO, opereert als een start up, maar wel afspraken over op welk moment terug geleverd wordt aan de business.	denk dat het goed is dat er even naar gekeken wordt, en ook zo organisatie breed