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Department of Business Administration

How the New Product Development team should be formed and function given the radicalness of the innovation

Master's Thesis in the
Corporate Entrepreneurship and Innovation Program

Paweł Polijaniuk

Jens Strinsjö

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Lund, Sweden. The 27th of May, 2014.

Jens Strinsjö *Paweł Polijaniuk*

Abstract

Title: *How the New Product Development team should be formed and function given the radicalness of the innovation*

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Authors: Jens Strinsjö and Paweł Polijaniuk

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Thesis purpose: The purpose of this Thesis is to examine how radical innovations are best developed, by analyzing them on the characteristics influencing them in order to measure their level of radicalness, and thus, form suitable teams and make them function accordingly. Moreover, the dissertation aims at filling the gap left in the literature regarding the aforementioned subject in the context of a high technology company.

Methodology: The study has a qualitative approach in the form of numerous individual interviews, accompanied by open discussions and observations from our internship company. Thus, the study has been based on our empirical material which has been analyzed on the basis of our research question with the use of an extensive literature review.

Theoretical perspectives: The theories applied in this dissertation are mainly relating to the area of corporate entrepreneurship, although there are some input from the area of project leadership and team formation in relation to the New Product Development process.

Conclusions: Our findings show how the top-management at innovating firms, within the high-tech non-consumer industry should focus on the characteristics of the radical innovation, in order to examine the level of complexity and uncertainty. By applying our model, the innovating firm will be able to neglect the one-size-fit-all approach, and instead achieve a more suitable and context based approach, which will increase the likelihood of NPD-success.

1. Introduction

1.1 Background

That New Product Development (NPD) according to Cooper and Kleinschmidt (2003) is an essential part for companies to continue their growth is not a new phenomenon. An innovating firm needs to put great efforts in ensuring that the fit of the new product stands in a clear relation to a number of factors. The authors state that the firm's new product development strategy, the culture of the firm and the innovation climate together with senior management involvement are the critical success factors for the NPD-process (ibid). Cooper and Edgett (2008) highlight how the NPD-processes are heading in the wrong direction. Whilst the spending on Research and Development (R&D) has only seen a small increase, the output in terms of new product sales has actually been decreasing dramatically. According to both Cooper and Kleinschmidt (2007), as well as Ahmad et al. (2012) around 58% of all projects that enter the development phase are commercialized.

One of the challenges for the innovating firm to reach a successful NPD-process is related to the team function and how leadership, and in what form, can increase the effectiveness depending on what kind of innovation it develops (Patanakul, Chen and Lynn, 2012). One challenge for industrial high-tech companies is that the research that has been done on the topic of team function and team formation in relation to the NPD-process, has been focusing on other industries, such as government and machinery, where there is no such a big challenge in terms of working in an ambidextrous manner (ibid.). Research by Sarin and McDermott (2004) investigated how the leaders should influence the project team's function in the high-technology market by implementing a democratic leadership style in order to make the project team learn and develop. Although, as stated by the authors, this democratic and learning focused leadership style has the ability to negatively influence the function of the team, in terms of lowering the creativity and opportunistic urge within the team and the employees (ibid).

Another challenge for the innovating firm is to form the teams in an efficient and correct way. Cross-functional teams have been argued as a key success factor for the NPD-process by several scholars (Zemlickiene and Maditinos, 2012; Schilling, 2011). There is however a challenge in determining to what extent the team should be formed in a cross-functional manner. Some scholars state that the use of cross-functional teams beyond a certain level might lead to a failure in reaching the goals (Ahmad, et al. 2012). One of the main advantages of using cross-functional teams is to get input related to the markets' needs and expectations, often through marketing and sales departments in order to increase the performance and market acceptance even for high-technology companies (Cooper and Edgett, 2008).

The team function, often including the role of the leader in the NPD-process should not be underestimated. According to Sarin and O'Connor (2009), the lack of success in the process is often related to a poorly functioning team. However, the authors also argue that the NPD-team often has to be managed in a clearly structured way, which is in contradiction to what is proposed by Patanakul et al.

(2012) and their findings about autonomous teams as well as how they should function in the NPD-process.

In order to increase the likelihood for NPD-success the development process should be based on the characteristics of the innovation being developed. Ahmad et al. (2012) argue that the innovating firm needs to put focus on the uncertainty and complexity for the innovation, prior to determining the NPD-approach.

1.2 Problem discussion

Many scholars state that the NPD-process should not follow a certain pattern, and instead, the strategy for the process should be based on the specific characteristics of the project (Ahmad, et al. 2012). This thought is shared by others, such as Holahan, Sullivan and Markham (2013) that stress the importance of choosing the development approach carefully given the type of innovation - incremental, more innovative or radical. Therefore, there should be no one universal NPD-process. The authors also state that what might be the best approach for the incremental project might be detrimental for the radical one. Although the difference between incremental and radical innovations is clear in terms of developing and handling the process, there are also differences in how radical innovations are perceived and thus developed at companies (Patanakul, et al. 2012). In relation to how some development processes can be detrimental depending on the different types of innovations, McDermott and O'Connor (2002) argue that the radical innovations themselves also might differ in such a way that one common practice might lead to a negative effect on the NPD-process.

Apart from the scholars stating that the development strategy and team formation should differ depending on the innovation type, Patanakul et al. (2012) also stress how the function of the team should be different given the type of innovation being developed. There is however some clear overlook in the researches that have been done within this area, since they have not investigated how the industrial high technology market functions in its NPD efforts in terms of the team-formation and team function. Another aspect not to omit, i.e. the project leadership which is a part of the team function, is also mentioned by Cooper and Kleinschmidt (2007) as one of the key attributes for increasing the chance of a high success rate of the NPD. The authors also argue how the project leader should be given the freedom to focus solely on one project at a time (ibid.).

Adscititiously, besides the importance of managing the team formation and team function in the NPD-process, there is another factor of great importance. Namely, the characteristics of which the process and project is judged upon, ergo what is their influence on team related aspects. This view is also shared by Ahmad et al. (2012) and Holahan et al. (2013) who state that the NPD-process should be based and managed upon the characteristics of the project. On a more overall level, the project should be based and judged upon four characteristics. Green, Gavin and Aiman-Smith (1995) argue for how the technological uncertainty, technical inexperience, business inexperience and the technology cost, i.e. development cost, are good measurements from the company's standpoint in order to measure the level of radicalness.

Other characteristics are in relation to what Cooper and Edgett (2008) mention. The market orientation of a high-technology firm is to be considered crucial, which is in contrary to many authors (Zhou et al., 2005; Hong, et al., 2013). What is more, this high level of importance of the market orientation, instead of the technology orientation, may be rather risky in the long run since it might reduce the drive for radical innovations, focusing on incremental ones instead (Zhou et al., 2005). The authors, i.e. Cooper and Edgett (2008) do not state explicitly for what kind of high technology market this notion is applicable. Nevertheless, to our best knowledge, in the literature there is a lack of division of what is exactly meant by high technology, e.g. business-to-business, non-customer high-tech manufacturers, software or hardware producers, etc. It means that the researches' results are basically lumped together.

According to Chiesa and Frattini (2011), the importance of having collaboration with external market players is to be considered as important as cross-functional teams contribute with market insights. Thus, there needs to be further research done in terms of investigating how a project team should be formed in order to gain the right amount of market input, without losing the technological edge or creativity capabilities. In relation to Chiesa and Frattini (2011), Schilling (2011) also argues for the importance of creating diversity within the team in numerous ways, increasing the value of the NPD-team.

Lastly, as mentioned previously, McDermott and O'Connor (2002) argue that the radical innovations can differ in such extent that they cannot be approached with one common practice, although there has not been any clear research on how companies within the non-consumer high technology industry should tackle this phenomenon. Therefore, it is rather clear that the gaps in the literature consist not only from the neglected industry point of view, but also when it comes to how the teams should be formed and work in accordance to specific circumstances deriving from the differences in the project radicalness.

1.3 Research question

The research question basically derives from the area of new product development with a clear focus on how teams should be formed and function, given the characteristics of a radical innovation, i.e. the level of radicalness. In the field of literature and research there is no consistent agreement regarding how the teams should be formed and function within different kinds of radical innovative project within the non-consumer high-technology market. Thus, the research question is built upon a lack of a unitary definition and consistency with regards to how an innovating firm should focus on the characteristics of a radical innovation, prior to forming a team and influencing its function. Moreover, Kahn et al. (2012) strongly suggest a need of exploring the area of best practices related to new product development, especially around issues related to project climate and company culture which is in line with the area of interest of this dissertation.

Therefore, the coined research question is in the form as stated below:

"*What is the relation between the level of innovation radicalness and the new product development team's formation and function, in the non-consumer high-technology industry?*"

The research question, as stated above, tries to differentiate types of radical technological innovations given their characteristics. According to our best knowledge, that kind of approach together with how the team could function and be formed depending on these circumstances has not been investigated.

1.4 Purpose

The purpose of this paper is to examine the relation between innovation radicalness and team formation and function since this subject seems to be neglected or the results in the existing literature are not consistent. The authors of this Thesis have served a five months long internship at a well-known Swedish Business-to-Business high-technology company, i.e. A-technologies. The host company can be considered as a good case example to be examined within the industry due to its position as a market leader in many dimensions, advanced and widest product portfolio, high pace of internal and external growth, and increasing profitability in the industry characterized by fierce competition, just to name a few. Moreover, the company is present and operates globally which exposes it to different cultures, and thus the level of generalizability increases. These factors lead to a justified notion that the host company possesses a considerable amount of NPD best practices, what was defined by Camp (1989) and summoned by Kahn et al. (2012, p. 180) as "a best practice can be defined as that technique, method, process, or activity that is more effective at delivering a particular outcome than any other technique, method, process, or activity within that domain".

Building upon this, the two projects investigated in this study were radical for the company and the market, as well as their success on the market was significant. Although the two innovations were to be considered as radical, they differed a lot in terms of the challenges in developing them for the company. They inhabited a difference in level of radicalness, making us as authors able to analyze and examine the dissimilarities in the NPD-process. Thus, these cases are justified and may serve as a source for exploration that is in line with the area of interest previously shown.

Therefore we are to combine the prior findings from literature with our findings and examinations from a five-month long internship in order to analyze how the industrial high-tech companies function in terms of new product development and above-mentioned factors, in comparison to the previous conducted research within the area.

1.5 Delimitations

As pointed out by Kahn et al. (2012) it can be generally said that a common issue when it comes to exploration of proper width of a phenomenon is related to comprehensiveness. In other words, there is room for questioning whether the presented practices are the only ones that contribute to the NPD-process's higher chance of being eventually successful. Another concern is the equality of the suggested dimensions (Kahn et al., 2012). The discovered suggestions or success factors may differ between each other in terms of their weight, meaning that their value and impact on the new product development

are not the same. Thus, the findings' applicability and their importance will depend on a vast spectrum of conditions, and therefore it is necessary to consider their appropriate deployment.

1.6 Key concepts

Innovation radicalness - Involving the concept of how innovations can differ, not only on the upper-level, such as incremental vs. radical (Schilling, 2011), but also in terms of how the radical innovations differ for the company given the project characteristics, their development in line with core capabilities, etc.

Team formation - How a team should be assembled, in relation to Patanakul et al. (2012) there are four main team types, e.g. heavyweight, lightweight, functional and autonomous.

Team function - Includes areas such as inter-firm collaboration and level of control the team is exposed to by the leader.

2. Theoretical framework

The Theoretical Framework chapter aims at providing the readers with relevant findings from literature related to the subject of interest. An extensive literature review was done, with a considerable focus on up to date literature positions, in order to secure a high level of latest discoveries.

2.1 Importance of NPD and measuring its success

The importance of new product development, according to Rogers (2004), is not to be underestimated. Inhabiting an expertise in the NPD-process and ability to adjust it to certain conditions may be even classified as a company's core competence that will contribute to developing winning products (Holahan et al., 2014). Among the researchers there are constant efforts to identify proper dimensions characterizing the NPD-process. One of the best known NPD-frameworks was presented and recently amended by Kahn et al. (2012), and now consists of such factors as strategy, process, research, project climate, company culture, metrics and performance measurement, as well as commercialization.

According to Rogers (2004) the ability to reduce the time to market is key if profitability and success are to be encountered. The ability to involve and align both customers and suppliers in the development process is also of key importance if success is to be obtained (ibid.).

The NPD-process can be supported by many approaches, however one of the most common ones is the Stage Gate Model and its variations depending on the company. The latest version of the concept was presented by its initiator Robert G. Cooper and was developed towards becoming more adaptive, flexible, etc. (Cooper, 2014). Since developing a radical innovation is encumbered with high level of uncertainty, the organization needs to put great efforts in creating a thoughtful scoping and business plan. This is to better anticipate the forthcoming challenges, as well as save time and be more prepared for the NPD-process (ibid.). According to Cooper, the earlier the definition of the project, in the form of its needs and requirements the better the process will be in terms of clarifying risks as well as assumptions made. Thus, the proof of concept or business case, should aim at involving the entire project team and identifying needs and requirements that the project should result in (ibid.).

2.1.1 Evaluating the success of New Product Development projects

Among the literature positions, it is possible to distinguish a couple of factors, at least labeled as the most important ones that determine and describe the outcome of the NPD-success. Ahmad et al. (2013) provide the readers with an example of such a list compiled out of others authors' work. The proposed measurement items consist of development speed (the most frequently used), product performance, market share and profitability. Ahmad et al. (2013) argue for how the development speed, i.e. time to market is one key success measurement. Apart from this the Return on Investment is also mentioned. Another aspect that is brought up by the scholars Landström and Löwegren (2009), is proposing the ability to stay within the boundaries related to time and money, as one measurement of the NPD-success.

In terms of judging the success of a new product, Griffin and Page (1996) argue for how the development cost and speed should not be given an overwhelming space in terms of judging the outcome. The scholars argue for the importance of looking at the overall outcome if the new product has influenced the company in a strategic way. If the outcome of the product not only includes a quick ROI and high development speed, but also makes the company able to leverage from new knowledge and strengthening the competitive advantage of the company for future product launches (ibid.).

Other scholars that in line with Griffin and Page (1996) argue for more long-term success measurements are Hultink and Robben (1995). The scholars point out how the innovating firm should be judging the success factors with both a long-term and short-term scope, in order to examine the innovation in an ideal way (ibid.). In order to measure the short-term success of an innovation in the most righteous way, the company should focus on the following factors:

- Product being launched on time
- Development cost

On the opposite side, the long-term measurements should according to Hultink and Robben (1995) focus on other factors:

- Customer satisfaction
- Customer acceptance

2.2 Project characteristics

According to Ahmad et al. (2012), there are basically two main characteristics of a NPD-project that make a significant impact on its performance, namely uncertainty and complexity. In spite of the amount of literature written on this issue, as well as a sort of common sense reasoning, there is not much of convincing empirical evidence that would directly support or dismiss the relationship between these phenomena, claim Ahmad et al. (2012). The lack of unambiguous answer is most likely caused by the complexity and no clear approach towards measuring it among the researchers and conducted studies (ibid.). What makes it even tougher is the problem of classifying and defining the uncertainty and complexity, as these terms are by their nature extremely fuzzy. These measurement approaches are as follows, just to mention a few: task difficulty, product and market newness, content and scope, high growth rates, technology change and competition, technology novelty (Ahmad, et al., 2013, p. 333).

Schilling (2011) points out that the look at radicalness of an innovation can be also taken through the prism of the level of risk incorporated. This is, among others, connected with a lack of knowledge within the company when it is dealing with highly uncertain and disruptive projects. Moreover, Holahan et al. (2014) claim that when it comes to radical innovations, due to the high uncertainty both from the technological and market point of view, it is very difficult to “associate outcomes with inputs”. Therefore, not only the result of the NPD endeavor is unknown, but also the preparation for the process, so that the NPD activities can be handled in an efficient manner, remains a question mark leaving a large

room for incertitude (ibid.). Additionally, Sarin and O'Connor (2009) found out that goal structuring by a team leader has a considerable impact on the NPD teams and their quality of collaboration. Thus, the more the project is characterized by uncertainty and complexity the higher likelihood that the goal will be fuzzy eventually leading to overall lower project performance.

Moreover, Schilling (2011) and Rogers (2004) also mentions how there are different kinds of product development projects, judged on how they influence the company's existing product portfolio. New product platforms involve major development effort to create a family of products that all can share the same common platform. If the company creates a product that is an extension from an existing product platform, they are creating a derivative of the existing product platform (ibid.). The incremental improvement to an existing product only adds some feature that will allow the product to stay competitive in the market place. The opposite are the radically or fundamentally new products that will differentiate from competitors' offerings (Rogers, 2004).

2.2.1 Dimensions influencing the radicalness of a product

In order to understand the radical innovation and the process of developing it, McDermott and O'Connor (2002) are stressing four factors to be used as a tool of measurement. The four factors, originally presented in a study by Green, Gavin and Aiman-Smith (1995) focus on the technological uncertainty, technical inexperience, business inexperience and the technology cost, from the company's standpoint.

Technological uncertainty

The technological uncertainty is closely connected to whether the NPD-process requires learning during the process, and to what extent this challenge affects the company. According to Green et al. (1995) the level of radicalness is influenced by the level of knowledge that is demanded for the NPD, i.e. how much learning is needed. The higher the level of unpredictability, complexity and difficulty the innovation inhabits, the bigger are the demands on the organization in terms of communicating and sharing information (ibid.).

Technical inexperience

In close relation to the first factor remains the technical inexperience that aims at the firm's experience of developing the new innovation. More precisely, this is the gap between the firm's current knowledge and the knowledge that is needed to develop the product. No matter how common the knowledge is outside of the company, it is the inside technical experience that will influence whether the innovation is to be considered highly radical or not (Green, et al. 1995).

Business inexperience

The use of technological learning often leads the firm into new markets and new areas of business in order to increase the opportunity to maximize the advantages of the new innovation. The gap between the current business experience and the required knowledge needed for succeeding with

commercialization of the new innovation is related to what Green et al. (1995) mention by the role of business inexperience, and its influence on the level of radicalness.

Technology cost

Argued to be the last factor of measuring the radical innovations is the technology cost, which according to Green et al. (1995) is related to the level of funding the company allocates to the project. The authors argue that projects that were heavily financed, was one of the factors that influenced to large extent whether they succeeded or not. Thus, arguing that the level of financing might be implying whether the innovation is radical and to what extent, or not radical at all (ibid.).

2.2.2 Market orientation vs. Technology orientation

It seems to be natural that the customers, their needs and the chase towards fulfilling them are of utmost importance for companies that want to grow, or at least maintain the current market position. Paradoxically, while obviously the customers should always stay at the first place, their demands are to large extent not known due to their short sight characteristic, as well as lack of expertise and knowledge related to the newest market trends (Zhou et al., 2005). Therefore, being too customer oriented may have a bad impact and negative consequences in terms of losing market share to the competitors, especially when developing a breakthrough innovation (ibid.). Nevertheless, some authors, e.g. Schilling (2011, p. 245), claim that it is the customers who are "often the ones most able to identify the maximum performance capabilities and minimum service requirements of a new product". Therefore they should be included in the product development teams. However, this actually depends on what exactly a firm wants to achieve, what is described in the paragraphs below.

Market orientation, according to many authors as stated by Zhou et al. (2005) can be basically treated as a synonym to customer orientation, in other words an approach characterized as customer pull. Thus, by putting the priority on customers and listening to the market, in form of both expressed and not explicitly expressed statements, a company strives to provide its, mainly existing, customers with superior value. Zhou et al. (2005) found that the market orientation is particularly beneficial in case a company works on a tech-based innovation (technology that increases benefits by improving already existing products on already existing markets) which focuses on addressing "the needs of mainstream customers" (ibid., p. 54). In contrast, the authors discovered a negative impact on market-based innovations, which is defined more as a state-of-the-art solutions aiming at new benefits for emerging markets. Therefore, it might be quite difficult for customers, especially the main ones, to accept a new product and find out what the real value is.

Technology orientation, on the other hand, refers more to technological push (Zhou et al., 2005), which is reflected in the notion that customers prefer technologically advances and outstanding products. Consequently, firms following this orientation tend to invest a lot in R&D activities together with the drive towards bold ideas. The authors conclude that the technology orientation has a positive association with tech-based innovation and, simultaneously, is neutral towards market-based innovation. This is in line with what Schilling (2011) recommends, i.e. conducting beta testing of

prototypes in order to get an early feedback from customers so that changes can be made before the product commercialization launch.

2.2.3 Types of Innovation and degree of control

According to Kuratko, Morris and Covin (2011), the type of innovation that is being developed is coherent with what kind of control level might be appropriate to apply. Aiming at the radical innovations, the control level should be very limited and the autonomy level should be high, whilst the incremental innovations might require a much more controlled approach (ibid.). However, this area seems to be not fully consistent, or at least there are nuances depending on what exactly is meant by controlling and at what level it is being executed. According to Holahan et al. (2014) and their study, it turned out that some ways of control may be desirable when developing a radical innovation, eventually leading to quite a few similarities to incremental innovation. These are especially in form of "less flexibility in the formal development process, more professional full-time project leadership, centralized executive oversight for new products, etc." (Holahan et al., 2014, p. 344).

Kuratko et al. (2011) also argue for how the development environment of the innovation will have an impact on the control of the development process. The type of department will influence whether there is a high level of autonomy or control. The authors argue that by giving up control to the employees, i.e. the team-members, they will feel more responsible for not only completing the task but also for doing so with high quality (ibid.).

2.3 Formation of New Product Development teams

Patanakul et al. (2012) distinguish four types of team structures, i.e. autonomous, functional, lightweight, and heavyweight-teams. According to the authors, the one of particular interest and rising popularity among companies that set teams for their NPD efforts is the first one, i.e. autonomous teams. Although Schilling and Hill (1998) argue that the autonomous teams are the best fit for developing innovations that are to be considered as breakthrough and major platform projects.

Autonomous teams and Self-managing work teams

The autonomous team, also called a new venture unit, is often a team that is in close relation and collaboration to a project manager, who also ideally is a senior member within the organization with full control over the resources of the team (Patanakul, et al. 2012). The team is separated from the other parts of the organization, and is allowed to handle all the parts of the project, i.e. marketing, manufacturing, distribution, etc. The biggest advantage of the autonomous teams, according to Patanakul et al. (2012), is their speed in reacting without being hindered by traditional formalities, such as resource allocation bureaucracy. One of the most common disadvantages is that these kinds of teams tend to expand the scope of the project and then having difficulties to be integrated back into the organization (ibid.). Another factor that distinguishes the autonomous teams from other constellations is the ability for the teams to create their own policies and procedures, e.g. reward systems in the search for getting more motivated project members (Schilling & Hill, 1998).

The self-managing work team (SMWT) shares some similarities with the autonomous team. However, this kind of constellation is, according to Patanakul et al. (2012), more of an informal team where the project leader might be elected by the members and not necessarily a senior manager. Although the project leader does take more of a coach or facilitator in his or her role as the leader, something that Uhl-Bien and Graen (1998) argue is leading to the team members being forced to take a bigger responsibility for managing their own technical contribution.

Functional and Lightweight teams

Working in a functional team structure indicates that the team is grouped together by discipline, i.e. having one group focusing on a particular aspect, something that Patanakul et al. (2012) argue leads to deep functional knowledge, but is lacking in terms of cross-functional interaction. Schilling and Hill (1998) also highlight the weakness of getting cross-functional input in the functional team, which also creates a lack of coordination in the NPD process. In relation to how Patanakul et al. (2012) explain the lightweight team as a team in high correlation to the functional team, with one major difference, i.e. that the project manager acts as the liaison in the project.

Heavyweight teams

The heavyweight teams often consist of a team with a core group of people that are typically dedicated and physically located in close relation to each other (Schilling & Hill, 1998). The project manager is, according to Patanakul et al. (2012), inhabiting a crucial authority and power over the team and the whole development process. The main advantage of this kind of team composition is to gain an effective coordination across different disciplines, i.e. departments and to have clear feeling of belonging to a team with a clear purpose and mission. The disadvantages are related to a clear competition for resources and also that the long-term career development of the project member is still in the hands of the functional manager, i.e. not the manager's that they permanently have in their heavyweight team (Patanakul, et al. 2012).

2.3.1 Cross-functional teams and communication over departments

According to Zemlickiene and Maditinos (2012) cross-functional integration is an important factor in the NPD, although the importance of different parties involved varies depending on the stage in the process. The presence of sales side of a company in the development team is crucial especially in terms of achieving a higher success rate for the innovation (ibid). Additionally, the importance of the marketing team and their input might be high given specific demands. Zemlickiene and Maditinos (2012) argue that the teams should be formed in such a way that a clear and ongoing interaction and information flow between these departments is fostered. Otherwise the collaboration might harm the innovation more than it contributes. Schilling & Hill (1998) also notices how the team composition in the development and commercialization process needs to be cross-functional in order to avoid a chasm between customer requirements and expectations vs. product attributes and offering.

One solution, according to Schilling (2011), to rectify the problems that occur when cross-functional teams are not assembled, or are assembled in a faulty way, is that the innovator can focus on building

product development teams that inhabit knowledge and expertise from broader surrounding. Namely, teams that consist of employees from more than one department, such as engineering, manufacturing, marketing, and sales, etc., have a higher chance of better results in the NPD process (ibid.).

2.3.2 Impact of the diversity within the product development team

In case of a company's market orientation, the relation towards new product performance can be moderated together with "the degree of competence diversity in the new product development team" (Gotteland and Haon, 2010). Thus, the competence diversity among the members of a new product development team should be carefully picked. Even though there is a proven positive impact of the diversity on the performance in terms of enhancing creative abilities, etc. it also may have a bad influence on the team's functioning abilities, e.g. an extensive diversity could create "inhibit interactions or cause conflicts" (Gotteland and Haon, 2010, p. 369). Thus, there are two entirely different situations where a firm may end up with. The main advantage of creating a diverse development team is illustrated as gaining a broader pool of knowledge and information and as mentioned by Schilling and Hill (1998), hopefully decreasing the development time.

Gotteland and Haon (2010) found out a quite unexpected dependence. Namely, that a low level of diversity within a technology oriented project team has substantially negative impact on the performance of a new product. In other words, when the existing competencies within the team are more or less the same it is tough to exploit the knowledge regarding available technologies. Thus, it seems to be promising for companies to include in their project teams people with diversified background and area of competence in order to grasp all the potential benefits from the new product's market performance. Another factor of diversity that has an increased impact on the team, in terms of being cross functional is to have people entering at different time stages, i.e. organizational tenure diversity (Schilling, 2011). This factor might help the team in terms of getting access to resources needed, as well as getting several viewpoints of similar problems or issues in the development process (ibid.).

2.3.3 Core competencies and capabilities

According to Holahan et al. (2014), core competencies are formed out of a set of capabilities that eventually differentiate a company from a strategic standpoint. The authors, as well as Schilling (2011) also summon another work, i.e. written by Prahalad and Hamel (1990), stating that core competencies are basically the core capabilities from which new core product offerings grow.

According to McDermott and O'Connor (2002) the NPD-team can have two alignments in terms of their influence on the development process, focusing on their competencies. Either the effect is competency enhancing, meaning that the firm is being strengthened through the existing set of knowledge, or the opposite which is the competency destroying which indicates that the knowledge is replaced in favor of the existing knowledge related to the firms initial strengths (ibid.). Although these are the two most common ways of looking at the area, McDermott and O'Connor (2002) found a third factor. Namely, the competency stretching which indicates how the competencies need to be the mean of pushing the

company into new competency domains. Something that heavily was influenced by the team members' ability to both use the existing knowledge, but also to adapt competencies and knowledge that allowed them to gain new abilities and experience that could benefit the NPD-process (ibid.).

2.4 Team function

Kahn et al. (2012) argue for how the use of an NPD process most likely will be the differentiating factor between success and failure of new product development. How the team should be working in order to attain the success is rather unclear, although Kahn et al. (2012) argue for a formalized NPD process that focuses on quality in its execution. The opposite, the poor practices of NPD are often characterized by an absence of documentation and process to guide the NPD (ibid.). According to Byers, Dorf and Nelson (2011) a team is nothing more than the people in it, effective if they manage to share the leadership of the team's task, have continuous communication and understand the tasks well. The team should be given feedback frequently and collaboration is to be considered as the norm, while learning is something that the team does together (ibid.).

2.4.1 New product development through the Stage-Gate model

The Stage-Gate model has been exposed to heavy criticism for being too rigid and linear, and thus not being able to handle more innovative product development projects (Cooper, 2014). According to Becker (2006) the Stage-Gate model in its initial form had a more negative impact on innovations, since the model treated all projects and products in the same way eventually leading to a slow and bureaucratic development process. Thus, the Stage-Gate had to be amended in a sense of reducing the amount of non-value adding work, and chiefly, it needs to be context-based, i.e. adjusted to certain company, industry, and overall circumstances around the project development (Cooper, 2014). A new idea towards the Stage-Gate model was based on a set of insights from several companies investigated by Robert G. Cooper (Cooper, 2014). The new notion is that the system needs to be adaptive and flexible, agile, and accelerated (ibid.). The core assumptions of the updated way of conducting projects are briefly described beneath.

The adaptive philosophy is secured by having a very iterative approach across the model. In order to achieve a more meaningful feedback from customers, they should experience the product as soon as possible. This is of particular relevance due to the fact that customers are not fully aware of what they want (Zhou et al., 2005). Thus, a "series of build-test-revise iterations" should be implemented, depending on the industry specifics. Flexibility is understood as a unique and adjusted way of working, i.e. the activities at the stages and gates differ for different projects, and ideally are in line with portfolio management. The same goes to criteria regarding Go/No-Go decisions. Lack of standardization makes the process more customized so that less innovative projects can be managed through, so called, fast-track versions where not all the steps are necessary, or some of them can be bound. By being agile it is meant to work with as short time frames as possible, so called sprints or scrums, so that a tangible, even if in an early version, product can be presented to stakeholders. Accelerated development process is achieved by having proper resources available and secured, as well as cross-functional teams, ideally dedicated to the task (Cooper, 2014).

Schilling (2011) argues that the stage-Gate model has its real value in control. By adapting to the Stage-Gate model the firm gets a clearer vision over the projects being developed, leading to the project manager being less likely to pursue bad projects. By having several Go/Kill decisions in the model, the risk for developing bad and expensive innovations is lowered, and the company can get a more transparent view of the process (ibid.).

2.4.2 Input from external stakeholders

Another kind of collaboration that is almost equally as important as forming the team in a cross-functional way in the NPD process is the ability to involve the critical members in the adoption network of the innovation, i.e. the resellers, distributors or other stakeholders (Chiesa and Frattini, 2011). In order to ensure a good collaboration with the partners, the innovator should focus on having a clear positioning of the innovation, making the competitive advantage of the innovation clear for the involved parties (ibid). By leveraging the multi-firm network, the innovating company can gain access to a higher flexibility that might reduce innovation time, but it also enables the innovator to gain valuable market input from the partners (Snow, et al. 2010). Not only increasing the chance of making the development process more efficient, the importance of involving partners, suppliers and customers also increase the possibility for product success and receptiveness (Schilling & Hill, 1998). The main advantage of using suppliers and partners is that the innovating firm expands their pool of information and knowledge, increasing the possibility of success (ibid.).

There are both advantages and disadvantages with external collaboration. One factor that will help the firm to speed up the development process by collaborating is related to gaining knowledge and input from an external party, rather than learning and developing them in-house (Schilling, 2011). Another advantage by collaborating is that the innovating firm might be more flexible since it is able to reduce its asset commitment in terms of not hiring the competencies needed, but instead gaining it through the collaboration (ibid.). In terms of achieving a successful and profitable collaboration, Schilling (2011) argues how the capability complementation and the capability transfer needs to be given thought. The capability complementation indicates whether the companies are able to 'combine' their pools, i.e. knowledge, know-how, partner contacts and resources but not necessarily transfer the information between the partners. The second dimension, capability transfer is more niched to how the collaborating firms actually can transfer knowledge, etc., in order to use it in an efficient way at the innovating firm (ibid.).

2.4.3 Key principles in using control that emphasize innovativeness

The paradox between the usage of both looseness and tightness in controlling the development of innovations creates a need for a more balanced approach according to Kuratko et al. (2011). In order to gain a more entrepreneurial philosophy, i.e. more innovative environment, the company or the project leader should focus on building his or her control influenced by the following factors that are stated below.

Control based on *'no surprises'* aims at providing the project group with correct and relevant information, leading to a lack of surprise since all who need to know, should have the information which

makes the performance level higher and the project group better at anticipating resource requirements. *Giving up control to gain control* focuses on the manager to give up control over a specific area or work task. If implemented successfully, the employees will respond with being more creative, working harder or conscientious, leading to control actually being gained at an increased level (Kuratko, et al. 2011).

The opposite of the more innovation oriented leadership is a style which focuses more directly on command and control. According to Kuratko et al. (2011) this style has more of a military connotation, meaning that control is tightly linked and is exerted from people above. In the same time, extensive measures of control are implemented in order to ensure that commands are executed (ibid.).

Apart from the two core principles above that are more innovatively aligned, i.e. *no surprise* and *giving up control*, Kuratko et al. (2011) state a few more critical elements in order to achieve a more innovative spurring level of control:

- Empowerment built into the job
- Organizational slack in terms of resources available
- Situational-based approach depending on type of innovation
- Mutual trust

2.5 Own model

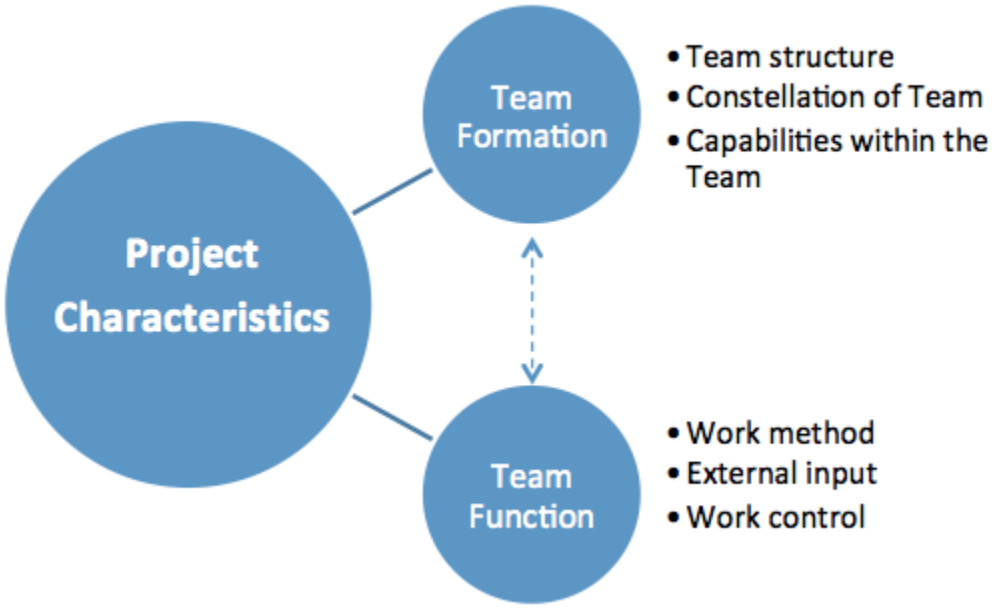

Figure 2.1 Critical success factors for conducting the NPD process

Our model as presented above, is highlighting what both Ahmad et al. (2012) and Kahn et al. (2012) argue about, namely how there are certain factors, i.e. characteristics of the innovation that should

steer and guide the NPD-process, videlicet the uncertainty and complexity. In relation to this, Green et al. (1995) argue that the radical innovations need to be judged and examined upon four additional characteristics in order to measure what is called the level of radicalness. Given these characteristics, it is in line with Patanakul et al. (2012) that the team should be formed given the type of innovation and not developed with a 'one-solution-suits-all' approach.

The constellation of the team can take several shapes. In line with Patanakul et al. (2012), who argue that more innovative NPD-projects need more autonomous teams with more self-control and less bureaucracy in the development process. In the NPD-process, there is according to Schilling and Hill (1998) a need for cross-functional input when forming the team, although as Holahan et al. (2013) state, the situation is to be examined upon the specific project. This thought is also shared by Ahmad et al. (2012) that stress how the level of cross-functional input should be considered given the orientation of the innovation. The market oriented innovations are often good at meeting market demands, although if the team is formed in a market driven manner, the risk of short-sightedness will decrease the value of the output (Ahmad, et al. 2012). Thus the teams are to some extent able to be more unified if the company is to pursue a radical innovation, deriving from the technology orientation, if there is some market input during the process.

Another characteristic that has a heavy influence on how the team is to be formed is what capabilities it needs and that it can inhabit. McDermott and O'Connor (2002) argue that the team should be formed in such a way that the competence is either enhancing or stretching, allowing the employees to both build upon existing knowledge, whilst making the company enter new domains. The competencies inhabited by the team is connected to what Schilling (2011) argues regarding diversity within the team, allowing the NPD-process to hopefully gain a higher quality in the work being conducted. Gotteland and Haon (2010) found that technology oriented innovations are urging for a higher diversity within the team, thus top-management should implement the diversity in the NPD-teams.

The function of the team stands in clear correlation to the characteristics that also influence how the team is formed. The level of control, as elaborated upon by Kuratko et al. (2011) is heavily dependent on how the team is assembled, which is originating from the characteristics of the innovation, i.e. the level of radicalness. The more innovative projects should according to Kuratko et al. (2011) be influenced by a project leader that works in a more empowering manner by leaving lots of autonomy to the team members, i.e. the 'giving up control to gain control' and 'control based on no surprise'. However the level of uncertainty and complexity of the innovation also put clear demands of clarity on the purpose of the innovation to be developed, in order to have an efficiently working autonomous team (Cooper, 2014).

Another characteristic that has direct influence on the teams function is the lack of competencies and knowledge in the innovating firm. Thus, the collaboration with external partners, i.e. leveraging the multi-firm network might lead to a higher flexibility in the NPD-process. Although, the ability to gain competence rather than the gained flexibility is seen as the main reason for involving external partners (Snow, et al. 2010). According to Schilling (2011) the teams function has to be clear in terms of

collaboration, either by combining the pools of knowledge, or if the lack of knowledge is big, i.e. capability transfer.

2.5.1 Project characteristics

Such factors as project climate, and company culture were highlighted amongst the most important factors within the NPD process by Kahn et al. (2012). The proposed model above strives to illustrate the importance of adapting the team formation and function based on the context of the innovation, i.e. as what Ahmad et al. (2013) call the depending characteristics: complexity and uncertainty. The level of risk is also one factor that is affecting the formation and function of the NPD-team, something that stands in clear relation to what Green et al. (1995) speak about. Videlicet, the technological uncertainty, technical inexperience, business inexperience and technology cost, are also important dimensions that need to be put in relation to the innovation being developed, in order to classify its radicalness.

The innovations position and origin, i.e. market oriented or technology oriented nature, should preferably be clarified, or at least estimated, at the beginning of the NPD-process. These factors may have an influence on the entire path of conducting the project efforts from the beginning till the commercialization results on the market. Thus, there might be a need for adjusting the endeavors to larger or smaller extent, depending on the conditions (Zhou, et al. 2005). In close relation to the level of innovativeness, i.e. incremental vs. radical alignment, is the level of control that is implemented to the team, leading to an outcome that either increases or decreases the level of autonomy, and thus the innovativeness of the NPD-team (Kuratko, et al. 2011). Another characteristic that is of great importance is the ability to sharpen the project and its scope, i.e. ‘sharpening the fuzzy front end’. This aspect can, according to Cooper (2014) be dealt with in a more qualitative and reliable way by creating a thorough proof of concept.

2.5.2 Formation of the New Product Development team

In accordance with Patanakul et al. (2012) there are four main types of forming the team in relation to developing new innovations. These four team constellations are presented as the autonomous team, functional and lightweight team, followed by the heavyweight team constellation. The type of team and how it is formed is dependent on a number of characteristics, namely the orientation of the innovation. A technology oriented or not fully market oriented innovation will need a more unified team. Still there needs to be some cross-functional input in terms of collaborating between departments.

Apart from these four types, one additional form that functions in close relation to the autonomous team, is the self-managing work team (SMWT) being described as a more informal constellation according to Uhl-Bien and Graen (1998).

Forming successful NPD-teams often include the ability to find a good balance between cross-functional teams, inhabiting a wide pool of competencies and knowledge. Schilling and Hill (1998) argue that the cross-functional teams are better at meeting market requirements and expectations. The diversity within the team, is however one aspect that is seen as key in order to access the resources needed, as well as getting several viewpoints on the development process (Schilling, 2011).

McDermott and O'Connor (2002) state that the competencies within the team can have two overall alignments and influences on the NPD-process, either the team members gain competence and use their existing knowledge, i.e. enhancing their knowledge. The other path is that the inhabited knowledge is destroying for the development process, and thus will be less useful and replaced with new insights. The middle alignment, found by McDermott and O'Connor (2002) is the competence stretching, illustrating how the team members are using both their previous knowledge as well as creating new insights and expanding their competencies.

2.5.3 Function of the New Product Development Team

Managing and keeping control over the process in an iterative way, together with obtaining certain decisions in order to lower the risk of poor decisions, is the main value of using the Stage-Gate model by Cooper (Schilling, 2011). According to Kahn et al. (2012) the Stage-Gate model is key in order to positively influence the innovative climate, which is an important factor for the NPD process. By executing control, in style of the Stage-Gate model the communication towards the team as well as the individuals making up the team becomes more efficient (ibid.).

Apart from achieving a good communication internally within the team, the external communication and iterations towards stakeholders is to be considered as a key part of the teams function (Chiesa and Frattini, 2011). According to Snow et al. (2010) the development process will gain a higher level of flexibility by tapping into the multi-firm network, allowing the process to have more qualitative input.

Although the Stage-Gate model is good in terms of controlling the overall development process, i.e. using gates and iterations in order to achieve quality and on-track progress. The team control has to be dealt with on a lower level, thus Kuratko et al. (2011) demand for control based on 'no surprises' and 'giving up control, to gain control' to mention the two overarching factors. The function of the team in the model, also describes the most crucial characteristics of a leader in charge of the project and his or her attitude towards tasks, activities, workload distribution, team members, etc. It delineates also the amount of freedom given to the employees which may differ depending on type of innovation the team is dealing with, e.g. incremental (with lower uncertainty, as named by Ahmad et al., 2012) vs. radical.

3. Method

The methodology chapter describes the approach of the research and provides information regarding how the research was conducted, how the data was collected and analyzed.

3.1 Overall research approach

Our approach is of the qualitative nature, an approach that Bryman and Bell (2011) state is, in opposite to the quantitative, highly influenced by words, rather than numbers. This thesis builds upon a case study conducted at our internship company - "A-technologies". The data collection process varies, as according to Eisenhardt (1989) and Bryman and Bell (2011) the procedure includes activities such as: archives, interviews, questionnaires and observations. The overall steps within our thesis are in close relation to the model by Bryman and Bell (2011), which indicates a highly iterative process. This model is also coinciding with Eisenhardt's (1989) argument for how the initial research question and area should be quite broad. Eisenhardt does however stress the importance of in a sense having a clear scope, as this is crucial in order not to become too overwhelmed by the amount of data to be collected (ibid). Given that the data collection started in advance of our research question being constructed, mainly through lots of informal interviews and meetings with employees at "A-technologies". Here is a close connection to Eisenhardt's (1989) argument for how this factor shift focus from theory *testing*, to *theory building.*

The thesis is of the case study nature, which interlinks "the detailed and intensive analysis of a single case" (Bryman and Bell, 2011, p. 59). The aim of this dissertation is to provide the readers with a comprehensive set of critical factors, based on the projects characteristics put in relation to team formation and team function, making the new product development process more efficient. Nevertheless, as pointed out by Bryman and Bell (2011), the case-study approach to conducting a research entails a question mark in terms of its generalizability, which is by definition to some extent limited. It is however believed that the proposed group of approaches driving the process towards overall better efficiency and effectiveness can be applied by other companies. Some of the factors are of universal nature and are clearly applicable to the wider business context, while the other ones might be working properly under more specific circumstances, i.e. similar to the company's examined environment and business ecosystem.

3.2 Data collection

The data collection for this master thesis has been done in a number of ways. The authors have been conducting in-depth interviews mixed with informal meetings, observations and the use of internal documents. The data collection has been related to identifying and then collecting relevant information and inputs from a number of cases, in order for us to as stated by Eisenhardt (1989) generate theory from the use of cases.

Given that the thesis is of the qualitative approach, it is words rather than quantifiable data that is being used and analyzed (Bryman and Bell, 2011). Thus we have been conducting numerous interviews, both

of the open and semi-structured approach in order to get as rich and informational data as possible (ibid.). The main advantage of using the qualitative approach compared to the quantitative one, is as stated by Bryman and Bell (2011) the ability to ask follow up questions and make the respondent elaborate in a much more detailed way than the quantitative approach allows the researchers to (ibid.).

3.2.1 Interviews conducted at A-technologies

During the internship numerous interviews have been conducted, all of them by both authors of this Master's Thesis. The initial process of the interviews has included a more or less brief introduction about the research scope and what is of interest. The interviews of the more open type have of course been less guiding in terms of specific factors and topics to focus on (Bryman and Bell, 2011). All the semi-structured interviews have been recorded and transcribed, mainly due to what Bryman and Bell (2011) argue about the importance of not only understanding *what* the interviewee says, but also *how* the interviewee says it, as well as not to lose any insight.

3.2.2 Use of interview guide

The semi-structured interviews have been aiming at a different set of employees. Naturally, there has been a slightly different interview guide used by adjusting it to the interviewees' position at the internship company. Nonetheless, the questions were however asked in a similar way (Bryman and Bell, 2011). The importance of having some kind of structure is in clear correlation to what both Eisenhardt (1989) and Bryman and Bell (2011) argue for as being crucial in order to use the multiple case study research to build theory through cross-case comparability.

The interview guide itself has been constructed in clear relation to what Bryman and Bell (2011, p. 475ff.) bring forth as crucial in their template. The questions were formulated given thought to whether it helps asking the research question, without being too narrow and leading and still having a natural flow and opportunity to follow-up questions. In order to ensure a high reliability the questions were asked in such a way that they were not leading.

Following the advices from Bryman and Bell (2011) and Eisenhardt (1989) regarding interview preparation, the interviews were divided into four broad categories that were in line with the research question, i.e. introduction to the project and product, project characteristics, team formation, and team function together with a focus on leaders. Moreover, the questions under those themes were developed through an extensive literature review which inspired the authors what fields are to be examined. Eventually they were adapted to the conditions surrounding the company and projects, as well as slightly to the interviewees' responsibilities in the projects.

3.2.3 Scoping a relevant sample at A-technologies

The main scope of the sampling strategy has been the non-probability sampling method, which according to Bryman and Bell (2011) implies that the researchers are looking for units in the population that are more relevant than others. The overall sampling method has been influenced by the snowball sampling where a big focus has been put on using the initial interviewees and their contacts in order to be led to further more relevant respondents of interest (ibid.). The fact that snowball sampling is used

primarily, if not solely in qualitative research, is related to the fact that Bryman and Bell (2011) stresses about how the qualitative approach is not as concerned with the external validity, in order to generalize. In a sense, the quota sampling has also been used in order to create a clear sample of project leaders and project members in the population of the company (ibid.)

The host company, as it was mentioned before, has under its umbrella a large product portfolio. Due to some constraints related mainly to time as well as access to data, it was decided not to investigate a number of products in a shallow way. Instead, a more detailed and in-depth approach was applied in order to explore the subject carefully. The choice was based on a set of informal interviews where a couple of potential products were indicated, however finally the number was reduced to two examples. Except for the strive of gathering what Bryman and Bell (2011) mentions as more quality characterized data, the authors also kept in mind the fact that this Master's Thesis area of interest was to some extent neglected in the past, and therefore the ambition was to contribute with well examined cases.

The two products chosen to be investigated in detail were selected upon the objective of this paper. Both of them met the requirement of being radical from the firm's standpoint, but simultaneously allowing to examine the type of radicalness in the function of the host company's core capabilities, i.e. the C1 having its roots in the core competencies while the T1 was developed totally outside of the core business. Another difference between the projects was how the teams were assembled, since they differed to large extent in size, possessed knowledge and competencies, etc. This allowed the authors to examine the dissimilarities and how the characteristics of the innovations influenced the NPD-process. Another shared criterion for both projects were that they had been launched during the same time, and both are to be considered as successful in terms of return on investment indicator, market share, customers' reception, etc.

3.2.4 Respondents list

The respondents illustrated beneath have all been chosen upon inhabiting knowledge and information about either project T1 or C1, or possessing information that was to be seen as relevant for the overall research. To large extent, the Snowball sampling has been used in order to get in touch with relevant employees (Bryman and Bell, 2011).

Position	*Gender*	*Project*
Product owner	Male	C1
Senior expert	Male	C1
Business Development Director	Male	Overall
Project leader	Male	T1

Distribution Manager	Male	Overall
Manager of New Business Department	Male	T1
Product owner	Male	T1
Project member	Male	T1
Project leader	Male	C1
Project member	Male	C1

Table 3.1 Respondents list

3.3 Method related to data analysis

In the beginning of our study, we went out at our internship company and conducted observations, open interviews and took part of internal documents circulation. In the latter stages we went on with more structured interviews and began to work in a more iterative way between data and theory, something that is closely related to what Bryman and Bell (2011) argue as recognizable for the grounded theory approach. As mentioned by Eisenhardt (1989, p.533f.) we took the approach of comparing and exploring relationships between the collected information from our cases. In order to do so in a qualitative and reliable way, the data that was gathered was coded. In relation to Bryman and Bell (2011), the data was broken down, examined and categorized, i.e. by the use of the 'open coding' process (ibid. p.577ff). Thereafter the data was put in categorize related to the team formation, function and the characteristics of the innovation. Hence the process has been in an iterative manner, deriving with constant focus on the research question, in order to as stated by Bryman and Bell (2011, p.578) 'manage the gathered data correctly'.

The analysis of the gathered data, in accordance with Eisenhardt (1989) has been focusing on building a clear and rich picture of each case, allowing us to search for patterns between the collected data. Furthermore the analysis has been searching for cross-case patterns, with the help of the categorization. Still there has been a clear focus on not drawing false or premature conclusions in our work, but keeping a non-biased approach as Eisenhardt (1989) explains it. Given that our data collection has been focusing on two in-depth cases, i.e. the T1 and the C1 at A-technologies, we have been searching for similarities and dissimilarities between the two cases. In accordance with Eisenhardt (1989) one of the biggest challenges in building theory from a case study is the analysis part.

4. Empirical findings

In this chapter the overall findings will be presented, starting with a small introduction of the internship company, A-technologies, followed by a more in-depth presentation of the two products that has been developed and launched.

4.1 Internship company - A-technologies

The internship company, A-technologies was founded in the early 1980´s in Sweden. It is today a highly successful IT-company that has experienced extensive growth over the last decade, in terms of revenue, employees and geographical reach, etc. (Annual Report, 2012). The company has one of the most extensive product portfolios in their industry, and they keep adding different new innovative product offerings towards their customers. The business model of A-technologies includes a two-tier partner network, where all of the sales towards end-customers are done through sales channels of the partners. As of today, the company has over 60,000 partners in their business network (Annual Report, 2012). According to the distribution manager at A-technologies, they are given a huge scalability through this partner network where they can focus on what they do best, i.e. continuous R&D and allowing the partners to be the sales force of the company (Distribution manager, 2014).

Illustrated beneath is the way to market for the products being developed by A-technologies, in accordance with the information above.

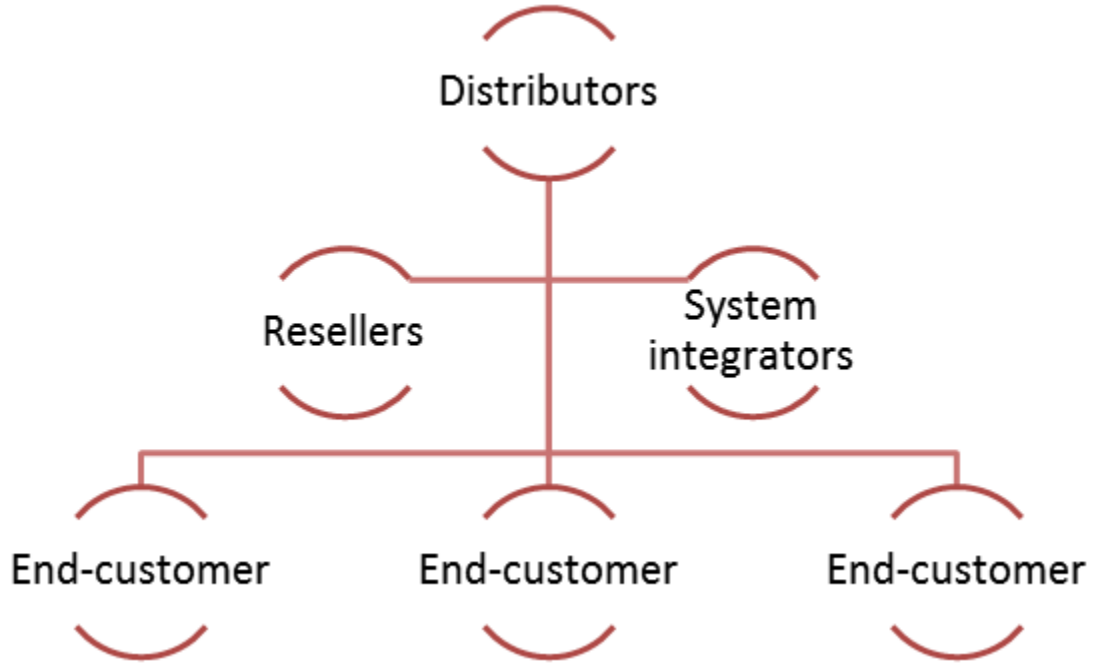

Figure 4.1 - Business model network of A-technologies (Annual Report, A-technologies, 2012)

4.1.1 Formal development process and roles at A-technologies

The Stage-Gate model is a formal and well-known tool for the project leader in order to control and manage the new product development process. There are seven formal stage-gates that the project leader needs to achieve in order to successfully develop a product (Internal documents, 2014). On an overall level, the stages in the model are used in order to ensure that the project gets the appropriate resources it will need, make an overview of the potential risks, efforts needed and the level of cost. Before the official closure, the project leader needs to validate the outcome of the project, and then approve that no more changes will be needed. The last stage before the handover includes making sure that all deliverables has been confirmed and are accepted before finishing the project (ibid.). This so-called 'toll-gate-plan' are to be developed by the project leader with input from the project team in order to agree on milestones, tollgates and risk exposure (Internal documents, 2014).

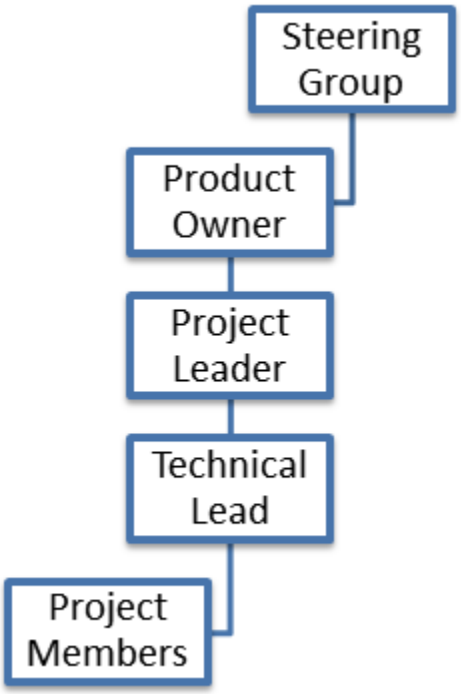

Figure: 4.2 - Process roles in the NPD-process at A-technologies (Internal documents, 2014)

Illustrated above is the formal hierarchy of the project development at A-technologies. The overall responsibility is within the steering group that has the power to shut-down and kill a project. They also have the responsibility to decide whether the project team has been able to deliver to a standard that allows them to move on to another toll-gate (Internal document, 2014). Functioning beneath the steering group, but also as part of it, is the product owner. The owner has the responsibility to define the product proposal and to continuously improve it with the help of the project leader. Apart from representing the external customers' interests, i.e. the market input, the product owner also has the responsibility to assign the project leader and to give him/her the necessary prerequisites needed (ibid.).

The role of the project leader is more operational and s/he has several responsibilities towards both top-management as well as the project members beneath. The role can be broken down into six sub-roles:

- **Up** - assisting the project owner in selecting and improving the requirements of the projects, as well as alerting if progress is not in line with expectancy
- **Down** - delegating tasks to the project members
- **In** - leading and managing the project members
- **Out** - managing the external communications with customers, suppliers and competitors
- **Back** - giving feedback to the project members
- **Forth** - planning and executing changes in the project, and producing correct deliverables and closure criteria in collaboration with the steering group

The technical lead is often an experienced engineer who is responsible for helping and assisting the project leader in the coordination related to the technical solutions within the project. Given the individual's experience within his or her field, they are also responsible for assuring a certain level of quality being delivered (Internal document, 2014).

4.2 Project T1

The start of Project T1 was initiated over six years ago, in 2008, but did not receive a formal go until three years ago. The T1-project was the second project that was initiated by the New Business department at A-technologies. The department solely focuses on developing products and offerings outside of the core business (Head of NBD, 2014).

4.2.1 Project characteristics

The T1 was a highly radical innovation for A-technologies given that they had never worked with a product like this before, neither had the market seen a product acting like the T1 does, which was one reason for the development time being quite extensive (Project leader, T1, 2014). The cost of developing the T1 was also quite high, even for a company that spends about 15% of the revenue into R&D. Adding to this, the initial budget was also exceeded by around 30% (Product owner, T1, 2014).

The development of the T1 was highly characterized by a high technological uncertainty and complexity. In relation to what the project member stated regarding the differences between the hardware and the software side, the hardware was more of the incremental alignment. In this aspect, A-technologies could in large extent use the existing products and components (Project member, T1, 2014). The software on the other hand was very novel, and according to the Product Owner, something like the T1 had never done, making it very complex for the company and its employees (Product Owner, T1, 2014). Thus, the T1 is working towards opening a completely new platform for future innovations for A-technologies and not only widening the existing product portfolio.

"I think it was a learning exercise for everybody. To say like this, The T1 project was probably the biggest platform project that was done at the company since the beginning more or less..."
Product Owner, T1, 2014

In relation to how the T1 was very complex it also influenced the engineers at the company to the extent that they had to learn, i.e. the technical inexperience was very high as the employees did not inhabit the knowledge needed to develop the T1. Thus, there were big demands on getting the right resources, something that was not fully obtained. According to the Product Owner, the project team was consisting of the resources that they had to their disposal, but they were not able to pick whomever they wanted within the organization. There could have been a more efficient development process according to the project member if there would have been any external input, i.e. expert consultant that had knowledge about the technology. In the latter stages of the product development, there was a product specialist with knowledge from the market area that was hired in order to help and support the product owner in the daily work tasks (ibid.).

The inexperience on the business side was easier to handle as the existing partner network to large extent could be utilized in an efficient way. Although there was a master's thesis that examined the potential fit between the T1 and the existing business model to ensure that it would be feasible from a strategic view (Product owner, T1, 2014).

Market orientation vs. technology orientation

The T1 project was both market- and technology oriented. Although it weighed to the market oriented path mainly due to the innovation being radical for the company and thus needing lots of customer and partner input, there were certain parts where the technology drive took over (Project leader, T1, 2014). According to the project leader for the T1 it was the parts that became too technology driven, that also had a big impact on the overrun in project time. One of the biggest set-backs with the technology oriented approach was mainly related to adding value that was very engineer driven and not a requirement from the market, although the project leader took the decision to pursue the idea in order to get an added value towards the customers (ibid.).

"I would say it was market oriented from the beginning, because it originated from the business side… that it came, and they said that the market wants this, we know that the market wants this… and they started the project with a master thesis, to explore it. And that's because they wanted to do it…"
Project member, T1, 2014

Types of innovation in relation to control

The T1 was developed at the New Business department (NBD) which functions like a separate venture from the rest of the organization. The NBD has some differences in terms of how they develop innovations, i.e. there are more of an informal approach and not as high focus on guidelines and formal models (Project owner, T1, 2014). The project team was led by the project leader, but the product owner was also heavily involved in the daily tasks. In total the product owner allocated around 80% of

his time to the T1, functioning like the go-to person in the development process. The project team was given quite a lot of autonomy, although they had specific demands that they had to do each week, e.g. working towards specific gates in the Stage-Gate model. But how the team got to these deliveries was to a large extent up to them and they also worked in a very close and iterative way with each other (Project Member, T1, 2014).

Sharpening the fuzzy front end

Before the initial assignment of engineers, there was a master's thesis that investigated the potential benefit of the new product, i.e. a form of a proof of concept. Complementing this technical investigation was also a business plan that examined how the new product would fit the current business model (Product Owner, T1, 2014). Although there was not any prototype stage in the development phase, rather the process that was supposed to culminate in a prototype became the actual end-product project. Thus, there were a lot of miscommunications between the development team and the top management, since the prototype quite quickly became the actual end product. Something that according to a team member of the T1 led to the engineers being forced to start over and fine-tuning the product, without gaining any valuable input from the partners of A-technologies (Project member, T1, 2014). One of the negative aspects of the project was the width of the scope, i.e. the criteria list, making it very diffuse and hard to grasp in the beginning stages, both in terms of choosing team members but also in terms of creating a clear vision of what to develop (Project leader, T1, 2014).

4.2.2 Team formation

The team formation was highly influenced by the project leader and his preferences and demands in terms of employees needed for the development. Given that the product was very innovative and radical for A-technologies, there was a need for several tech-leads who were in charge of different aspects, i.e. firmware, software, electronics etc. Together the project manager, technologies manager and the tech-leads went through the project scope, and tried to figure out what kind of resources and to what extent they were needed in order to ensure the future of the development (Project leader, T1, 2014).

According to the project leader of the T1 development, all the resources need to be set and clear before the official 'Start-stage' in the Stage Gate mode. Although what normally happens is that the resource allocation becomes quite iterative, where the project leader needs to have a continuous discussion with the resource manager throughout the development process (ibid.).

"And then you can start work, but what normally happens throughout the projects is that you realize that you need a little bit more here, and a little bit less here. But that's always a continuous discussion with resource managers, or the line managers." Project leader, T1, 2014

Team constellation

The team members of the T1 were to large extent originating from the NBD, although there were lots of inputs from other departments within A-technologies. In some instance, the team was formed and divided into separate functions, focusing on the in-depth knowledge of the team members. Since the NBD functions as a separate venture within the organization, there was more slack in terms of procedures and rules, although the development process still had to follow the main procedures in terms of allocating resources, etc. (Product owner, T1, 2014). As mentioned by the Project Leader (2014), the team was given quite some freedom and autonomy in order to work in their own pace, still aligning with the overall process.

In summary, there was a core of engineers that originated from the NBD, while some input was gathered from other departments working beneath the project leader and product owner during this development process. The project leader functioned more as a liaison, focusing heavily on keeping communication flowing and aligning the overall process. The product owner was however, one of the actors that had direct authority and could implement changes (Product Member, T1, 2014).

Cross-functional input and diversity in the NPD-Team

The development team itself was highly influenced by engineers and was not cross-functional in many ways. Instead, it was more unified. Overall the team had approximately 50 team members, throughout the process and around 40 of them were pure engineers, whilst the other ten were mixed between managers and other key stakeholders (Project leader, T1, 2014). The team did however get continuous market input, although from a centralized source: the product owner, functioning like the main source of external inputs (ibid.). In terms of classifying the NPD-team, it cannot be seen as cross-functional in terms of involving a broad variety of backgrounds, i.e. marketing, sales, etc. It was heavily engineer populated, however these engineers had of course different backgrounds and knowledge basis, making them all contributing to the T1 (Product Owner, T1, 2014).

> *"More of a… unified team, it consisted solely of engineers almost…"* Project Member, T1, 2014.

One factor that was emphasized by the Product Owner (2014) was that the team became quite diverse. There were several engineers coming and going given different reasons. Although this lead to a loss in time, the development process became more qualitative, since each new input had different views of it and made small iterations in order to improve it (ibid.). One aspect that however made the team less diverse was that there were a lot of optimists, which according to a project member led to the project being delayed, given that the criteria-list was not attacked with a more critical view of the development. Instead, there were a lot of inexperience engineers which put more of a focus on learning how to work in projects, and in how the company functions itself (Project Member, T1, 2014).

"… They talked about that the technology was fun and could be useful for the customer, and no-one really questioned it, …, if we've had a couple of more pessimistic and experienced engineer's they would probably have said if we go this route, we actually need to hire or at least have an expert consultant, since it's such a big field, and we had such limited knowledge." Project member, T1, 2014

Core competencies and capabilities

One factor that was very different from any other project being developed previously at A-technologies was that the knowledge needed to develop the T1 did not exist internally. To some extent the knowledge that existed at the company and in the project team could be utilized but in order to solve certain problems there had to be some intense learning before being able to overcome the hurdles (ibid.).

"Doing the hardware was a piece of cake. Doing the software, firmware – that was a big thing. We were doing something that nobody has done before, neither here at the company or anywhere else."
Product owner, T1, 2014

Although all the knowledge did not exist within the company, there were many features that were building on certain areas that some employees had knowledge and know-how within, making them able to leverage that to some extent and thus building upon existing competencies (Product owner, T1, 2014).

4.2.3 Function of the NPD-team

One key factor to handle is to keep people involved and 'educated' throughout the development process. Even though the specific employee is not active in the development process at the current stage but instead is working on other projects, there needs to be some ambidextrous skills from the engineer in order to have a solid ground, when they start at the new project. According to the project leader for the T1, it is crucial to keep the team-members informed and inviting them to meetings, in order to get some kind of basis or foundation of knowledge of the project, especially when dealing with more radical innovations (ibid.).

In order to maintain the control over the development process, the Stage-Gate model is applied throughout A-technologies, although at the NBD it is applied in a more iterative and less formalized manner, allowing some autonomy in its implementation (Project Leader, T1, 2014). By using daily short meetings, i.e. 'scrum-meetings' the project leader was able to get input and quick discussions for a short period of time. Although the meetings were aiming at a more overall level of each sub-part of the project, the project leader was able to get a good understanding on the overall issues or problems (ibid.).

External input in the NPD-process

As the T1 was a very radical innovation, and was developed by an organization that never had done anything similar to it, there was a need for input and collaboration with more knowledgeable sources.

This was however not the full reality of the T1, instead there was a lack in terms of getting input from the more experienced partners in the business network (Project Member, T1, 2014).

"And we should definitely had guys working with the development partners to look at the API of the T1." Project Member, T1, 2014.

One reason for the external collaboration being quite limited was related to the fact that the development partners were asking for a more finished product, rather than a beta prototype. The communication and collaboration started almost a year in advance, although as mentioned previously, the received feedback became quite shallow as the development partners were not too interested in a beta prototype. Still there was a major value in the collaboration, as it increased the value of the product and also functioned as a bridge for knowledge between both parties (Project Member, T1, 2014).

"...There was a lot of talk with them, almost a year in advance. But why we wanted to do the prototype was to get feedback and learn. But the feedback wasn't as thorough as we wanted, since we didn't get it out in time." Project Member, T1, 2014.

Utilizing control that emphasize innovativeness

In terms of giving input to the team and influencing the team members, this is the responsibility of the project manager, thus when the product specialist wanted a feature added or done in a different way, this had to be brought to the product manager who then ordered it to the project leader (Project Leader, T1, 2014). Although this was the formal and official way of doing it, the project leader of the T1 stated that they worked in a more agile and flexible way by letting the product specialist attend the morning meetings and bring up his thoughts during this session (Project Leader, T1, 2014). In terms of having control over the development team, this was limited to the project leader and the product owner. Thus, the product specialist were not allowed to approach a team member and put a new feature on him directly, but was forced to take his input from the market through the top-management of the team firstly (ibid.). One aspect that differed from how other projects are being handled at A-technologies was the involvement of the Product Owner, who had a direct and very flexible link to the development team (Product Owner, T1, 2014).

The leadership of the project team was in a sense coming from several sources, both the Project Leader, the Project Owner but also from the Steering Group. The product owner stresses how the development team was not managed, but instead led by him, as being part of the team and working with them on the same level (Product Owner, T1, 2014). The team members were also given a lot of freedom and trust in terms of how they worked, although this autonomy and freedom were companioned by uncertain and fuzzy criteria and demands, making the team quite unaware of what exactly to develop (Project Member, T1, 2014).

"One big difference comparing with the normal R&D is that I am involved every day, I am at every meeting, every day, every stand up. So it is much more flexible and much more relation. So I would say it is a big difference comparing to other development projects..." Product Owner, T1, 2014

To large extent, the team was given and also taking such level of autonomy that it managed to solve most issues and problems internally within the team. The development team felt that they had the responsibility to develop a qualitative product, partly due to them being able to have their own input in how to proceed with the process (Project Member, T1, 2014). In the same time, the product owner sheltered the team from external threats and risks in order to increase the motivation.

"…but actual problems during the technology phase, was informal within the developers, and the project leader… yes, it was very much a team effort, still we were very separated between the parts."
Project Member, T1, 2014.

4.2.4 Overall outcome of the T1

Judging the T1 and labeling it as a success or not, is dependent on numerous factors. The development speed of the product cannot be seen as very efficient, given the miscommunications that reduced the development speed. This was according to the project owner not an issue however, since quality and reliability was given a higher focus, as it was a very new and radical product being developed. The budget was exceeded, both in terms of time and money, where the latter was exceeded by approximately 30% (Product owner, T1, 2014).

"We had a pretty good steering group that was very determined what we should do, and had right priorities … our top priority was reliability and quality. Those were the two top priorities. And the project cost and time to market were less important." Product Owner, T1, 2014

In relation to sales levels, the T1 have been more or less sold-out, meaning that A-technologies has been selling the same amount as they have been able to produce, illustrating a very good market acceptance and market pull for the product (Project leader, T1, 2014). Although the T1 has not been out on the marketplace for much more than six-seven months, the initial return on investment has been quite quick, forecasting it within less than 12 months (Product Owner, T1, 2014).

"...it all depends how you calculate. But anyhow, we have pretty short return on investment."
Product Owner, T1, 2014

One factor that might be more valuable than the pure financial and market share related ones, are the new technical platform that A-technologies been able to create through the creation of the T1. The amount of learning and knowledge that the company, and the department itself, has been able to gain has meant a huge increase in the competitive advantage of the firm, as they are moving into new markets with the T1 as the foundation (Head of New Business, 2014). Thus, the T1 has opened completely new market opportunities for A-technologies both through its original offering as a product, but also as a future platform for new offerings, leveraging from the existing knowledge and technology.

4.3 Project C1

The C1 project was started as a sort of a tradeoff within the R&D Department at A-Technologies. A certain idea was put on hold by the company's executives and simultaneously transformed into another one, a bit more simple but based on the same assumptions according to a company's Senior Expert (C1, 2014), who was involved in the idea generation and proof of concept phase.

4.3.1 Project characteristics

The C1 concept was considered as radical. Firstly, it was new from the company's perspective. Even though the product derived from the core competencies and specialty of the company, it opened a totally new chapter in the product portfolio. Therefore, the employees had to face a lot of new challenges. Secondly, it was new from the market place's standpoint, due to the revolutionary character of the product comparing to what was known within the industry before, not only in terms of the technology applied but also in terms of the quality and price (ibid.). Moreover, it opened a new market niche and thus new business opportunities.

"It was completely new... and a new type of business as well." Project Leader, C1, 2014

The C1 product development process was characterized by, similarly to the T1 project, high uncertainty. However, that aspect differs a lot comparing to the product described previously from the technological standpoint. Namely, in this case, the dimension of uncertainty was in the form of a number of issues related to the hardware side of the product rather than to the software, as it happened with T1. The software used for the project development was well known and tested by the company's employees, while the hardware was remaining as an unexplored field, within which one considerable concern occurred.

"The main feature was completely new at the company, so no one had a 100% competence in that area." Project Member, C1, 2014

However, the uncertainty factor comparing to the T1 project was also different as the C1 project basically derived from the core capabilities of the company.

"It was kind of core competencies, same channels that we are using otherwise and the people understood the concept quite easily." Product Owner, C1, 2014

On the other hand, the C1 had to face exactly the same problem as the T1, i.e. the newness of the market and the business opportunities that were to be opened.

Market orientation vs. technology orientation

The concept for a new product appeared internally within one of the departments belonging to the host company's R&D organization. It was both technologically and market driven (Product Owner, C1, 2014). Technologically driven due to a new possible solution that was noticed by the employees, namely a

change from analog to digital technology used in C1' sort of products, as well as all the issues that the change implicated. The market drive was however more reflected in the awareness, at least to some extent, of a need on the market for smaller and more compact solutions. Thus, the project team had to work, to some extent again, in line with what was currently missing on the market place.

Types of innovation in relation to control

Flexible and iterative approach is something that works in favor of speeding up the process and can be reflected in the Project Leader's quotation, i.e. "this looks good, let's go for this" (Project Leader, C1, 2014), however it should be also reinforced by ability to take decisions quickly. Another factor in this matter is that the C1 Project Leader (2014) was not afraid of making decisions according to his "gut feeling", what as he mentioned, is extremely importance under the circumstances of total newness and uncertainty.

"The feeling was let's go for this because a lot of things were totally new and we did not know what is the best practice or what the market needs". Project Leader, C1, 2014

A factor that influenced positively the team behavior and attitude was, according to the C1 Product Owner (2014), a large amount of novelty in it. As he coined it, it was something that "triggered a lot of happy faces".

Sharpening the fuzzy front end

The project sparked quite some discussion on a high level at the company (Project Leader, C1, 2014). Due to the innovation driven culture in the company the concept has been accepted what resulted in a pre-investigation study leading to an early prototype which was then shown to the product manager as well as to the CEO.

According to the C1 Product Owner (2014), a clear criteria list or the goal drawn by the proof of concept is very important. This is one of the characteristics of the C1 project, and as he mentioned:

"Sometimes we might forget that as product manager how important it is for developing organization to understand what it is you want. It is also important in the beginning of the project at least to convey the image that you want to achieve".

A risk or problem that might occur due to having too clear list of requirements is that it may diminish the level of innovativeness. In order to lower the impact of this issue, the company was always open for discussion and people coming up with new ideas (Product Owner, C1, 2014).

The development time of the first version of the product took approximately 15-16 months (Product Owner, C1, 2014) which is considered to be a short amount of time. One of the reasons for such a quick development was a well-defined list of requirements which comprised a narrowed down set of expectations and features, but simultaneously giving a good overview what the project is going to be

about. What actually allowed it to be fulfilled was a prior preparation to the product development, i.e. an investigation or so called proof of concept. Another aspect that contributed positively to the process was a decision of using old but reliable and well known software platform. These aspects contributed positively to reducing the time to begin work on the project due to reducing overall vagueness in the beginning.

"... For being a new concept I think it was quick. But I think that was also based on the fact that there was a proof of concept that helped us to make it faster." Product Owner, C1, 2014

4.3.2 Team formation

The proof of concept, something that was of a great value before the actual work on the product began, was developed by a team not associated with the future project team. When it was done the team has started looking for right resources that could take over the concept, and it was eventually taken under the roof by the Product Owner, as he has seen a potential (Product Owner, C1, 2014). The proof of concept team was rather small, which was according to the C1 Product Member (2014) not necessarily the best choice as he felt that a bigger group of people would have been able to prepare the proof of concept in a more effective way.

According to the way of forming teams at the host company the project teams are built upon the estimation of the project's difficulty, complexity, as well as the target date. The assessment of resources needed is done based on those factors with the release date kept in mind so that the likelihood of delay is reduced. The project leaders (project managers) or the product owners are not allowed to pick certain persons directly themselves. This is rather done by resource manager (owner) together with the project manager, and sometimes can eventually end up as a "kind of a lottery" (Project Leader, C1, 2014). It was no different in this case. Nevertheless, the potential team members are being drawn from the candidates' pool with an appropriate knowledge and experience within the area of interest, where the final set up should be able to accomplish the task before the set product release date. The potential project members have no authority over choosing a project they would like to be part of.

During the C1 development a product specialist's role, which is broadly speaking to gather information regarding the problems current product is causing or what is being expected from the product, was greatly limited due to the product's newness to the market. Therefore, the amount of feedback and usefulness of the input was modest, but way more significant for further product improvements.

In order to sum up this sub-heading and emphasize the characteristic of team formation, it seems to be relevant to summon a quotation from the C1 Project Leader (2014):

"We are flexible even though the structure (the Stage Gate model) is not that flexible maybe because the company works like a small team, even though the firm is big. We work as a small team."
Project Member, C1, 2014.

Team constellation

The team consisted almost purely of a small group of engineers, literally a couple of them (according to the C1 Project Member 6 core people), what makes the team strongly unified, without any exchange of people throughout the development process. According to the C1 Project Leader (2014), using teams that are to large extent unified is something rather common at the host company, regardless the type of innovation. Also, the importance of having a core group, i.e. unvarying, throughout the process regardless the size of the project was emphasized by the C1 Project Member (2014).

Cross-functional input and diversity in the NPD-Team

Apart from people employed at one of the testing departments, the previously mentioned small group of engineers was considered to be the main resources (Project Leader, C1, 2014). They were responsible for noticing the need in the industry, for the idea generation, as well as for pushing forward the concept. Nonetheless, some of the marketing people were involved too, mainly in the later stages of the product development process, starting from the "middle zone" in the Stage Gate Model. This was concerning, however, to large extent the utility aspects of the future product rather than having an impact on the product's vision. As it was mentioned by the Product Owner (C1, 2014), the engineers are more of visionaries pursuing sometimes bold ideas, while sales forces, for instance, are closer to what is today on the market, thus being not fully able to envision what is going to happen on the market in long term perspective, generally speaking.

In general, the sales team for instance, can contribute a lot to the product amended releases. But when it comes to a new concept it might be quite risky to listen to their expectation very carefully due to a number of requirements from the market, e.g. what the competitors have to offer, what would finally lead to a way longer development process. As the C1 Product Owner (2014) said: *"Sometimes they do not have as long horizon or vision"*. Thus, generally speaking, the engineers were more of visionaries while the sales people tend to stick too much to what was what currently offered on the market. Since it is necessary to stop somewhere with all the ideas, *"it was good perhaps not to talk and ask for feedback too many people before we did that first product"* (Product Owner, C1, 2014).

In order to be prepared to serve a market vertical that was previously unknown to the company, there were two people involved in the process on a quite early stage, i.e. a person from the marketing and sales division, as well as one technical writer (Project Leader, C1, 2014). These employees stayed involved throughout the process. The formerly mentioned one was acting as an important source of insights regarding the market the new product was to be launched on, at least from the very beginning perspective. Thus, knowledge regarding market requirements and the overall possibility of use in the machines the product was supposed to be installed had to be attained in order not to develop something that will be impossible to install within product's intended scope.

Core competencies and capabilities

According to the C1 Project Leader (2014), among other things shown in this chapter, one of the reasons for being able to develop the product that quickly was the small size of the team and the team members' dedication to the task. The C1 Product Owner also mentioned that it is generally good to keep consistency within the team and build up the competence for a particular product. This approach was utilized in the C1 development as there were no big turbulences. Otherwise, if there are problems that the team has difficulties to solve it would be good to bring in new people with a fresh look on the situation.

A common thing in the host company, also encountered in the C1 development is the phenomena of people joining and leaving the team while the product development process is still ongoing. While this can be sometimes considered a positive aspect in terms of bringing new and fresh insights to the team, according to the C1 Project Leader (2014) it is very important to keep the core resources along the entire product development. Otherwise there might be a problem and inconvenience related to the loss of knowledge and necessity of learning new members. In case of C1, the main people were involved all the time, but some of the team members appeared there only for a couple of months, depending on needs.

Moreover, what is of utmost importance was the deep involvement and commitment of the project management group, as well as the capability of taking decisions quickly by, to some extent, one person - certainly depending on the situation. Additionally, clear specification of the project is always desirable. In this case, the list of requirements was clear enough which means the scope of the project was narrowed down resulting in lower level of vagueness for the team members, as well as in collecting right people to the project.

The project management and the team members were aware of the risks involved and tried to avoid them from the very beginning. Thanks to previous experience certain risks were mitigated in advance owing to the right order of dealing with particular activities. Furthermore, the risks were also minimized due to the fact that the engineers involved in the project were very experienced, which is considered as a key factor when it comes to problem solving (Project Leader, C1, 2014). However, obviously, getting right resources might be often tough due to as prosaic reasons as employees being occupied with other responsibilities. Another factor contributing to risk minimization was the usage of well tested technology:

"But I think minimizing some of the risks, e.g. work with known technology as much as you can, I think that probably helped." Product Owner, C1, 2014

According to the C1 Project Member (2014) an approach to solving problems depended on a type of a problem. Namely, technical problems were kept within the team, while the ones related to more overall aspects such as functionality or market perspective were being solved both internally by the team members and with the project leader or product owner.

4.3.3 Function of the NPD-team

According to the C1 Project Leader (C1, 2014), there was a quite interesting way of working in the beginning. Since the concept specifications were rather clear one model was developed according to them, while two additional ones remained more open to discussion and brainstorming so that the potential for right functionality, reducing the size, etc. could be examined. Therefore, these two were acting as experimental objects in order to getting as familiar as possible with this totally new solution. Thus, the team was encouraged and involved actively in idea generation, while the management team was very open to all the suggestions presented by the project members. This attitude, once again, is of great importance, and simultaneously in line with the company's strategy and culture.

According to the C1 Project Leader (2014), generally the way of work throughout the new product development process does not differ so much with respect to stages or gates. Thus, there is not much of a need of special adjusting the team to particular stages in the Stage Gate model. What is, and was during C1 development time, is the function of communication in the model. Informing the team members about the current stage is of great importance as the activities to undertake depend on the project phase.

Communication however is in general a very important aspect in the NPD process. Having a physically short distance as well as the ability to communicate often and freely with team members and other experts helped significantly during the product development according to the C1 Project Member (2014).

In the beginning of the project the team has received a list of requirements which consisted of 5 pages long document. In order to avoid the risk of diminishing creativity due to having too specific product specifications, the entire team was encouraged to review the document and passing the feedback to the product owner. Thanks to this process there was a possibility of coming up with new solutions and changes before the actual work has started. An active role of project management fostered the process. (Project Leader, C1, 2014). Furthermore, all the team members were already familiar with the requirements through discussions what eventually led to a more efficient start of the project.

It is up to the team if they would like to be more agile by using scrum for instance, or to apply more waterfall development approach. Thus, the team may decide to work with more flexible method when it comes to the software, and with the Stage Gate model when being agile is simply not possible, e.g. when developing mechanics or hardware.

External input in the NPD-process

The concept, or at least the direction that indicated where to go, was primarily excogitated by a team of engineers as mentioned before, however during the development process some input from the market was gathered as well, mainly through cooperation and field testing at the business partners' sites, i.e. system integrators and one company involved (Project Leader, C1, 2014). The main sources of the market input could be indicated somewhere in the middle and after it on the Stage Gate model timeline, and the managing team was directly involved in collecting market insight, i.e. the Product Owner

together with the Project Leader were both present when visiting customers and business partners. The team has gathered also quite some input from interested customers who, by seeing how much flexibility the product is delivering, did come up lots of ideas (Product Owner, C1, 2014). An exceptional situation was noticed just at the beginning of the project when the team visited of one the stakeholders, i.e. a system installer, to find out exactly what was being produced on the market at the moment, what are potential expectations, etc.

Something that was new to the C1 Project Leader (2014) was an overall number of visits and interactions with external partners and potential customers not only in the country of company's origin, but also in two countries outside the borders. However, according to the Project Leader (C1, 2014) this behavior could be classified a bit as exceptional, but needed to conduct due to entering a new type of business and lack of insights of this particular market place.

When it comes to showing the product internally, i.e. in this case to the sales team, it has happened late, namely just around 2 months before the product was officially launched (Product Owner, C1, 2014). In such a way the Product Owner tried to avoid lots of frustration among people when they are notified about a certain product, have some expectations, but afterwards they have to wait for it due to delays that happen frequently. The same approach went to public announcement, which occurred just a couple of weeks before product introduction.

Utilizing control that emphasizes innovativeness

Both leadership layers, i.e. the product owner as well as the project leader, were assuring a large amount of freedom to the team members, what is in line with the company's culture and philosophy. The C1 Project Leader (2014), for instance, had rather loose attitude towards his team members assuring them quite some level of independence and flexibility, but he was also protecting new and not relevant requirements to enter the project (Project Member, C1, 2014). However, this attitude did not reject a large amount of support given to the team members, or instructions if needed, and could be characterized by general openness. Nonetheless, the appropriate leadership style depends on a member's personality, age, experience, etc. rather than on the role they have, e.g. software or hardware engineer.

"…If they just work on right things. Then they are allowed to drift away a bit… I am pleased with what they would like to do it is okay, as long as it gets done." Project Leader, C1, 2014

"Freedom and self-autonomy is good if you know where you are heading, if you have a go. Otherwise you will just keep on guessing." Project Member, C1, 2014

Another philosophy presented by the Project Leader during the C1 development was his not bureaucratic approach towards dealing with formal documentation, as well as towards formal and long project meetings. The C1 Project Leader clearly stated that an extremely effective part of way of leading the project is conducting small talks to all of the project members every day, even if the conversation is to be related to ordinary life issues rather than to the project's details and specifics. Spending time on a

"person by person, and face to face" basis is claimed to be way more efficient than spending this time on a more aggregated level, i.e. on the formal and big project meetings.

Decision making process can be characterized as rather decentralized (Product Owner, C1, 2014). The Product Owner and the Project Leader had quite some steering room in this project, where most of the information was flowing through those two professionals (Project Member, C1, 2014). However this generally derives from the company philosophy. He also claimed, according to his previous experience, that this approach differs a lot from what can be seen in other companies, where managers tend to be involved in every decision quite often. Thus, the role of managers in this case was more to lead and control what has been previously mutually decided, rather than to manage in a tight manner.

During the C1 development the Project Leader was in charge of two projects in the same time. The ability to handle this phenomenon depends to large extent on the resources there are under the command. More experienced people are more responsible and do not demand guidance and so much support. Nonetheless, according to the C1 Product Owner (2014), it is good to be involved in the product development process from the very beginning till the very end, without handing over the project from one department to another as it happens in other companies. In such a case the knowledge about product's history and overall commitment and passion for it is likely to be lost.

According to the C1 Project Leader (2014) a considerable amount of benefits were secured thanks the product owner's presence at the team meetings and visibility during the development time. Furthermore, the openness towards new suggestions and ease of communicating with him contributed greatly to the product development efficiency and effectiveness. This was also secured by having a short physical distance between all the employees involved in the process.

4.3.4 Overall outcome of Project C1

The overall outcome of the C1 project was very positive. The ROI indicator, i.e. return on investment, and the breakthrough point was achieved just after a few months, i.e. 2 - 3, after the product launch, while the money spent on the development were more or less in line with what was budgeted (Product Owner, C1, 2014). The new solution was widely accepted on the market covering almost 60% of the market share in its segment nowadays. Moreover, it has revolutionized this particular market vertical providing the customers with a new approach towards video monitoring, also by shifting the technology from analog to digital. Additionally, it became a beginning of a new product line (Project Member, C1, 2014).

"…But this one (the C1) was completely different and got a lot of interest, and opened the doors".
Product Owner, C1, 2014

5. Analysis and discussion

As mentioned previously in this dissertation, the process of developing innovations differs to a quite large extent, especially if they are of the incremental vs. radical nature (Holahan, et al. 2013). Although there is a quite unitary understanding and acceptance on how innovations should be developed given their specific prerequisites, there has not been any in-depth research on how radical innovations can differ, and thus, it needs to be addressed given the characteristics they inhabit (Ahmad, et al. 2012; McDermott & O'Connor, 2002). Given the findings from the two projects being developed at A-technologies, the T1 and the C1, both are to be considered radical, although there are many differences between them.

5.1 Characteristics influencing the T1 and the C1

Beneath are illustrated the two development projects that have been in-depth examined at A-technologies. They are put in relation to the theoretical framework, presented in Chapter 2 in order to illustrate the similarities and dissimilarities occurring between the two radical development projects.

	Variables	T1	C1
Project characteristics	Type of innovation	Non-core radical innovation	Core radical
	Deriving from the core competencies	No	Yes
	Criteria list	Broad and unclear	Narrowed, clear
	Level of uncertainty & complexity	High	Medium
	Technological uncertainty	Very High	Medium
	Technical inexperience	High	Low
	Technology Cost	High	Low
	Business Inexperience	Medium	Low
	Development orientation	Technology and market	Technology and market
	Development Time	~36 months	~15 months
Team formation	Type of team	Lightweight as basis, input from self-managing	Lightweight and self-managing
	Core group	Shifting	Kept

Team function	Diversity within team	Medium diversity with limited cross functional input	Low diversity with some cross functional input
	Team size	Big, > 40 employees	Small, ~ 6 employees
	Influence on core competencies	Competence stretching	Competence enhancing
	Leadership control	Empowering and flexible	Empowering and flexible
	Influence by team members	High	High
	External input	Early but not qualitative	Low/medium, late input
Measuring NPD-success	Product launched on time	No, around six month delay	Yes
	Return on Investment	< 12 months	~ 2 months
	Development cost	30% above budget	Within the budget
	Customer satisfaction & acceptance	High	Very high

Table 5.1 Project characteristics influencing the T1 and C1

* The scale in the table has five ranges, varying from very low to very high

5.2 Project characteristics

There are according to Ahmad et al. (2013) two main characteristics that influence a new product on how it is perceived in terms of the level of innovativeness, namely its uncertainty and complexity. Relating the T1-project to the uncertainty and complexity, the innovation was very difficult to develop given the newness both from the market and company's point of view (Product Owner, T1, 2014). The scholars, McDermott and O'Connor (2002) argue that the radical innovation needs to be examined by focusing on four other factors, where the technological uncertainty is closely linked to whether the new product development leads to any learning for the company. As mentioned by the Product Owner (2014) one of the key factors for why the project was delayed, i.e. approximately six months, was due to the massive amount of learning that had to be implemented for the engineers before solving issues related to the development process.

"But at the same time it was learning period for everybody. None of them was working within the area of the T1 before." Product Owner, T1, 2014

Comparing the T1 to the C1, the development process in the latter one was more aligned with the core competencies within A-technologies, however the amount of learning was lower in the C1-project. Still

there were some major novel solutions being implemented in the project (Project Member, C1, 2014). This difference in learning and competencies inhabited by the project development teams is the reason for classifying the T1 as 'non-core radical' whilst the C1 is classified as a 'core radical' innovation. As mentioned by the Product Owner, there were some parts in the C1 that were more novel, and thus requiring a bit more learning. But as mentioned by the Project Member, most of the issues were solved by having discussions internally, illustrating how the knowledge gap as mentioned by Green et al. (1995) was not as significant as in the T1-project.

"Yes, and I think the 'feature' specifically was something that was new to us, and a little bit more risky perhaps from the technical perspective." Product Owner, C1, 2014.

In close relation to how the company was forced to learn when developing the T1, the technical inexperience, i.e. the gap between the inhabited knowledge and the knowledge needed within the company was very noticeable in the development of the T1. Even though A-technologies is a very big organization with over 800 employees located in Sweden. The development team had to externally recruit a product specialist in order to gain more knowledge in relation to the product (Project Leader, T1, 2014). In this instance there is a big difference compared to the C1, where the knowledge to large extent was available internally within the organization, which according to Green et al. (1995) is one factor that will imply that the innovation was not of the highest radical level.

One factor that did not imply such a big issue was the business inexperience, i.e. how well the T1 would fit into the current business model. Given that the market was urging for a product like the T1, and that the innovation was developed with the collaboration of the partner network, the company could to large extent leverage the width of their current partners (Product Owner, T1, 2014). However, as the innovation was far from the existing product portfolio, there was a need for ensuring the fit prior to the launch (ibid.). According to Green et al. (1995) this illustrates that the innovation is to be considered not extremely radical, the business inexperience of the firm, A-technologies, was however very high. It was rather the partners that had some experience that the firm could leverage, making the innovation radical to a large extent from the perspective of A-technologies (ibid.). The C1 was as mentioned before, originating to large extent from the core capabilities within A-technologies, thus there was a good fit with the current business model. Although the innovation was able to open up new business opportunities, and according to the Product Owner of the C1, the flexibility of the product made it adaptable to markets that were not thought of and strategically scoped prior to the launch.

"...and then this great flexibility that you can get from the C1 also triggered lots of ideas amongst people. So they (the customers) came up with new ideas how they would use it." Product Owner, C1, 2014.

Technology cost, i.e. the cost for developing the innovation is mentioned by Green et al. (1995) as a factor that might guide the level of radicalness of the innovation. From the view of the T1 there was a big undertaking in both money and time, two factors that tend to be interrelated for new product development at A-technologies as there is a lot of man-hours put in to each project (Product Owner, T1, 2014). Even though the C1 had a development time of slightly more than one year, there was also a

proof of concept prior to the start. Thus the total development time was approximately slightly less than two years (Project Leader, C1, 2014). The main difference towards the T1 was apart from it taking about 36 months, the size of the development team. Here the C1 was quite small, around 6-7 employees compared to around 40 engineers working on the T1 for more than three years (Project Leader, T1, 2014; Project Member, C1, 2014).

5.2.1 Orientation of the developed innovations

Whether an innovation is driven by the market or by technology has a large impact on how the product is to be perceived by the actual buyer (Zhou, et al. 2005). In general the culture at A-technologies tends to be more technology driven, as the customer does not really know what they want, until they see it (Senior Expert, A-technologies, 2014). Although the T1 started as a market driven innovation, the technology drive took over quite extensively in the development, causing some delay in time, and thus exceeding the budget. Although Zhou et al. (2005) argue that tech-based innovations need to put big effort in listening to customers if the innovation is to deliver a superior value, the T1 has been able to create this by being technology driven. Nevertheless, although the T1 started as a market oriented innovation, and then became more technology driven, there are some resemblances with what Zhou et al. (2005) argue for in how none of the alignments should be allowed to take too much space. The C1 was also quite iterative in how it shifted from technology driven to a more market oriented approach in the end. As the Senior Expert (2014) who was part of the proof of concept of the C1 mentioned, in how the customers do not know what they want in two years, making the company very limited if they solely focus on their input, which also stands in relation to how Zhou et al. (2005) warns for short-sightedness when relying to heavy on market orientated innovations.

5.2.2 Influence from a clear proof of concept

One factor that the level of radicalness of the T1 led to were that the initial scoping of requirements and criteria for the project lacked some clarity. Mentioned by a project member the initial criteria list was very broad and unclear. Since it was very new innovation, for the complete organization, there were some preparations for the criteria being quite unclear, although it became a bigger issue in terms of loss in efficiency than anticipated (Project Owner, T1, 2014).

"…It took too long time, converting the specifications I made to project tasks." Project Owner, T1, 2014.

In accordance to Cooper (2014) the proof of concept needs to attain such quality and clarity that it will give the entire project team a unified view of the outcome and involve the whole group. During the development of the T1, there was a master thesis that to large extent acted as the proof of concept, being accompanied by a business plan, there were still some issues in terms of clarity. One key factor with the proof of concept is, according to Cooper (2014), to be able to better anticipate the future needs in terms of resources, something that according to the project leader of the T1, still became a quite iterative process.

In this aspect the C1 was to be considered as more successfully managed than the T1, since the proof of concept gave the development team a solid foundation to work on, meaning that they could start working with the actual product immediately (Project Member, C1, 2014). Relating to the above

mentioned aspects regarding previous project characteristics, the T1 are to be considered as more complex and radical than the C1, and thus this had a big impact on the criteria list being unclear.

"In the beginning we receive a document which is like five pages long and the whole team is reviewing the document, and passing feedback to the product owner. So we can always come up with solutions and changes before it is released." Project Leader, C1, 2014.

One main difference between the T1 and the C1 was that the C1 project team, in accordance to what Cooper (2014) argues as critical, was allowed to give input and be more flexible in how the end-product should be developed, in an very early stage in the development project (Project Member, C1, 2014). The T1 development team had more of a crisis meeting after a while, given that the criteria and demands to be developed, where very unclear and created confusion and time-lag for the project (Project Member, T1, 2014). Thus the C1 did manage the process in a more efficient way, mainly due to the proof of concept serving a greater value than in the case of the T1.

5.3 Team formation

The way the teams were formed differed a lot between the T1 and the C1 projects. Although both were considered as radical innovations they did not follow the 'template' that was proposed by Patanakul et al. (2012) in terms of how development teams should look given their innovative scope. The T1 project was developed at the New Business Department at A-technologies. The difference with this department comparing to the more traditional R&D-department that was in charge of the C1 is that they often tend to 'loan' employees and resources from other departments (Project Leader, T1, 2014).

> *"I've actually had a lot to say I would say, because we can choose from basically the team of New Business, but we are often allowed to be borrowing from other teams"* - Project Leader, T1, 2014.

5.3.1 Types of teams

Although the T1 was developed at the New Business department, and was a radical innovation to the company, the team was not formed as Patanakul et al. (2012) picture the autonomous team. The T1 team had a lot of own responsibilities, but was at the same time still forced to follow internal regulations, meaning that they had to be allocated resources rather than just taking what they wanted. Another factor that is in opposite to the autonomous team is the fact that the speed in reacting and making decisions was not very successful. During the development phase, the project stood still for almost more than one month, during which decisions was being discussed with the whole development team (Project Member, T1, 2014). Therefore, it can be clearly noticed that project characteristics such as non-core competencies, overall uncertainty, inexperience, etc. contribute negatively to establishing a proper type of team and making it function efficiently.

The C1 team was assembled with the resources available at the R&D-department, and worked more as a mix between a light-weight and self-managing team. The different groups were focusing on their specific tasks and the cross-functional input was achieved through the project leader. Although Patanakul et al. (2012) argue that the project leader only functions as a liaison with no power, the project leader of the

C1 was given quite some power and autonomy over the process making him able to give the development team freedom in how they would complete their task (Project Member, C1, 2014), which is a consequence of the project requirements and the goal being well diagnosed. Another factor that differed in relation to the T1 is that the product owner was not as involved in the C1-project. According to the Project Leader he was more focused on the overall process, and not in delivering the in-depth details directly to the engineers, rather he used the project leader.

"...but I think it is important that project leader at least is on top of what is happening and being discussed in the project, because he is kind of responsible for making it happen on time, and to the right cost." Product Owner, C1, 2014.

In terms of the team formation differing between the top-management and the development team within the T1, the C1 is to be considered as more consistent, i.e. functioning like the light-weight team as mentioned by Patanakul et al. (2012). The project leader had a clear authority and autonomy from the product owner, who deliberately stayed out of the project when it came to less important and detailed issues. Instead, there was a clear collaboration, where the project leader and project owner had continuous communication and worked together in terms of gathering market input and alike (Project Owner, C1, 2014). One factor that differed in the C1, as mentioned by Patanakul et al. (2012) about the light-weight team, was that the project leader actually was given power as in a heavy-weight team, with some restrictions in terms of resources, etc.

5.3.2 Cross-functional input and diversity in the NPD-Team

Given that A-technologies as a company is very engineer-intense, with a high quota of engineers working at the company, the cross-functional input did mainly consist of different types of engineers. Apart from this, the cross-functional input is to some extent also given with collaboration with marketing or sales within the company. For the development of the T1 the team consisted of 30-40 team members, where the majority was engineers and the rest were key stakeholders, such as steering group etc. (Project Leader, T1, 2014). Thus the T1 development did not work in relation to what Zemlickiene and Maditinos (2012) and Schilling (2011) argue as crucial, with the continuous input from the marketing and sales team in order to avoid the chasm between market expectancy and the actual outcome. This was mainly due to a high technological complexity and uncertainty, as well as the pursuit towards radicality, thus it was mainly engineers involved in the project.

Similarly, the C1 product seems to be also in quite contradiction to what is suggested by Zemlickiene and Maditinos (2012) and Schilling (2012). The C1 Product Owner (2014) highlighted the notion that while having a strong cross functional team might be good for product amendments (as it is happening at the moment with new C1 release), this is probably not the most effective way when working on a new concept, i.e. radical innovation. Thus, it seems that a new innovation project is to be a sort of a playground for engineers without being too widely open towards strict recommendations or demands from the current situation on the market place. In such a case the potential for coming up with a successful solution in, for instance, two years long perspective would be hindered. This is probably a direct derivative from the host company's culture, i.e. ability to experiment and fail.

Although the development team of the T1 was not assembled in a truly cross-functional way, but more as a unified team, the market input were still given in order to deal with some uncertainties within the project. This was although given in a concentrated way from the Product Owner who also was the driving force behind the innovation. Apart from this, the team became more cross-functional in the latter stages, as a product specialist were assigned and recruited to A-technologies, in order to unload and help the product owner (Product Owner, T1, 2014). Schilling (2011) argues for how the team needs to inhabit a width of knowledge, preferably with employees from different departments. Even though the T1-project team was not cross-functional in terms of consisting of employees from several departments, i.e. marketing, sales, etc. they did inhabit a width in knowledge and came from different engineering departments, something that proved to be useful in the development (Project Owner, T1, 2014).

Nevertheless, the company rather follows the Gotteland and Haon (2010) finding that too extensive diversity could hinder the quality of team members' interactions. Employees from non-engineering departments were involved in the work, however to a limited extent. This is also a factor that has an impact on the size of the teams. In case of the C1-product, the team and especially the core unit was deliberately kept small and unified so that the engineers could work out solutions towards the clear goal relatively independently. The T1 team, however, due to its non-core capabilities characteristic needed more learning and resources. Nevertheless, the team was kept largely unified in terms of mainly engineers being involved in the process, so that the risk of "too much" influence from other departments could be limited.

5.3.2.1 Diversity and implication of the core group

In contradiction to the C1-project, the T1 development process included a relatively high diversity within the team, both in terms of knowledge and expertise, but also in terms of experience. One aspect that actually hindered the efficiency of the development was due to the fact that there were many new employees in the development team. One aspect that the T1 lacked in the development team was a mix in terms of personalities with the project members. There were a lot of optimists within the team, but not that many pessimists that were able to question the deliveries wanted by top-management (Project Member, T1, 2014). Gotteland and Haon (2010) argue for how the project team should be picked in order to create a diverse team, this is however not without struggles at A-technologies, since the 'T1-project' had to go with the resources available, no matter the personalities, experience etc. (Project Leader, T1, 2014; Project Owner, T1, 2014).

"I would say everybody brings something new, new ideas, new thoughts. Even if they are experienced or inexperienced. Every person brings something new to the table." Product Owner, T1, 2014.

Having people coming and going during the development phase are in many cases seen upon as a inefficient factor, and even though it prolonged the process for the development of the T1, it also enriched it in terms of giving inputs to the areas encumbered with uncertainty and complexity. Schilling (2011) argues for how the organizational tenure diversity might lead to an increasing impact on the team, helping the development process in terms of getting access to resources needed, and especially getting different views of problems or issues. In the T1 there was a very high level of organizational

tenure diversity, having a number of engineers coming and going, thus being forced to go through the predecessors' work before adding its own input (Product Owner, T1, 2014), what was omitted at the C1 by having a strong and stable core team. Nevertheless, the differences in the project characteristics caused different needs for having diversity in the teams.

5.3.3 Influence on core competencies

During the development of the T1, a lot of learning and iterative work was needed in order to solve problems and issues deriving from project characteristics, relating to how radical the product was for the company, since they did not inhabit all the knowledge needed in order to finish the project. Thus, in close contrariety to what Prahalad and Hamel (1990) argue regarding how new product offerings are growing from the core competencies at the innovating firm. To large extent the competence inhabited by the employees, were what McDermott and O'Connor (2002) argue as competence stretching or in a sense even destroying. For the C1, there was more of a concordant to the existing knowledge inhabited by the engineers, although to some extent there was a need for learning but not in the same extent as for the T1.

"…And no one in the house knew how to do it, A-technologies don't do this kind of solution (The T1 product), until now... So they had to find ways to learn..." Project Member, T1, 2014

Even though the team members had to learn new knowledge and adapt in order to solve the issues and problems related to the 'T1 project', it was not solely competence destroying in terms of the previous knowledge. Since the team to some extent was constructed of employees from other departments, e.g. the electronics engineers, they were going back to their initial department after the closure of the T1. Thus they were experiencing what McDermott and O'Connor (2002) labels as stretching their competence, since they are to work with developments involving their previous knowledge, i.e. related to the core offering of A-technologies. For the C1 team, it was to large extent solely competence enhancing, since the work-task in large was building on prior knowledge and experience, thus not being as demanding as the T1 in terms of stretching.

5.4 Team function related to the NPD process

How the team functions are closely related to a number of characteristics of the innovation. The complexity and uncertainty has an impact on the team members and their work methods. As Byers et al. (2011) stress, continuous communication needs to occur in order to reach a common shared understanding of the end-goal in the NPD-process.

"...communication, from the beginning we had a list of I think 300 demands, that's huge… and we had to slice it incredible, and if we would have done everything it would have taken twice the time."
Project Member, T1, 2014.

5.4.1 Teams' behaviour within the Stage Gate Model

As mentioned earlier, the team lacked some diversity in terms of pessimist, making them less able to point out flaws and problems in the proof of concept, which in the T1 case consisted of a master thesis,

and not a formal proof of concept. As mentioned by Kahn et al. (2012) a formalized and quality driven NPD-process is to be sought after in order to decrease the risk for failure. Even though the master thesis provided A-technologies with a good foundation on the technical side of the innovation, there was an urge for clearer and more distinctive instructions. Byers et al. (2011) argue that there needs to be a unitary understanding of the task to be done, something that the T1-project were lacking, mainly due to the high level of radicalness the product implied, i.e. the complexity and uncertainty characterizing the innovation.

On the opposite side, the C1 was very efficient and effective in terms of starting in a high pace from the beginning. This is clearly related to the fact that the team had a good and solid foundation to stand on, i.e. the proof of concept was clear for the whole team. This aspect differs as mentioned previously to the T1, where the team was not involved at such an early stage in terms of clarifying the future end product. Thus, the teams' function is in accordance with Byers et al. (2011) highly dependent on a clarity and efficiency in the communication, something that the T1 lacked in terms of a proof-of-concept, which was not executed in the best manner. Hence, how the team functions is also highly dependent on the uncertainty and complexity that Ahmad et al. (2012) argue of the innovation, forcing top-management to put more effort in clarifying and uniting the development team.

5.4.2 Utilizing control that emphasizes innovativeness

In both the T1 and the C1 the level of autonomy and freedom from top-management was quite high, although not only benefitting the NPD-process. In the T1, the high level of autonomy in relation to the lack of clarity in what to be done, led to a less efficient process. In the C1, the level of autonomy together with a clear proof-of-concept resulted in a highly efficient NPD-process. Thus, the level of control to be implemented by the project leader, should be dependent on what Green et al. (1995) use to classify a radical innovation. The level of radicalness is dependent on the technological uncertainty as well as the technical inexperience, since this has a great impact on whether the members are able to work successfully in an autonomous environment.

"My type of leadership is more like playing as a coach, if you take sport terms. I am the coach and I am playing at the same time. I am one of the guys in the team. More than sitting on my high horse and pointing with my hand." - Project Owner, T1, 2014.

Although Patanakul et al. (2012) argue that a high level of autonomy is crucial when developing a radical innovation in a successful manner. The T1-project showed how this is highly dependent on having a clear vision on what to develop. Otherwise the high level of autonomy might be harmful. Sarin and O'Connor (2009) are also stressing the importance of having an open environment, where team members are allowed to give input, etc. This factor was present in both projects, although as the technical inexperience was much lower in the C1, the direct input from the team members were able to convert their work into value in a faster way.

Hence, the team function and how they operate is highly dependent on having a clear criteria list, i.e. proof-of-concept. This does however imply that the level of technological uncertainty and complexity is

manageable for top-management. Since this was an issue in the T1, the findings indicated that a lower level of autonomy actually might have been needed, in order to increase the efficiency.

5.4.3 External input in the NPD-process

The external input in the case of the examined products is in form of having insights from the external stakeholders, e.g. customers, business partners, etc., and thus reflected more in the market layer. The notion presented by Schilling (2011, p.245) regarding the "customers being able to identify the maximum performance capabilities (...)" in this case can be interpreted twofold. Before the actual development process started, both projects were equipped with information coming from the market. However, their influence was limited on purpose in order not to get locked in a very rigid box of what customers expect.

The T1-project was in terms of the technical inexperience and uncertainty very novel for A-technologies, although their business network inhabited partners with knowledge about the certain product area. Thus, the value in leveraging this knowledge was to be considered as crucial, a factor that to some extent was neglected. As mentioned by the Project Member for the T1, the delay in time resulted in a very limited amount of input from the knowledgeable partners. The C1-project, which was developed in a more manageable and well-known area, i.e. lower complexity and uncertainty had the ability to gain more input from the external partners. Hence, the key factor for top-management tend to be aligning with having a budget slack, in terms of time in order to gain the valuable input that is needed from the external partners. Communication, as mentioned previously is also a derivation from the high level of complexity that influence the development process, thus this part needs to be dealt with in a delicate manner from the project leader and owner in terms of managing the factors that hampers the NPD-process, i.e. the high level of uncertainty and inexperience.

5.5 Indicators of new product development success

Previously argued for, there are two ways of measuring the success of a newly introduced innovations, namely long-term and short-term scoping. In accordance with Hultink and Robben (1995) the ideal way of measuring the success, is by dividing the factors. Thus the following paragraphs are examining the T1 and the C1 with both long-term and short-term focus.

5.5.1 Long-term success measurements

The success of the T1 stands in clear relation to the success factors that are argued by Griffin and Page (1996), illustrating how the product has had a huge impact on A-technologies in terms of creating new knowledge and allowing the company to expand their competitive advantage by entering completely new markets. With the T1-product, the company has been able to gain lots of new knowledge and competencies within the organization, given that their employees have been forced and thus able to learn new ways of practice. This phenomenon is particularly interesting and of great importance due to the fact that the T1 product had to be developed within the entirely unknown field for the company, i.e. outside of the core capabilities and expertise. According to both Hultink and Robben (1995) and Griffin

and Page (1996), the strategic influence in terms of new offerings to the product portfolio, has been achieved by both the T1 and the C1-projects.

The C1 project contributed to the company's knowledge in a similar way as the T1 and what Griffin and Page (1996) illustrates in terms of creating knowledge, however to considerably smaller extent and in other dimensions, e.g. more within the hardware side than software. The main reason behind it is the fact that the project derived from company's core competencies. Even though it was radical and the firm was able to build a new product line upon this product, it was still developed out of the main expertise, however not without a number of issues pushing the team members to learn.

As mentioned by the Head of the New Business department (2014), the T1 will function not only as a product but will also be kept at the department in order to leverage from the technological competencies by the product. In accordance with what Ahmad et al. (2013) mention as important, the T1 will be able to not only gain a value through the performance of this specific product, but by keeping the T1 within the department there will most likely be more added value by continuous development, with the T1 as the platform.

5.5.2 Short-term success measurements

One factor that is described as key in terms of gaining success in the market is according to Ahmad et al. (2013) the development speed, market share and profitability. Building upon this, the ability to stay within predetermined budgets, both in terms of time and money are mentioned by Landström and Löwegren (2009). The T1 was according to the Product Owner (2014) exceeding the financial budget with more than 30% and the time-frame was postponed with around six months. Although the scholars argue this is to be a sign of failure, there has been a different view from the steering group at A-technologies as they focused more on the quality and reliability of the product rather than the speed to market, i.e. more of the long-term measurements (Product Owner, T1, 2014).

"We had a pretty good steering group that was very determined what we should do, and had right priorities. … Our top priority was reliability and quality. Those were the two top priorities. And the project cost and time to market were less important." Product Owner, T1, 2014.

Even though the long-term success factors are the most significant ones for the T1, the short-term indicators are also impressive. The return on investment for the C1 was obtained after approximately two months, but the T1 will reach this quota within 9-12 months, which is to be considered as quite rapid given the long development time, i.e. high technological cost.

Alluding to Ahmad et al. (2013) and their factors for gaining success in the market, it can be clearly seen that the C1 product fulfilled them well. The development speed according to, the Project Leader, Project Member and the Product Owner (2014) was fast especially when taking into consideration the radical nature of the project. Namely it took around 14-15 months excluding the proof of concept phase that is estimated to consume a couple of months. In relation to what Landström and Löwegren (2009) state

with the importance of staying within the boundaries relating time and money, the C1 were a success, the time-frame were pretty much kept to the day (Project Member, C1, 2014). Thus, the short-term measurements are rather impressive especially the gained market share which is gauged to be around 60% in its field.

6. Conclusions and implications

Relating to our research question stated in the beginning of this dissertation:

"*What is the relation between innovation radicalness and the new product development team's formation and function, in the non-consumer high-technology industry?*"

Through our analysis of the findings originating from the two cases at A-technologies, i.e. the T1 and the C1 the outcome highlighted how they shared some similarities in the characteristics. Mainly by both being quite technology driven and developed by quite unified teams, i.e. not so cross-functional. But one main difference was the ability to use the in-house competencies, where the T1 had a much higher learning included in the development, in order to solve problems and issues. The C1 was more in-line with the current offerings at A-technologies, and thus were to large extent able to leverage the competence that existed within the organization. In relation to the innovations differing between being non-core and more in line with the core competencies, within the company, there was a big difference in how the teams are formed and functioning.

To only take the difference in innovations on a more overall level, i.e. incremental vs. radical into consideration, as proposed by Holahan et al. (2013), when forming teams and their function, is not an enough solution according to our findings. Our findings show how the level of radicalness, i.e. depending on a number of characteristics such as technical inexperience, technological uncertainty and the complexity has direct impact on the NPD-process. The formation of the team when dealing with highly complex and novel innovations, e.g. the T1 need to be aligned with a certain level of diversity and preferable seniority in the NPD-team in order to critical assess the proposed proof-of-concept. When teams are formed in relation to developing less radical innovations, i.e. the C1, the most important factor tend to be a high level of autonomy in relation to clear communication.

In contradiction to what Patanakul et al. (2012) state regarding the autonomous teams being the best fit for more radical innovations, our findings show a different view on the topic. In the T1-project the team was working more on a functional basis with some input from the self-managing work team. However there is a need for clarity in terms of the scope for the innovation if the team is to function efficiently in an autonomous way. For the C1, there was a clearer scope allowing the team to operate in a more efficient and autonomous manner. In conclusion, there is a need for a clear and thorough proof of concept in order to let the team function efficiently during the development stage, without losing time and resources when the team members do not see the direction indicated by the project.

According to our findings, the vision that is to be chased can be clarified by having large input from the market in terms of examining what is "out there", getting a higher level of overall preparation, etc. After this stage, which contributes considerably when developing a proof of concept, the team should be to large extent "cut off" so that the team members can work relatively freely on briefly described radical innovation. Thus, the unified team significantly can work without being influenced too much by endless insights from other departments, features possessed by competitors, customers' demands, etc. This

approach needs to be shifted after launching a tangible version of a product when the function of team change and there is a need for more cross-functional input, so that the product can be amended. This is especially desired when developing product updates, or just incremental innovations.

The level of cross-functionality within the team was argued as key from both Schilling (2011) and Zemlickiene and Maditinos (2012), a factor that was too large extent neglected in both the T1 and the C1-development teams, working more with unified teams. The level of diversity was in a sense higher, although in the T1 it might have been too much turbulence in terms of the core constantly shifting, whilst the diversity of personalities lacked on some level. The C1 was managed in a way that allowed the core too stay the same, making the team better at communicating and solving problems internally.

Relating to the function of the team, the technical inexperience and the uncertainty has a big influence on how the team will execute in the NPD-process. Thus the management, i.e. project leader and owner, should focus on these factors in terms of determining a suitable level of control. Our findings has shown how a high level of uncertainty and complexity, is not best suited with a high level of autonomy, but rather a more direct level of control from the top-management.

Focusing on the conclusion, the process of developing a radical innovation should be heavily based on the context it is surrounded by. As illustrated in our comparison-table in Chapter Five, there are several differences between the two innovative projects, most of them connected to the characteristics of the innovation. Previous research and dissertations, e.g. Patanakul et al. (2012) and McDermott and O'Connor (2002) have been trying to create a formalized and quite rigid template, but in our opinion the field relating to radical innovations is too broad to be approached by one mindset that is pre-determined. Thus, the management team should take the characteristics presented in this research into consideration, prior to launching a development team, in order to hopefully increase the possibility for a successful product development process in terms of the team formation and function.

6.2 Implications for managers

Our analysis shows how managers need to approach the NPD-process with a context based mind-set. Classifying an innovation as incremental or radical and then implementing a pre-decided strategy is not sufficient. When developing radical innovations, top management needs to focus on the characteristics influencing the project. One key factor is to allow certain slack for the more non-core radical innovations, although it needs to be accompanied with a clear scope, i.e. proof of concepts in order to increase the efficiency in the development process. The team formation and function is key in terms of achieving a successful new product development process. In terms of achieving this, our findings suggest that the characteristics of the project and its environment should be the basis for decisions, in order to create a solution that fits properly to the specific project.

The project characteristics should be carefully estimated and the NPD goal ought to be clearly visible and understood by the team members. Under these circumstances the managers will be able to assess

more correctly resources needed and thus form the most appropriate teams. Moreover, while dealing with different sorts of radical innovations, thanks to a clear vision the team members can work in a more autonomous and flexible way, what contributes very positively to the NPD process as the research has shown. However, in order to assure that, the managers need to inhabit rather strong power and decision making ability, but simultaneously they should stay open towards the team members trying to empower them. A considerable level of freedom within clearly drawn boundaries enhances the outcome of core, as well as non-core radical projects.

Furthermore, the teams regardless of their size should contain a core group of people, ideally not changeable. According to the outcomes, it contributes to the smoother work due to an easy access to the main knowledge and history of all the activities that have been done. Outside the core team it is advisable to have more diversity and change depending on the stage of the process, so that fresh ideas, solutions, insights, etc. to the project can be delivered.

6.3 Implications for future research

Given that our data collection has been solely focusing on qualitative data, and also been centralized at our internship company, A-technologies, future research should preferably be of the quantitative measurement. In accordance with Bryman and Bell (2011) the quantitative approach will better explain and generalize 'why things are the way they are', rather than explaining how they act, as our study has been focusing on. (Ibid., p.163).

One aspect that should be kept in mind while considering a research within this area is the number of investigated cases. In this dissertation, even though the two products were chosen carefully and the host company is a truly globally operating organization, more firms and products investigated would lead to an even higher level of generalizability. Additionally, the study shows the way for future examination of high technology companies from the broader perspective, or in general other industries, as the outcomes might be of high importance in other context as well.

Moreover, as the project characteristics turned out to be a crucial determinant of the team formation and its function, it could be advisable to try to find more variables that could have an impact on the working process. This might an area particularly prone to discussion and certain circumstances due to an always open question regarding the list's comprehensiveness and quality of the items included, as pointed out by Kahn et al. (2014).

Reference list

Aarikka-Stenroos, L., & Sandberg, B. (2012). *From new-product development to commercialization through networks,* Journal of business research, vol. 65, pp.198-206.

Ahmad, S., Mallick, D., & Schroeder, R. (2012) "New product development: impact of project characteristics and Development practices on performance", Journal of product innovation management, vol. 30, pp.331-348.

Bryman, Alan., and Bell, Emma. (2011). *Business research methods,* Oxford University press, 3rd edition.

Byers, Thomas., Dorf, Richard., and Nelson, Andrew. (2011). *Technology ventures – from idea to enterprise,* McGraw-Hill Education, 3rd edition.

Chiesa, V., Frattini, F. (2011). Commercializing Technological Innovation: Learning from Failures in High-Tech Markets. *Product Development & Management Association.* 28: 437-454

Cooper, R., & Kleinschmidt, E. (2003) "Benchmarking the Firm's critical success factors in New Product Development", Journal of Product innovation management, vol.12, pp.374-391.

Cooper, R., & Kleinschmidt, E. (2007)"Winning business in product development: the critical success factors", Research technology management, vol.50, pp.52-66.

Cooper, R., & Edgett, S. (2008) "Maximizing productivity in product innovation", industrial research institute, pp.47-58.

Corkindale, D. (2010). *Towards a business model for commercializing innovative new technology,* Innovative marketing, vol.7, pp.37-51.

Datta, Avimanyu., Reed, Richard., & Jessup, Len. (2013). *Commercialization of innovations: an overarching framework and research agenda*, American Journal of Business, vol. 28, pp.147-191.

Gotteland, D., Haon, C. (2010). The Relationship Between Market Orientation and New Product Performance: The Forgotten Role of Development Team Diversity. M@n@gement vol. 13 no. 5. Pp.366-381

Green, S., Gavin, M. and Aiman-Smith, L. (1995) *Assessing a multidimensional measure of radical technological innovation,* IEEE transactions on engineering management, vol. 42, pp. 203-214.

Gresham, G., Hafer, J., & Markowski, E. (2006). *Inter-functional market orientation between marketing departments and technical departments in the management of the new product development process,* Institute of behavioral and applied management, vol.8, pp.43-65.

Griffin, A., & Page, L. (1996). *PDMA success measurement project: recommended measures for product development success and failure.* Journal of product innovation management, vol. 13, pp. 478-496.

Holahan, P., J., Sullivan, Z., Z., Markham, S., K. (2014). *Product Development as Core Competence: How Formal Product Development Practices Differ for Radical, More Innovative, and Incremental Product Innovations*. Journal of Product Innovation Management. 31(2): 329-345.

Hong, J., Song, T-H. and Yoo, S. (2013) "*Path to success: How do market orientation and entrepreneurship orientation produce new product success?*", Journal of product innovation management, vol.30, pp. 44-55.

Hultink, E.J., & Robben, H. (1995) *"Measuring new product success: The Difference that Time Perspective Make",* Journal of Product Innovation Management. Vol. 12, pp.392-405.

Kahn, K. B., Barczak, G., Nicholas, J., Ledwith, A., Perks, H. (2012). *An Examination of New Product Development Best Practice*. Journal of Product Innovation Management. 29(2): 180-192

Kuratko, D., Morris, M., & Covin, J. (2011) "Corporate entrepreneurship and Innovation", South-western cengage learning, 3rd edition.

Landström, H., & Löwegren, M. (2009). *Entreprenörskap och företagsetablering,* Studentlitteratur AB, upplaga 1.3.

McDermott, C.M., & O'Connor, G.C. (2002) *Managing radical innovation: an overview of emergent strategy issues,* Journal of product innovation management, vol. 19, pp.424-438.

Rogers, D., Lambert, D., & Knemeyer, M. (2004) "The product development and commercialization process", The international journal of logistics management, vol. 15, pp. 43-56.

Patanakul, P., Chen, J., & Lynn, G. (2012) "*Autonomous teams and New Product Development*", Journal of Product Innovation, Vol.29, pp.734-750

Sarin, S., & McDermott, C. (2004) "The effect of team leader characteristics on learning, knowledge application, and performance of cross-functional new product development teams", Decision science, vol.34, pp.707-739.

Sarin, S., & O'Connor, G. (2009) "*First among equals: the effect of team leader characteristics on the internal dynamics of cross-functional product development teams*", Journal of product innovation management, vol. 26, pp. 188-205.

Schilling, M., & Hill, C. (1998). *Managing the new product development process: Strategic imperatives,* Academy of Management Executive, vol. 12, pp.67-81.

Schilling, M. (2011). *Strategic management of technological innovation,* McGraw-Hill Education, 3rd edition.

Slater, S., & Mohr, J. (2006). *Successful development and commercialization of technological innovation: insights based on strategy type,* The journal of product innovation management, vol.23, pp.26-33.

Snow, C., Fjelstad, Ö., Lettl, C.. & Miles, R. (2010) *Organizing continuous product development and commercialization: The collaborative community of firms' model,* Journal of productive innovation management, vol. 28, pp.3-16.

Talke, K., Hultink, E. J. (2010). Managing Diffusion Barriers When Launching New Products. *Product Development & Management Association*. 27:537-553

Uhl-Bien, M., & Graen, G. (1998) *Individual self-management: Analysis of professionals' self-managing activities in functional and cross-functional work team.* Academy of management Journal, Vol. 41, pp.340-350

Wheelwright, S., & Clark, K. (1992) *Creating project plans to focus on product development,* Harvard Business Review, Vol. 70, pp. 70-82

Zemlickiene, V., Maditinos, D. I. (2012). Marketing Strategy Formulation for Innovative Product Development Process. 13(4): 365-374

Zhou, K. Z., Yim, C. K., Tse, D. K. (2005). The Effects of Strategic Orientations on Technology and Market-Based Breakthrough Innovations

Appendix

Interview guides

Introduction to the project and the actual product

- What was the company's orientation when starting the project?
  - From where did the idea originate? (Source of origin)
  - Why the market or tech-orientation approach?
  - What if the other orientation was applied?
- Could you classify the project, in terms of what innovation it was? What is your definition on that (from the company's standpoint)
- Could you elaborate more on the overall development process for the project?
  - Any specific barriers or pitfalls vs. very efficient ways of working?

Project characteristics

- How would you describe the project out of the: following factors?
  - Technological uncertainty
  - Technical inexperience
  - Business inexperience
  - Technology cost
- How did you manage to handle and cope with these factors?
- How long time did the project take to develop?
- Could you elaborate upon the project, focusing on the complexity and uncertainty for A-technologies?

Team formation and way of working in the New Product Development process

- How would you explain the competencies needed for the project?
  - Did they existing internally? – How did they influence the existing knowledge?
- How was the team formed in relation to the project and its type of innovation?
- Are there any formal procedures to follow when it comes to team formation?

    - How was the NPD-team handling input from above?
    - Were you able to stay agile and flexible in your work?
- How did you reason about external input?
- How do you look upon using the stage-gate model in the NPD-process?
- How did it function in your specific project?
- Overall pro's vs. con's with this project model?

The characteristics of the project owner involvement

- Did you manage the level of risk?
    - How did you manage to handle this aspect?
        - Leveraging from known capabilities; outsourcing; ignore it (exclude the NPD-team from threats/issues)
- Did you use informal networks in order to speed up the process?
    - Informal pools/slack of budgetary means, resources etc.