Aalto University
School of Business

Identifying success factors that support breakthrough innovation development

Constructing a breakthrough innovation appraisal framework for a case company in Finnish forestry industry

Master's Thesis
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Työn nimi Läpimurtoinnovaatioiden menestyksekkään kehittämisen taustatekijät – Läpimurtoinnovaatioiden arvioinnin viitekehys suomalaiselle metsäalan yritykselle

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Tutkimuksen Tarkoitus ja Tavoitteet

Tämän tutkimuksen tarkoitus ja tavoite on tunnistaa menestystekijät, jotka vaikuttavat läpimurtoinnovaatioiden menestykseen ja kehittää case yhtiölle havaintojen perusteella läpimurtoinnovaatioiden arvioinnin viitekehys. Tutkimuksella on sekä käytännöllistä arvoa case yritykselle että akateemista arvoa tutkimuksen vastatessa Davila ym. (2005) kutsuun jatkotutkimuksesta, miten strukturoida prosessi, joka tukee menestyksellistä radikaalia innovointia.

Aineisto ja Metodologia

Tässä tutkielmassa sovelletaan konstruktiivista tutkimusotetta. Konstruktiiviset tutkimukset tuottatavat arvoa kehittämällä tosielämän ongelmien ratkaisuun malleja, suunnitelmia, viitekehyksiä jne, sekä osallistumalla akateemiseen keskusteluun näiden pohjalta. Tämä tutkimus kehittää läpimurtoinnovaatioiden arviontiin viitekehyksen.

Tutkimuksen pääasiallisena aineistona ovat haastattelut, jotka tehtiin case yrityksessä keväällä 2019. Tämän lisäksi yrityksen eri divisioonien innovaatiotoiminnot antoivat tutkimuksen tekijän käyttöön innovaatioprosessiensa prosessikuvaukset, sekä projektien raportointipohjat. Tutkimuksessa kehitetty malli perustuu edellä mainitun aineiston lisäksi aihetta käsittelevään akateemiseen kirjallisuuteen.

Löydökset ja Akateeminen Kontribuutio

Tutkimuksen merkittävin akateeminen kontribuutio on, että se vastaa Davila et al. (2005) kutsuun jatkotutkimuksesta kehittämällä heidän kaipaamansa konkreettinen viitekehys.

Suurimmat erot läpimurtoinnovaatioiden ja vähemmän riskiä sisältävien innovaatioiden välillä ovat tyypillisesti projektin alkuvaiheessa. Tämän jälkeiset vaiheet muistuttavat enemmän toisiaan, koska kertyneen tiedon vuoksi läpimurtoinnovaatioiden riskiprofiili madaltuu. Läpimurrot eroavat alkuvaiheessa käytettävissä olevan taloudellisen tiedon ja muiden ”kovien lukujen” osalta, näihin tukeutuminen on osoittautunut kannattamattomaksi toisin kuin matalampiriskisten projektien kohdalla. Oppimisorientoitunut ja iteratiivisempi ote on osoittautunut paremmaksi lähestymistavaksi. Ehdotettu konstruktio ottaa nämä asiat huomioon.

Tutkimuksen havainnot viittaavat siihen, että innovaation suhteen tuottoisimpien yritysten prosessit saattavat erota vähemmän tuottoisien yrityksien prosesseista nimenomaan läpimurtoinnovaatioiden osalta. Tämän havainnon totuusperän varmentaminen on jatkotutkimusmahdollisuus. Tämän lisäksi tutkimus nostaa esiin useampia muita jatkotutkimusmahdollisuuksia. Tutkielma pohtii myös muita aiheita case yrityksen innovaatiokontekstissa tutkielman konstruktiivisessa osiossa.

Avainsanat konstruktiivinen tutkimus, läpimurtoinnovaatiot, innovaatioprosessi, ohjauskehikko läpimurtoinnovaatioille

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Purpose and Objective of the Thesis

The purpose and objective of this thesis is to identify success factors that affect the success of the development of breakthrough innovations, and to construct a breakthrough innovation appraisal framework for a case company based on the findings. It holds both practical value to the case company, and academic value through answering to Davila et al. (2005) call for further research on how to structure the control process to support radical innovations to prosper.

Data and Methodology

This thesis follows constructive research approach (CRA). CRA studies contribute to research by solving real life problems by constructing models, plans, frameworks etc. to tackle those problems. In this thesis, the construct is the breakthrough innovation appraisal framework.

The primary source of data in the thesis are interviews that were conducted at the case company in the Spring of 2019. In addition to this, process description documents and reporting templates provided by the different divisions' innovation functions were examined. The eventual construct is based on these, and to relevant academic literature.

Findings and Academic Contribution

The main academic contribution of this thesis is that it answers to Davila et al. (2005) call on further research by constructing and proposing a framework for it.

Main differences between breakthrough innovation projects and other, less risky, innovation projects typically lie in the fuzzy front-end of the development. The later parts of the process are more similar, as when more information about the breakthrough project is gathered, the risk level of the breakthrough project decreases through acquired information. Breakthroughs differs in the fuzzy front-end as relying on financial figures and other hard figures does not work well. More iterative and learning oriented approach is needed. The proposed framework reflects these factors.

The findings of this thesis indicate that the most productive innovator companies might have processes that are built more for successful breakthrough innovation development rather than generally for great innovation development. If this is indeed the case is left for further research.

This thesis offers also other possibilities for further research. Several other topics related to the case company's innovation are discussed in the constructive section of this thesis.

Keywords constructive research approach, breakthrough innovations, innovation process, framework to assess breakthrough innovations

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List of abbreviations

BSC	Balanced Scorecard
CRA	Constructive Research Approach
IRA	Insider Action Research
IRR	Internal Rate of Return
KPI	Key Performance Indicator
MCS	Management Control Systems
NPD	New Product Development
NPV	Net Present Value
R&D	Research and Development
VoC	Voice of the Customer

1 INTRODUCTION

1.1 Background, motivation and main findings

This constructive thesis builds a framework to assess breakthrough innovations for a case company in the Finnish forestry industry. The framework is based on the learnings from the best practices identified in academia, and based on interviews at the case company this thesis was conducted for. The main contribution of this thesis is the constructed framework. In addition to this, several other areas of improvement for the case company are discussed in less detail.

The case company is a large forestry company based in Finland. The company has had to transform itself in recent years due to the shrinking demand of paper, and increasing demand of wood based products in other segments. The company still has a strong desire to increase the sales of new products, and especially breakthrough products, that the company characterized as completely new products going to new customer segments. The processes used at different divisions of the case company are mostly built to support the progress of non-breakthrough innovation projects. Therefore, there is a need at the case company to develop processes that cater for breakthrough innovation development. This thesis is written to support this initiative.

Johnson (2001) discusses the importance of innovation for large organizations. He states that as business cycles decrease in length it is more crucial for large organizations to put innovation back on the agenda. However, many people "living and breathing large organizations" seem to have lost faith in the innovation ability of the company as the company reaches certain size.

Innovation is not a monolithic phenomenon, but various processes that require different types of control systems. However, we know very little about how the management control systems vary for different types of innovation, how they are designed, how they are used and how they interact with informal control systems. (Davila et al. 2009) This thesis tries to partly answer to two of these four questions, how the control systems vary and how are they used.

Nagji and Tuff (2012) characterized three types of innovation:

- Transformational: Developing breakthroughs and inventing things for markets that do not yet exist
- Adjacent: Expanding from existing business into "new to the company" business
- Core: Optimizing existing products for existing customers

Nagji and Tuff (2012) examined the relative importance of transformational, adjacent and core innovations. They discovered that 70% of returns in high-performing companies come from transformational, 20% from adjacent and 10% from core innovations, meanwhile the resource allocation was 70% core, 20% adjacent and 10% transformational. This raises an important question, why do the companies allocate resources to projects that contribute so little to the returns? Developing transformational/breakthrough innovations is a great way for a large company to truly grow, as the growth of the company is not limited to the growth of their customers or growth of the customer segment, but the company can expand to new areas of business totally new to the company. Therefore, it is important to ask the question, how do companies assess transformational/breakthrough innovation projects, and to develop tools to assess that might suit that type of innovation better than the tools currently used.

After conducting the interviews, it became quite apparent that the problems that the company had with assessing breakthrough innovation efforts were in line with Cooper and Edgett's (2008) seven principles to improve new product development performance, a study that the author of this thesis did not know of when conducting the interviews. Their study examined 105 companies' new product development (NPD) performance, dividing the companies to three different groups, high performing (top 25%), average (average of all companies) and poor performing (bottom 25%). The study identified 7 principle that separated the best performers from the rest, and which other companies could potentially use to boost up their NPD performance:

1. Customer focused with voice of customer work
2. Heavy front-end loaded homework before development begins
3. Spiral development – information loops with users through-out the development process
4. Holistic approach driven by effective cross-functional teams
5. Metrics, accountable teams & continuous improvement through post launch reviews and continuous learning.
6. Focus and effective product portfolio management
7. Next generation Stage-Gates, which are lean, scalable, adaptable, automated and support open innovation.

The identified problems in the thesis interviews were closely alike with the principles introduced by Cooper and Edgett (2008). Therefore, the literature review (section 2) and the findings (section 4) are structured according to the seven principles.

The eventual construct had multiple suggestions for the case company, with the main findings being that they should adopt a separate track to cater for breakthrough innovations in their stage-gate model and that it would make sense for them to unify the processes between different divisions. Other identified suggestions are discussed in the construction section.

The breakthrough track would be much more iterative and much more front-end loaded, with the first two stages, concept shaping and concept validation, being treated almost as one stage rather than two different stages. Activities of the two stages could be conducted simultaneously, and the gate 1 between the stages would be to unlock more resources for the project. This thesis provides two options on which the case company could focus on in the gate 1 decision. The later parts of the stage-gate model would follow typical linear, less iterative, adjacent stage-gate process. The breakthrough process should focus in the early stages more on the learning aspects, how to get the project to benefit from the process rather than just controlling the process outcome. In the eventual go / no-go decisions at the gates non-financial factors should play more important role in the early parts of the process.

Process unification would make sense for the case company for multiple reasons. It would enable the divisions to speak common language and share the best practices. Secondly it would enable the process development much more efficiently, when the company would be able to develop common processes rather than multiple parallel processes. It would eventually also make the sharing of resources, meaning people working with the development projects, possible between divisions. This would further benefit the sharing of best process practices and practical development knowledge, and it would also open a door for cross-divisional innovation project prioritization if the company has an urgent need to do so.

The change process to having common process guidelines would not be an easy sell. In fact, there has been an attempt of innovation process unification a couple of years back at the case company. This process unification resulted in one-size-fits-all stage-gate model that had a lifetime of few weeks, after which the divisions started modifying this model to better suit their needs. Nowadays, the main reason behind the differences between the stage-gate processes at the divisions seems to be their mix of product innovations. The divisions with mostly adjacent innovations have a stage-gate model designed to cater for adjacent innovations, and divisions with mostly breakthrough innovations have a model catering their unique needs. The main problem with this one-size-fits-all solution may have been the fact that it indeed was one-size-fits-all solution, which did not take into consideration the unique nature of breakthrough innovations. Therefore, adopting the first solution, meaning side-track for breakthrough innovations, could be the key for the adoption of the second solution, process unification.

1.2 Methods, structure and academic contribution

This Thesis is a constructive case study in a single company context. It will use constructive research approach (CRA), which means it is problem solving through the construction of models, diagrams, plans etc. (Kasanen et al. 1993), or in this case problem solving through the construction of breakthrough innovation appraisal framework.

The main data collection methods were interviews conducted with key players from the innovation departments of different divisions and from group-wide "Innovation and R&D" function. The heads of innovation, or persons closely connected with the innovation process development of their division, were interviewed from five divisions (see Table 4 for the full list of interviewees). Moreover, the construction was done in collaboration with people from the Innovation and R&D function throughout the process, verifying findings and cross checking if they have found similar problems with the problems identified in the interviews.

The next section of the thesis is literature review. First topics of the literature review are related to innovation, and the use of stage-gate model commonly used to manage the innovation processes. Second section of the literature review focuses on management control systems in innovation management context. The third section of the literature review is structured following the seven principles identified by Cooper and Edgett (2008), and it explores the best innovation practices identified in academia. The last part of the literature review ties everything together, and ponders the identified best practices through breakthrough lens.

The third section of the thesis discusses the research methods and the limitations of the thesis. Fourth section introduces the case company and presents the key finding. Fifth section discusses the findings of the fourth section in relation to the existing literature. Sixth section is the constructive section, which is structured to "tier 1" and "tier 2" issues. Tier 1 issues are the framework to assess breakthrough innovations, and process unification at the case company. Tier 2 issues are software tools for communication and communication overall at the case company, varying governance models for innovations and setting up clear go / no-go criteria, identifying home for breakthrough innovations, and last tier 2 topic discusses the early parts of adjacent innovations. The division to tier 1 and tier 2 does not imply the importance of the topics, the tier 1 issues are simply discussed in more detail. The seventh section concludes the thesis, presenting key findings and offering possibilities for further research.

This thesis does not have clearly defined research questions, it is more exploratory in nature. Even as this is the case, it takes inspiration from e.g. Davila et al. (2009) call for further

research: how do companies manage the resource allocation process around innovation, how do they combine objective and subjective measures of performance in innovation context, why do companies use stage-gate systems for their incremental innovation efforts? How do they manage radical innovation where plans are not going to be met?

This thesis answers to Davila's (2005) call to find out how to structure the control process to encourage new radical innovations emerge and prosper. This is done by constructing a framework to assess breakthrough innovations. The unique part of the framework, and the contribution of this thesis, is not in the detail of the constructed framework, the details themselves have been already identified in the academic literature, but in gathering the details into a single framework.

2 LITERATURE REVIEW

2.1 Innovation and innovation process

2.1.1 Innovation, R&D, and NPD

Innovation is a buzz word of the 21st century business world. In the academic literature, it is often paired with entrepreneurship (Johnson 2001) and research and development (R&D) (Enkel et al. 2009)**,** and it has number of meanings attached to it (Johnson 2001). Therefore, it is crucial to clarify the meaning of this term, and discuss its difference to R&D and new product development (NPD). The Organisation for Economic Co-operation and Development (OECD) defines innovation as:

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

OECD defines R&D as:

"Any creative systematic activity undertaken in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this knowledge to devise new applications."

The key difference in these definitions is that innovation is the implementation of knowledge to create products, services, or processes and R&D is the creation to increase the stock of knowledge. However, they are closely connected and innovation is dependent on R&D. Another key term in this context is NPD, which refers to development of new products. It is easy to see that these terms are intertwined. NPD can be seen as a subtopic of innovation, meaning innovation activities include NPD.

Moreover, the word innovation can be divided to subsets, these subsets of innovations have diverse set of meanings attached to them. Maschitelli (2000) says that scholars have described these subset with terms like evolutionary versus revolutionary, incremental versus radical, continuous versus discontinuous, and sustaining versus disruptive. For example, Nagji and Tuff (2012) characterized three types of innovation:

- Transformational: Developing breakthroughs and inventing things for markets that do not yet exist
- Adjacent: Expanding from existing business into "new to the company" business
- Core: Optimizing existing products for existing customers

The richness and diverseness of these descriptions of subsets remains a challenge.

2.1.2 Characteristics of transformational Innovation

Nagji and Tuff (2012) define transformational innovation as developing breakthroughs and inventing things for markets that do not yet exist. Denning (2005) describes that transformational innovation entails a transition from a known and secure mode of operating to one that is unknown and potentially chaotic. Championing transformational innovation is like going to ("guerilla") war against all elements inside the organization that benefit from the status quo. Therefore, transformational innovation is naturally linked to change management, if the company succeeds in developing transformational innovations, during the process they also change their operating model to serve the new business segment. He further suggests that transformational innovations are by their nature also disruptive, as they introduce products and services that change the business landscape with dramatically different value propositions than their predecessors.

Transformational innovation might get confused with other terms that describe similar kind of innovation, like disruptive innovation or breakthrough innovation. Christensen et al. (2015) speak about disruptive innovation and note that all breakthrough innovations are not disruptive innovations due to two factors, disruptive innovations originate from low-end or new-market footholds, and disruptive innovations do not catch up with mainstream customers before quality catches standards. These two factors have more to do with how the innovations affect, or disrupt, the current market, how they are originated and how they expand to different market segments, not based on the financial success of the innovation as one might first consider, and as they suggest is associated with breakthrough innovation. Disruptive innovations differ from transformational innovations as disruptive innovations do not have to be for new markets, they may be a new approach to the old market.

According to Denning (2005) different kind of leadership is needed to enable transformational innovation, as traditional command and control models are more adequate to maintain the status quo than to contributing change. He continues that the process of introducing transformational innovation is inherently unstructured, there is no orderly sequences or phases even when the

management tries to establish such sequences and phases. However, there are pivot points that transform the dynamics of the communication about the transformational innovation, when the top management blesses the idea and when the benefits start to flow in. In essence, this divides the transformational innovation process to three parts:

1. Before top management blesses the idea → innovator(s) need to persuade the top management
2. After top management has blessed the idea → innovator(s) need to protect the idea against all the forces that benefit from the status quo
3. Once benefits start to flow → the innovator / innovation is now the establishment and the opposition is "the guerillas"

Narrative tools such as stories are in the center of the persuasion and they are complemented with traditional analytic approaches. It is crucial for the top management to understand this dynamic between transformational innovation and challenging the status quo, when thinking about disruptive growth strategies. (Denning, 2005)

Herstatt et al. (2008) studied 497 Japanese NPD projects and compared radical versus incremental innovation projects. In their study, the radical innovations were characterized as new to the world products, which is closely alike with Nagji's and Tuff's (2012) definition of transformational innovations. Incremental innovations included product modifications, cost reductions and repositioning in the market. The radical and incremental innovations differed significantly in two aspects in their study. The respondents learned significantly more in the radical innovation projects, and radical innovations also built a significantly higher competitive advantage compared to incremental innovation projects. The authors proposed that the biggest difference between the radical and incremental NPD projects is related to uncertainty, especially to the market and the customer uncertainty, as both these are totally new to the company.

In the next sections of the literature review several studies using different terms for types of innovations that are that are closely alike with transformational innovations are cited. These terms are gathered in the table 1 below, and they are again explained as they appear in the later parts of the literature review for clarification.

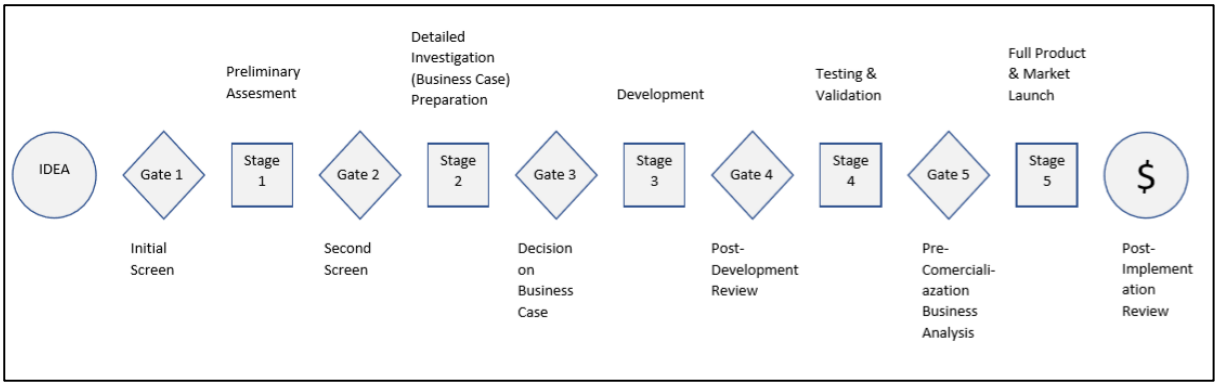
Table 1: Terms cited in this thesis that are closely alike with transformational innovation

Term for the innovation and source	Meaning of the term
Transformational innovation (Nagji and Tuff 2012)	Developing breakthroughs and inventing things for markets that do not yet exist
Discontinuous innovation (Veryzer 1998)	Radically new products that take leaps in terms of customer familiarity and use
Radical innovation (Herstatt et al. 2008)	New to the world products
Disrtuptive innovation (Christensen et al. 2015)	innovations that originate from low-end or new-market footholds

2.1.3 Stage-Gate approach to Innovation

Cooper (1990) provides a stage-gate framework for NPD that has distinct stages and review points (called gates) between them. Figure 1 below illustrates an example of this framework. Stage-gate is both operational and conceptual model that helps to move a new product from an idea to market launch. (Cooper 1990)

Figure 1: Stage-Gate Model (Cooper 1990)



The stage-gate model divides the innovation process to distinct stages, and each stage has a group of prescribed activities, for example field tests or pilots. Usually, each stage is more expensive than the stage before. On the other hand, as more information is gained throughout the process, the risk is managed. The gates between the stages are where the process is controlled. Each gate has a set of deliverables or inputs, and a set of criteria for these deliverables. The output are the decisions at the gate, e.g. go / no-go / put on hold decisions for the project, and the action plan for the next stage. Usually a group of senior managers, with authority to allocate resources, act as a group of gatekeepers at each gate. (Cooper 1990)

Many companies have turned to different variants of stage-gate models (Phillips et al. 1999). According to Cooper (1990), companies are increasingly turning to stage-gate systems to reduce the cycle time and increase the "hit rate" of new products. However, they have also been said to be too time-consuming, time wasting and bureaucratic (Cooper 1993).

Even as the origin of the stage-gate model is from the 1990s, it is still widely used, although in some cases with slight modifications. For example, Hertenstein (2000) surveyed 75 industrial design managers working in NPD, from this sample everyone reported that their organization is using a stage-gate model. Ettlie and Elsenbach (2007) found in their study that 48.6% of automotive engineering NPD managers use traditional stage-gate model and about a third use modified version of it.

A more recent study from Cooper and Edgett (2012) that studied NPD processes of 211 US large business units, with median sales of 1B$, indicated that almost all, 90%, of the best performing (top 25%) companies had a formal and clearly defined stage-gate system in place, meanwhile from the worst performers (bottom 25%) only 44.4% had such system in place. Another major differentiator in their study was if the processes were really used or if the processes were just simply mapped out and in place. Of the best performing companies 60% indicated that they really use the formal process, and from the worst performers only 18.5% indicated so.

2.2 Managemet control systems in innovation management context

Guo et al. (2018) confirmed prior studies' (Bedford, 2015; Bisbe & Malagueño, 2009, 2015; Bisbe & Otley, 2004; Cardinal, 2001; Davila et al., 2009; Stouthuysen et al., 2017; Ylinen & Gullkvist, 2014) reports that there is a positive association between management control systems (MCS) and product innovation in general. Their study examined three types of controls, input controls, behavior controls, and output controls in four different situations, process innovations in high- and low-technology sectors and product innovations in high- and low-technology sectors. Input controls assist with the management of resources related to innovation (e.g. employee training and hiring new employees), behavior controls are mechanisms that regulate activities that convert inputs into outputs (e.g. formalized rules and routines), and output controls define targets that results are evaluated against (e.g. indicators of innovation results, market research activities). The results of the study are gathered to the table 2 below.

Table 2: Association between different MCS and product innovation. Guo et al. (2018)

	High-Tech Product innovation	**Low Tech**
Input Control	Positive association with only process innovation	Positive association with only process innovation
Behavior Control	Equally relevant for process and product innovation	Stronger positive association with process than product innovation
Output Control	Equally relevant for process and product innovation	Equally relevant for process and product innovation

Most interesting results from the point of view of this thesis are the roles of output controls, as project measures belong to this group, and the role of behavior controls, as stage-gate model fits to this group of controls. They both are relevant for both product and process innovations in both technology sectors.

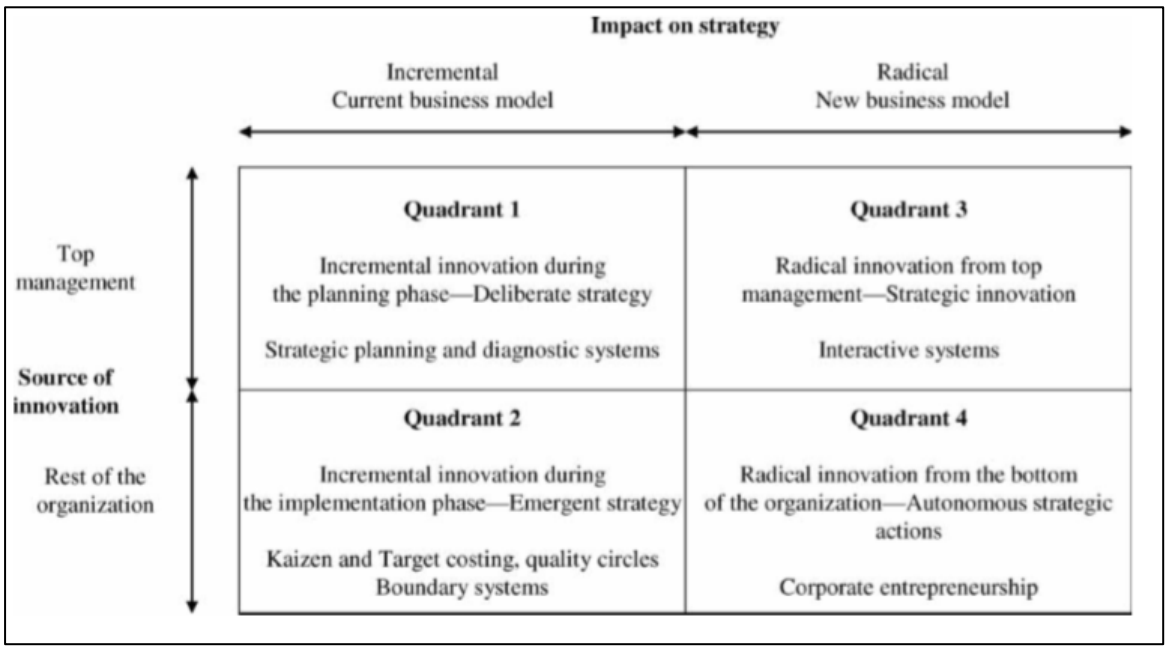
Davila et al. (2009) say that traditional control tools encourage command and control approach, and that they are designed to eliminate innovation, which is inefficient process because the high likelihood of failure. They cite Amabile (1998) saying control has been seen as a hindrance to innovation, which relies on motivation, freedom, experimentation and flexibility, and that the role of management control systems in innovation settings should be minimal. They further say and cite that formal management control systems have been dissociated from innovation in favour of culture (Tushman and O'Reilly, 1997), team composition (Dougherty, 1992), communication dynamics (Allen, 1970) or leadership (Clark and Fujimoto, 1991). However, Davila et al. (2009) emphasize that control mechanisms heavily influence the environment where the work happens, and thus their role in innovation should not be neglected.

Davila et al. (2006) describe innovation as a process with stages. They highlight the need to actively manage the stages and rely on control systems to do so. Davila et al (2009) state that if managers treat innovation as "black box", where the only formal control mechanism is the fund / not-fund decision, managers can only hope that the clan control will lead to relevant beneficial project proposals. They propose that innovation requires formal tools that are flexible enough to take advantage of unexpected opportunities but strong enough to keep the right direction.

Davila (2005) proposes that different kinds of innovations emerging from different levels of the organization benefit from different types of control systems and strategies. He divides the type of innovation to incremental (ideas that fit the current business paradigm of the company) and

radical (ideas that create a completely new business paradigm for the company) and the source of innovation to top management and the rest of the organization (see figure 2). Research that support quadrant 4, radical innovation emerging from the rest of the organization, is minimal. How to structure the control process to encourage new radical innovations emerge is an open question that this thesis tries to answer to.

Figure 2: Control systems and strategies supporting radical and incremental innovations to emerge from different levels of the organization (Davila, 2005)



2.3 Seven principles of successful innovation

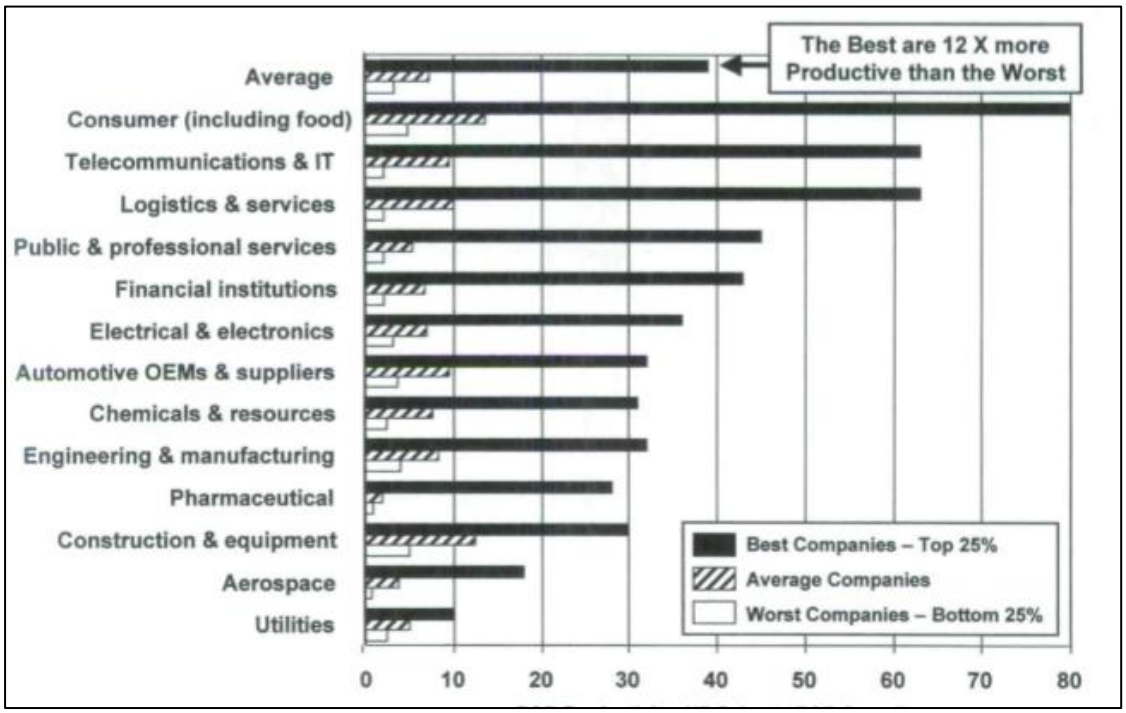
Nagji and Tuff (2012) examined the relative importance of transformational, adjacent and core innovations. They discovered that 70% of returns in high-performing companies come from transformational, 20% from adjacent and 10% from core innovations, meanwhile the resource allocation was 70% core, 20% adjacent and 10% transformational. This raises an important question, why do the companies allocate resources to projects that contribute so little to the returns?

Cooper and Edgett (2008) measured NPD productivity, measured by five-year sales from new products as a percentage of company's total sales compared to R&D spending, also as a percentage of company sales, and noticed huge differences between the best (top 25%) and the worst (bottom 25%) performers within industries. The average difference between industries

best and worst performers was almost 12 times, meaning the best performers got almost 12 times sales compared to R&D spending as the worst businesses did. Figure 3 has a comparison of different industries best, average, and worst performers. They further listed seven principles, based on best practices identified from this sample of 105 firms, that companies can use to better manage their NPD process. Those seven steps, and related academic studies are gone through in the next sub-sections.

$$NPD\ Productivity = \frac{(Sales\ (or\ Profits)\ from\ NPD\ last\ 5\ years/\ Sales)}{(\text{R\&D Spending / Sales})}$$

Figure 3: NPD productivity of best, average and worst companies from different industries (Cooper and Edgett, 2008)



2.3.1 Customer focused with voice of customer work

According to Cooper and Edgett (2008), the customer should be an integral part of the whole process, from idea scoping to development all the way to validation and beyond. Listening to the voice of the customer (VoC) should not be mixed with small incremental product improvements requested by the sales force, this goes beyond that, and aims to boost up development of breakthrough products. Some of the methods to capture VoC that were identified among best performing companies were:

- Customer visits with in-depth interviews. The whole project team should take part in these.

- "Camping out", a method where non-intrusive observation of the customers at their homes, factories or offices is conducted
- "Lead user analysis", working together with your customers to identify new solutions
- Focus group problem detection sessions
- Brainstorming events with customers, the customers are invited to "innovation day" where the attendees are working with company people in teams. The purpose of this is to "rip apart" the current products
- Crowdsourcing using online based approaches, open your doors to customer wishes.

Brettel and Cleven (2011) studied how partnering with externals affects the NPD performance of a company. They studied five different types of partners, customers, suppliers, universities, competitors and independent experts. Their study revealed that companies with heterogenous network of partners performed better in terms of sales turnover from new or improved products. Customers, suppliers and universities had positive effect on NPD performance, meanwhile partnering with competitors and independent experts did not have significant impact on NPD performance.

Customer involvement had the strongest effect on NPD performance. Customer involvement helps companies to align their products to customer needs. However, found customer needs may represent the needs of just one specific customer while ignoring other potential customers or current customers (Bonner and Walker, 2004). Also, the customers may be unable to communicate their needs effectively even if they know precisely what they want (Thomke and Von Hippel, 2002).

Suppliers were the second most important group contributing to NPD performance. Collaboration with suppliers helps companies to ensure that their products are producible, and to update their products to new technology (Primo and Amundson, 2002). Wasti and Liker (1997) suggest that long-term mutual relationship and geographic proximity favour supplier involvement. Doz (1996) reminds about protecting sensitive knowledge and avoiding serious dependency when collaborating with suppliers.

Collaboration with universities also had a positive effect to NPD performance. According to Cohen et al. (2004) universities have two important roles, suggesting new ideas and helping with completing foundering projects. However, more effort in communication is needed due to the bureaucratic structures, so they are more suited for strategic long-term R&D partnerships.

Enkel and Gassmann (2008) studied open innovation and the use of outside knowledge sources that firms use. Customers topped the list with 78% of firms out of 144 using customers as a

knowledge source. Other major sources in their study were suppliers 61%, competitors 49%, research institutes 21%, and other sources 65%, which includes for example partners from other industries.

Veryzer (1998) studied eight firms' discontinuous product innovations and their processes in doing these innovations. Discontinuous innovation refers to "radically new products that take leaps in terms of customer familiarity and use". He found that four out of eight firms had formal processes to assess these innovations, but even in the firms where the processes were not established clear logic behind the development could be found. He found that the processes in the firms were less customer driven and more exploratory than in typical incremental innovation efforts. He proposes that discontinuous product innovations may be hard to understand for the customers due to their very nature, they break the logical chain of product evolution (incrementally adding characteristics based on needs). As the developed product might be totally unfamiliar to the customer, meaningful data cannot be gathered from the customers as they do not really grasp the purpose of the product.

Sounders et al. (1998) studied 101 NPD projects at high-technology firms (R&D expenditures +5% of sales), and they suggest that both R&D/customer and R&D/marketing integration have a positive effect on NPD performance but these integrations benefit different areas of NPD performance. R&D/customer integration decreased cycle times, and improved R&D technical and commercialization effectiveness. R&D/marketing integration was found to be important for market forecast accuracy, product launch proficiency, commercialization effectiveness, and prototype development proficiency. They conclude that managers can use the different effects that R&D/customer or R&D/marketing integration have on NPD performance when they spot need to improve certain areas in NPD performance.

2.3.2 Heavy front-end loaded homework before development begins

Rationale behind having front-end loaded process is that the front-end loaded work pays itself back, as it leads to higher success rate and it also saves time further up the process. According to Cooper and Edgett (2008) the key issues to consider, in an order where they should be conducted, are:

- Conduct a quick preliminary market assessment early in the process
- Technical assessment and source of supply assessment, that e.g. includes probable materials and equipment needs, early in the process
- More detailed market research (VoC), concept testing and value to the customer

- After the steps above, the acquired information is put into action, and more detailed product definition is done. Here the project scope, target market, product concept, features, value proposition, target price and other high-level specs are specified.
- After this it is time for detailed financial and business analysis, using the data that has been gathered. This could include e.g. net present value (NPV) or internal rate of return (IRR).

An example of heavy front-end loaded homework working in practice comes from Toyota. Toyota's lean product development process has gained a vast number of admirers, and it has outperformed its American competitors in terms of faster product development cycles, and doing so while using significantly less engineers. The Toyota NPD process is a complex entity and it would be unfair to point out a single factor for their success. This being said, one key aspect in their product development is heavy front-end loaded homework that results in time savings through less design modifications at the next parts of the development. (Balle 2005)

Toyota seeks to identify all possible troubles early on, and tackle the problems at their sources. In this "noisy" first stage many alternatives are explored. A process of ambiguity and negotiation leads to conflicts, that are often solved by customer satisfaction criteria. As the design process progresses, the sets of solutions narrow gradually based on information received from stakeholders. This progressively reducing specifications and resolving ambiguity leads to considerably shorter development cycles, as the later stages of the process move smoothly. During this critical first stage product engineering, manufacturing engineering, purchasing and quality have representatives working closely with each other in the leadership of the projects Chief engineer to make sure different perspectives are understood. After this first exploratory stage, comes "detailed planning" stage where drawings of the product are realised, with a goal "Zero EC", meaning no engineering changes once the drawings are realised. (Balle 2005)

According to Veryzer (1998) the major difference between NPD processes of incremental and radical innovation lie in the fuzzy front-end. Herstatt et al. (2008) studied 497 Japanese NPD projects and discussed the benefit of having fuzzy front-end loaded development process for NPD projects in general, and for radical compared to incremental innovation projects. According to Cooper (1998), the fuzzy front-end covers the idea generation, initial screening, preliminary evaluation, and concept evaluation stages. Cooper (1998) stresses that in the fuzzy front-end both marketing and technical activities are important, while the inadequate market analysis in the fuzzy front-end being number one reason for new product failures. Herstatt et al (2008) findings indicate that the fuzzy front-end development reduces both technical and market uncertainty of projects and that it leads to higher efficiency (financial and personnel

resources planned to conduct the project versus actually used resources) and effectiveness (evaluated project outcome versus actual project outcomes, e.g. meeting profit targets, customer satisfaction and competitive advantage). They found that both radical and incremental NPD projects benefit from the fuzzy front-end work.

So, the front-end loaded work reduces uncertainty and results in better estimates related to efficiency and effectiveness (Hestatt et al. 2008). The main contributor in their sample of firms for the reduced uncertainty were customers, while the second most important information source were competitor analyses. The firms gathered customer information via direct contact, but the companies also evaluated customer complaints and conducted surveys. They concluded that frequent customer contact in the fuzzy front-end development was a key to NPD projects success. The customer requirements were understood fairly well after the front-end development but the companies seemed to have trouble in translating the customer requirements to product specifications. The authors propose there seems to be a lack of communication between marketing and technical people, the requirements are not translated to technical language. This was even more evident in radical NPD projects.

Herstatt et al. (2008) found that in the planning phase, it was significantly harder to estimate the market size and the customer price sensitivity for radical innovations compared to incremental innovations. Also, potential competitors and their products were harder to estimate in radical innovations.

Bertels et al. (2013) discussed the drivers for success in breakthrough and incremental product development in the front-end of the development. The front-end refers to be the first parts of a typical stage-gate model, the discovery of the idea, idea scoping and building the business case. According to Bertels et al. (2013) the three most important areas in the activity development for incremental products in the front end of innovation process that separate successful companies from less successful companies are current market knowledge, idea enrichment (information system the company uses for sharing, capturing and building new ideas), and concept definition (formal methods for understanding the market and sales efforts, technical aspects, manufacturing feasibility and economics, basically the formalness of the business plan). The current market knowledge is the most important activity of the three. They propose that standard approaches, such as focus groups, are not performing well enough in providing deep insights needed. Ethnographic techniques, where the customers are observed in their own environment produce a better result, e.g. watching the consumers using the products in real situations to spot possible nuisances.

Bertels et al. (2013) studied also breakthrough product success in the front-end of the development, and they found that current market knowledge, white space disruptive market knowledge and idea enrichment using technology inventions were important for the success. Idea enrichment using technology inventions refers to the extent that the company is assessing new technologies and technology-driven inventions. The concept definition, meaning the formalness of the business plan was not critical factor in the success of breakthrough products. However, they propose that the process of building the business plan may be beneficial.

According to Bertels et al. (2013) the white space disruptive market knowledge refers to the degree to which the company looks for new disruptive business and technology opportunities, reviews those business and technology opportunities and is willing to accept lower margins than in their current business for those opportunities. They argue that understanding the white space market is fundamentally different process than understanding the current market. They site Lynn et al (1996) who examined breakthrough projects from General Electric, Motorola and Searle, in those projects the products did not follow the Stage-Gate process. They relied on "probe and learn" approach, which was an iterative process, where the early versions of the product were tested in the market, redesigned based on the feedback and then tested again. They give another example citing Garvin and Levesque (2005) who studied IBM's highly successful emerging business opportunity (EBO) unit. The EBO is separated unit at IBM that focuses on exploring the white space opportunities. According to them, understanding the needs of the market in a new opportunity is an iterative process, and sometimes it would take a year to a year and a half to get the strategy right, it could change multiple times during the process.

Bertels et al (2013) conclude that understanding the market is important for both incremental and breakthrough innovations but formal methods for quantifying the market and sales were important drivers of success only for incremental products, not for breakthrough products. The processes and practices for breakthrough product development are significantly different than for incremental product development. More iterative and learning approach has proven to be more successful in breakthrough product development.

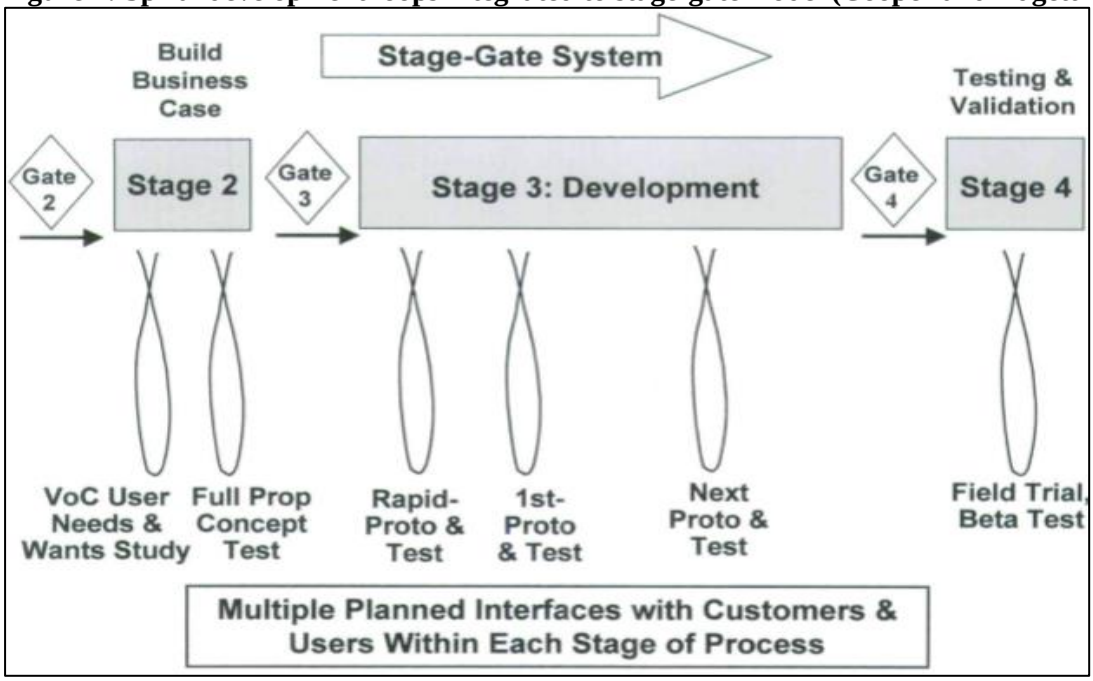
Evans et al. (2013) say that the primary reason for new products to fail is insufficient time and resources spent at the front-end of the development. The time and resources are spent in the front end to build an extensive knowledge base before making significant investments in the development. This enables companies to fail fast, and avoid spending significant resources later in the process to products that are not viable or do not fit the strategy. They continue that the front-end involves much more than listening to the voice of the customers, it involves

conducting detailed competitive analysis, understanding the global trends shaping the opportunity and gaining diverse perspectives of different thought leaders. For the best performing companies the front-end of the innovation is jointly owned process that takes into consideration multiple different perspectives. For the higher-risk, long-term projects, some companies use incubators to foster them in safe space, allowing the gathering of information and addressing difficult challenges without exposing them to intense scrutiny.

2.3.3 Spiral development – information loops with users through-out the development process

According to Cooper and Edgett (2008), testing with the customer in real time is crucial so that the developed product does not come out of the stage-gate model as already outdated. There could be many reasons for this. The markets may have shifted, other competitive products may have been introduced or the customer simply did not know what she wanted. Integrating spiral development loops "build-test-feedback-and-revise" to the stage-gate model may help the company to avoid such misperceptions. See Figure 4 for a visualization of this process.

Figure 4: Spiral development loops integrated to stage-gate model (Cooper and Edgett 2008)



Veryzer (1998) studied eight firms' discontinuous innovation processes. He proposes that what really seemed to be the key in these types of projects was prototyping much before than in typical incremental innovation projects. First prototypes preceded opportunity analysis, assessment of market attractiveness, market research, and financial analysis. He characterized the overall process messy and the progression of activities to be sometimes unconventional, as

new technology is adapted to product applications, it is an iterative process. This was especially so in the early parts of the NPD process. However, he had a differing opinion to Cooper and Edgett (2008) about involving customers in the feedback loop early in the process for discontinuous innovation projects.

Herstatt et al. (2008) spoke about the prototyping as a tool to reduce uncertainty in the front-end of development. The prototypes could be early physical prototypes or virtual prototypes. They argue that the use of prototypes can reduce both technical and market uncertainty. The prototypes can be used for checking the technical feasibility and for communicating with different stakeholders, including team members, customers and management. Herstatt et al. (2006) studied Japanese companies and found out that almost 90% of them used early physical prototypes, meanwhile 11% used virtual prototypes. Similar to this, Souder et al. (1998) found out in their study, that higher perceived technical uncertainty leads to higher design change frequency in NPD projects.

2.3.4 Holistic approach driven by effective cross-functional teams

Cooper and Edgett (2008) suggest that NPD projects should have cross-functional team that sticks together from the very beginning of the project all the way to the end. The team should also have a clear leader who leads the project passionately from the beginning to the end. The team should be held accountable for the project, measuring the team's performance against previously defined success criteria.

Sounders et al. (1998) study indicates that R&D/marketing integration has a positive effect on NPD effectiveness, and they propose that due to this positive effect, the expense of maintaining high collaboration with R&D and marketing people is justified. They also propose that when the uncertainty (technical and market) is higher there especially is need to limit this uncertainty with collaboration. For example, in their study they found out that higher market uncertainty affects product launch proficiency and market forecast accuracy, meanwhile R&D/marketing collaboration positively affects the product launch proficiency and market forecast accuracy. Therefore, the higher the uncertainty, the more need for collaboration there is.

Dougherty (1992) also speaks about the value of collaboration between marketing and technical people in innovation context. She says that the commercial success of new products depends on its design meeting with customers' needs, and that effective design requires that technological possibilities are linked with market possibilities, where collaboration between the

departments is the key. Dougherty's (1992) research was not limited to marketing and technical collaboration, she further discussed that collaboration with also manufacturing and sales departments leads to success of new products.

However, Dougherty (1992) notes that there are also barriers to collaboration. All these four departments have their own "interpretive schemes" that barrier the collaboration, and linking the market needs with technical needs. These interpretive schemes form the context where the people think, they provide shared assumptions about reality, they identify what issues are relevant for that department, and they affect how people make sense of those issues. She proposes that because of these interpretive schemes, the departments tend have different focus related to the technological-market knowledge, possibly none of them understanding the whole picture. She says that organizational routines tend to separate, rather than coordinate these different thought worlds. According to her, correcting these interpretive barriers requires both cultural solutions and structural changes within the innovation organization. She proposes three different processes that are all needed to overcome these barriers:

1. Building on the Thought Worlds. All the departments (thought worlds) may focus on aspects that others ignore. All thought worlds should contribute to the design, and actively challenge each other.

2. Developing Collaboration Mechanisms. She proposes that structures alone will not solve the collaboration issue, the participants of interdisciplinary teams may still rely on people from their own thought worlds when issues arise. She proposes that shared customer understanding may be a key here, and taking joint responsibility for customer related activities, such as market research plans, technology audits, customer focus groups and visits with users could enhance collaboration

3. Developing the Context for Collective Action. She proposes that the interactions between the though worlds should be based on joint-development and appreciation, and that product definitions should be collectively understood based on first-order customer knowledge. Managers can build this context of collective action by fostering the processes of joint learning, customer interaction, and knowledge development.

Troy et al. (2008) studied 25 different studies that examined the effects of having cross-functional integration in innovation projects and how this affected different aspects of new product success. Their findings indicate that cross-functional integration may have a direct effect on new product success but the combination of cross-functional integration with many

other factors may be more significant. For example, they found that the organizational level on which the integration happens has a significant impact on the integrations success. Integrating teams (different background people working on a single project) had much higher effect on new product success than collaborating higher up on organizational level. They also suggest that high-tech industries may benefit more from cross-functional integration than low-tech industries (who also benefit but less), and services may benefit more from collaboration than products. They conclude that most of the variables that they found to significantly affect the new product success were managerially controlled (e.g. level of integration, type of information shared, which functions and how many functions to integrate) or context specific (e.g. industry, product / service, and country of origin), and thus management can capitalize on their knowledge on their products, firm characteristics and external factors to design the type of cross-functional integration that best suits their specific situation.

2.3.5 Metrics, accountable teams & continuous improvement through post launch reviews and continuous learning.

Cooper and Edgett (2008) say that the best performing businesses put metrics, or in other words success criteria, in place and measure the performance against planned target values. The project team and the leader should declare their projections for the metrics as part of the overall business case at the go-to-development gate. Based on these projections and other data, the go-to-development decision is made, and later in the upcoming gates the project team is held accountable for achieving the targets, and that affects the go / no-go decision at the gates. The most popular metrics are sales and profit measures. Metrics that capture time, like time-to-market were used by over 80% of the companies. Other measures mentioned were customer satisfaction related, like returns, complaint tracking, and customer surveys.

According to Cooper and Edgett (2008), one common pitfall that businesses do is not measuring the performance of new products after the launch against the targets set during the development phase. Only 22.1% of the companies in the study had post-launch reviews. This makes holding the project team accountable for the results impossible, also learning and continuous improvement cannot be done properly without this step. The post-launch review can be seen as the last step of accountability for the project team. Measuring actual numbers against the target values, spotting variances and conducting root cause analysis based on the variances enables learning, and results in better project performance in the future.

Other authors also speak about the link between measuring performance and managing performance. According to Lebas (1995) performance management and performance

measurement are not separable, performance management proceeds and follows performance measurement. According to Bourne and Bourne (2011) performance management and performance measurement involve a vide set of skills and activities, ranging from strategic thinking and detailed analysis to more soft skills such as facilitating discussions to gain commitments to actions, to make sure things really happen based on the measurements. Bourne and Bourne (2011) says that the basic five roles of performance measurement systems are:

1. Establishing your current position
2. Communicating direction
3. Influencing behavior
4. Stimulating actions in the most important areas for your business
5. Facilitating learning

As Cooper and Edgett (2008) mentioned, post launch reviews can be powerful tools in organizational learning, spotting variances and conducting root cause analyses based on those variances. However, studies from Vaivio (1999 and 2001) suggest that non-financial measures could have a learning aspect through the whole project, as the non-financial numbers can do more than passively monitor and communicate. Non-financial numbers cause new dimensions of performance to become visible to other parts of the organization and they stimulate discussion, which assist in knowledge sharing and even new knowledge creation as a result of the discussion.

When it comes to what kind of measures should be used in innovation context, authors argue that it depends on the type of innovation, and the stage the innovation is in. Nagji and Tuff (2012) suggest that traditional financial metrics are appropriate to evaluate core and adjacent innovations but they assess poorly transformational efforts in the early stages. They propose that financial figures should eventually have more role for transformational innovations also, in later stages when more information is acquired. Bertels et al (2013) found that quantifying market and sales numbers in the front-end of development were important drivers of incremental product development projects success but for breakthrough products they did not have a significant value. Similar to this, Herstatt et al (2008) found out that the market size and customer price sensitivity were significantly harder to estimate for radical innovations than incremental innovations. Bertels et al (2013) found out that the business plan itself did not have a significant impact on breakthrough products success, meanwhile they did not rule out that while the plan itself did not have impact, the process of conducting the plan might have had impact.

So, it seems clear that financial numbers and market numbers are appropriate for adjacent type innovation projects also in the early parts but for transformational type efforts, something completely different is needed. Nagji and Tuff (2012) propose that the companies should do the polar opposite of financial numbers to assess transformational efforts in the early stages. They propose using a combination of non-financial and internal metrics, that would enable the organization to learn. As an example they mention Google, who has only one initial hurdle for transformational innovation efforts. That hurdle is that the company is likely to learn from the effort, financial and market factors come later in the process when they have something to pilot.

The importance of measuring performance in innovation context more generally has been acknowledged as well. Using balanced scorecard (BSC) or key performance indicator (KPI) type sets of measures in innovation context or in project management is not a new idea, e.g. Bremser and Barsky (2004) and Stewart (2001).

Bremser and Barsky (2004) studied the use balanced scorecard in R&D context. They recommend participative cascading approach that links organizational level BSC to BSCs used at lower levels of the organization. The idea of their model is simple, to link organizational level BSC metrics to lower level BSC metrics, in this case R&D departments metrics. As the higher-level metrics have been designed in collaboration, the R&D department further communicates these targets to lower levels of the organization, e.g. R&D units, and they design R&D unit level BSCs that are linked to the R&D department BSC. They further suggest that metrics used in the organization's stage-gate model can be connected to the BSC. For example, the organization might have firm level measure "time to market" that is linked to R&D department's measure "number of product ideas approved for gate X" that is further linked to R&D units' measures about their project progress.

Stewart goes even further (2001) suggesting that individual projects can be considered as "mini-organizations" that require the same kind of clarification and benchmarks as the parent organization. She proposes that to better manage projects, health checks utilizing balanced scorecard approach should be used throughout the project life cycle. According to her, "on-time, on-budget" objectives are the most common measures in most of the organizations for projects. Shifting the focus to more comprehensive BSC type approach companies would get better understanding on how individual projects benefit the whole organization, how well they are managed, how the management could improve (the project), and what is the strategy aspect of the project. The tool she proposes would be used to analyse projects on a portfolio level rather than on a single project level. She further says that the inputs and outputs of BSC must

be clearly defined, as what is not clearly defined cannot be clearly measured. She also suggests that companies should set goals for the measures, evaluate its position in relation to the future goals, and have a plan on how to achieve said goals.

However, in practice not all companies have these a formal links between performance measurement and innovation. Hertenstein (2000) examined performance measures in NPD context. She found that many firms do not use any kind of measures for NPD performance explicitly. However, the firms that did use, used both nonfinancial and financial measures. The link between the measures and company level strategy were preserved weak, unlike for example Kaplan and Norton (1992) and Bourne (2011) say it should be, and further improvements in this area were requested by the surveyed NPD managers. Moreover, the managers were generally dissatisfied with the NPD performance measurement.

2.3.6 Focus and effective product portfolio management

According to Cooper and Edgett (2008) most of the organizations have too many product development projects underway for their limited resources, and their project portfolios contain too many low-value projects. The product development projects should be carefully analysed and focused through effective project portfolio management system, starting with a larger pool of projects and by systematically removing the weaker ones with series of gates.

Formal portfolio management systems are rare in even the best performing businesses, from whom 31% indicated having such system. They are still significantly more likely to have such system compared to poor performing businesses, with only 3.8% of them indicating that they have such system. To somewhat similar extent, the best performing businesses are outperforming the poor performing businesses in balance between number of projects and resources available, they have better balance of short-term and long-term projects, and their project selection results in higher value-to-the-corporation projects.

Some tools that the high performing businesses indicated to use in their formal portfolio system include:

- Strategic Buckets: setting up buckets of resources for certain type of projects (e.g. project type, market segment, technology)
- Product and Technology roadmaps: map out major technologies, platforms, and projects that are needed in the next 5-7 years.
- Scorecards: Gatekeepers employ rigorous qualitative methods at the gate meetings to pick out and prioritize the best development projects.
- The Productivity Index: financial tool that tries to maximize the overall value of the portfolio subject to personnel or financial resource constraints.

The end goal of any project portfolio management is simple, to invest the scarce resources to the projects that benefit the company the most in the long run. Cooper et al. (1999) definition of portfolio management:

"Portfolio management is a dynamic decision process, whereby a business's list of active new product (and R&D) projects is constantly updated and revised. In this process, new projects are evaluated, selected and prioritized; existing projects may be accelerated, killed or deprioritized; and resources are allocated and reallocated to different projects…"

Cooper et al. (1999) investigated how 205 large U.S. companies manage their R&D and new product portfolios, and they found vast differences between the companies' practices and their performance. They identified 4 groups of companies based on two factors, surveyed management fit and overall quality rating of the portfolio methods used. Unsurprisingly, the benchmark businesses, companies with high management fit and quality rating, had the best performing portfolios both economically and in strategy alignment. They also tended to use more methods (almost 3 on average) than the other groups. More interesting is to examine the techniques used. Financial models (like NPV, IRR) were used the most often but ironically, they resulted in the worst economic value. Strategic approaches (business's strategy is the basis for money allocation) and scoring models (projects are scored based on multiple criteria) were the next popular models, and they yielded the best performing portfolios. Combination of multiple methods resulted in a better performing portfolio than just relying on one method. Benchmark businesses relied less on financial methods and more on strategic methods. According to the authors, what seems to really set benchmark businesses apart from the rest of the companies was that they employed a much more formal and explicit methods, and consistently for all the projects.

According to Sanchez and Robert (2010) most indicators used in project portfolios are financial or schedule based. They propose that companies should develop KPIs for project portfolios taking into consideration the strategic perspective and the objectives of the portfolio. The KPIs would measure the realization of key benefits of the projects and achievement of portfolio level objectives. The key strategic performance indicators would be used to early detect performance variances that may hinder achieving the strategic objectives of the project portfolio, and corrective actions would be taken if the indicators suggest that project(s) are performing below par.

Cooper and Edgett (2012) studied the innovation practices of 211 US large business units. Their findings indicate that gatekeeping role should be clearly defined. From all businesses 70.8% had clearly defined gatekeepers and from the best performers (top 25%) the number was even higher with 85%. More differences between the companies arise when the question if gatekeepers may change from gate to gate depending on the evolving risk profile of the project, or from project to project depending on the risk level of the project. From worst performers (bottom 25%) only 18.5% had changing gatekeepers, meanwhile from the best performers 45% did. The authors suggest typically in larger and more risky projects, higher level executives should typically act as gatekeepers, meanwhile in low risk projects lower level personnel may act as gatekeepers. However, even in large or riskier projects, senior people do not necessarily have to make all the gate decisions, for example idea screen where significant commitments are not yet required. In 35% of businesses they studied, gatekeepers changed from gate to gate, and in 26.2% the gatekeeper group was totally static. Moreover, the meaningful contribution of gatekeepers, meaning for example coming prepared to the meeting, asking insightful questions and understanding the project prior to the meeting, differed significantly between the worst performers, from whom 14.8% indicated so, and best performers (52.6%).

When it comes to the go/kill decisions for projects, Cooper and Edgett (2012) study indicates that simply having criteria defined is a strong differentiating factor between the best performers (85% of businesses employ) and worst performers (25.9%). Often these criteria are in form of scorecard that evaluates the merits of the project. However, what the scorecard should specifically include for different types of projects in different stages is less examined question, and one where further research should be conducted. Another key best practice is having defined deliverables, with 90% of the best performers indicating having this, the number is significantly lower within worst performers, 46.2%. Often these deliverables are in form of templates. However, again what the templates should consist of for different types of projects at different stages is an issue where research is limited.

The best performers seem to fare much better also in objectivity and fact base for their decisions, in respect that the decisions are indeed made at the meetings, and in gatekeeper support for the made decisions. From the best performers 57.9% indicated that their decisions at the gates are "objective and fact based", meanwhile from the worst performers 14.8% indicated so. From the best performers 60% said they indeed do go / kill decisions at the meetings, from the worst performers only 25.9% did. In some companies the gate decision meetings seem to be more information sessions about the project updates than decision making forums. Support for the

made decisions refers to unanimity of the decisions by visibly supporting the gate decisions, and by committing resources from their departments to the projects based on the decisions. From the best performers 66.7% indicated having this, and from the worst only 14.8% did.

2.3.7 Next generation Stage-Gates

According to Cooper and Edgett (2008) companies are now building the next generation Stage-Gates, which are lean, scalable, adaptable, automated and support open innovation:

- Lean: Companies have borrowed value stream analysis method from lean manufacturing, and they systematically try to eliminate non-value adding steps from the development process in order to streamline the process and accelerate the time-to-market.
- Flexible and adaptable innovation process: Stage-gate model is able to adapt to changing conditions and unstable information. It supports simultaneous execution of activities within different stages. Even whole stages can overlap. They propose that the key is to weight the cost of delay of the project and the cost of being wrong. Not waiting for the perfect information may be the right thing to do in some cases.
- Scalable process: Stage-Gate model is not one-size-fits-all solution. The different projects range from high-risk platform development projects to small-scale product improvements. The different projects contain significantly different levels of risks. The nature of the Stage-Gate should vary depending on the project.
- Automated Stage-Gate: Companies utilize software tools to make the Stage-Gate process and the pipeline visible in real time.
- Open innovation: Stage-Gate systems can be modified to accommodate open innovation. For example, P&G has built a system that enables their network of partners to participate in the process all the way from ideation to product launch.

Other studies also acknowledge that some modifications to the basic idea of stage-gate models have emerged, like adding scorecards to the gates, self-managed or online gates, integration with portfolio management, or building better governance models (Cooper 2009). Grönlund et al. (2010) have built a model to incorporate open innovation theme to stage-gate model. Still, the basic idea, systematic stages with gates where the go / no-go / hold decision are made, remains strong. The idea of not having one-size-fits-all stage-gate model is also in line with Davila (2005) proposition that different kinds of innovation benefit from different types of control systems.

Cooper and Edgett (2012) studied 211 business units NPD performance, and divided the companies to best performing (top 25%) and worst performing (bottom 25%). They examined

the use of rigid one-size-fits-all process compared to having flexibility and scalability in the process to cater for needs of different risk-level projects. In practice, this could mean for example having a full stage-gate model for longer high-risk projects, and shorter streamlined version for small product enhancements. On average 62.3% of companies indicated having this flexibility in their processes. From the best performers 75% indicated so, and from the worst performers only 37% had such processes

2.4 Summary of discussed theory

There are huge differences between the best and worst performing companies when it comes to NPD productivity (Cooper and Edgett 2008). What we know is that most of the returns in high-performing companies NPD come from transformational innovations (Nagji and Tuff 2012). Therefore, it is crucial to examine the seven principles identified by Cooper and Edgett (2008) to increase NPD productivity through transformational/breakthrough innovation lens.

Principle 1, VoC:

There are mixed signals related to VoC and transformational type innovations. Veryzer (1998) speaks that in this kind of innovations, customer involvement is not beneficial as they cannot understand the proposed solutions because they break the natural chain of incremental product development. Study from Herstatt et al. (2008) does not support this. Their study indicated that customer needs were understood relatively well for this type of innovation, but translating those needs to technical language was insufficient. This indicates that a common problem may lie in the processes within the companies' technical and marketing people rather than with the communication between the company and the customer. Herstatt et al. (2008) also suggest that hard numbers related to customers and markets are hard to estimate for this type of innovations. Bertels et al. (2013) suggest that the formalness of the business plan does not hold significant value for this type of innovations. However, they note that understanding the market is important factor for success for all types of innovation.

To conclude all of this, it seems that VoC is an important factor also for transformational innovations. However, not all customer related activities have been proven beneficial. It seems that companies should try not to focus too much on quantifying the customers or the market in the early phases, and they maybe should not ask for concrete solutions suggestions from the customers who might think too narrowly. Rather they should try to understand what the customers might need, develop a solution for the need, and ask for feedback for the solution.

This kind of iterative learning approach has proven to be successful in breakthrough product development (Bertels et al. 2013)

Principle 2, Front-end loaded homework:

Many authors speak about the value of heavy front-end loaded early parts of the NPD process (Cooper 1998, Bertels et al. 2013, Herstatt et al. 2008, Veryzer 1998). Cooper (1998) stresses that both marketing and technical aspects are important in the front-end, and Herstatt et al (2008) say that technical and market uncertainty can be reduced with heavy front-end development. The front-end loaded process has been proven to be beneficial for both transformational type innovations and for incremental innovations (Herstatt et al. 2008). It seems to be more what the heavy early stages should be focused on for different types of innovations (Veryzer 1998, Bertels et al. 2013) rather than skipping the front-end for certain types of innovations.

Bertels et al. (2013) studied what are the most important aspects for breakthrough and incremental products success in the front-end of the development. For breakthrough, they found that current market knowledge, white space disruptive market knowledge and idea enrichment using technology inventions were important for the success, meanwhile the formalness of the business plan was not critical factor in the success of breakthrough products. The three most important indicators of success for incremental products were current market knowledge, information system the company uses for sharing, capturing and building new ideas, and the formalness of the business plan.

Principle 3, Spiral development:

Cooper and Edgett (2008) suggest that integrating "build-test-feedback-and-revise" loops to the stage-gate model helps the companies to avoid launching products that are not already outdated. This seems to be especially so for transformational type innovations. Veryzer (1998) says that for discontinuous innovations prototyping comes usually much before than for incremental innovations. Herstatt et al. (2008) speak about prototyping as a tool to reduce technical and market uncertainties, and that the prototypes can be used in communication with different stakeholders. Sounders et al (1998) found that that higher perceived technical uncertainty leads to higher design change frequency in NPD projects. All this indicates that the riskier the project is, the more companies rely on these "build-test-feedback-and-revise" loops that Cooper and Edgett (2008) speak about.

Principle 4, Holistic approach, cross-functional teams:

The idea of having cross-functional NPD teams is widely spoken in the academia and endorsed (e.g. Cooper and Edgett 2008, Troy et al. 2008, Dougherty 1992) but how this relates to transformational type innovations compared to other types of innovations has had less coverage. However, there are traces that could indicate that more high-tech and riskier projects, like transformational innovation projects, might benefit more from cross-functional teams than less risky projects. Sounders et al. (1998) speak about collaboration as a tool to reduce uncertainty, the higher the uncertainty is, the more need for collaboration there is. Troy et al. (2008) suggest that high-tech industries may benefit more from cross-functional integration than low-tech industries. This could suggest that high-tech projects would benefit more from cross-functional integration than low-tech projects.

Principle 5, Metrics, accountable teams, continuous improvement and learning:

The question of what metrics should be used to evaluate innovation projects depends on the type of project and the stage of the project. Hard financial numbers (Nagji and Tuff 2012) and market indicators (Herstatt et al. 2008) have been deemed to be poor at evaluating transformational type innovations, especially in the early stages. Similar to this, officialness of the business case in the front-end does not hold significant value for this type of innovations (Bertels et al. 2013). Nagji and Tuff (2012) propose using combination of non-financial and internal metrics, that would enable the organization to learn, to assess transformational efforts in the early stages.

When thinking about measures more broadly in innovation context, what measures should be used to evaluate the whole innovation organization, similar shift away from mostly financial measures to incorporating also other factors seems to have gained popularity. Bremser and Barsky (2004) discuss linking organizations BSC to innovation functions BSC, and further to innovation units BSC. Stewart (2001) proposes conducting health checks to projects using more comprehensive BSC type approach compared to typical “on-time, on-budget” measures. This way companies would get better understanding on how individual projects benefit the whole organization, how well they are managed, how the management could improve (the project), and what is the strategy aspect of the project. However, measuring performance does not seem

to happen that well in practice. Hertenstein (2000) examined performance measures in NPD context and found many firms do not use any kind of measures for NPD performance explicitly. In the firms that did use, the link between the measures and company level strategy were preserved weak and further improvements in this area were requested by the surveyed NPD managers. Moreover, the managers were generally dissatisfied with the NPD performance measurement.

Principle 6, Effective portfolio management:

According to Cooper and Edgett (2008) formal processes to manage innovation project portfolios are rare even in best performing companies (31%) but still much more widely used than in poor performing companies (3.1%). Cooper et al. (1999) study also indicated that the companies that systematically use formal and explicit methods consistently for all projects in their innovation portfolio management have better performing portfolios. When it comes to methods that were used, using many different methods to evaluate innovation portfolio resulted in better project selection. Relying more on financial indicators like NPV and IRR resulted in poorly performing portfolios, meanwhile relying more on strategic approaches and scorecards resulted in the best performing portfolios. Sanchez and Robert (2010) argue that most of the indicators used are financial and schedule based, and more emphasis should be placed on strategic perspective and assessing the objectives of the project portfolio, and that companies should develop KPIs that take these into consideration and use them in the decision making.

Principle 7, Next generation stage-gates:

Cooper and Edgett (2008) say that stage-gate models are not one-size-fits-all solutions but they can be modified to different situations. They can be modified for example to encourage open innovation, to cater for different risk-level projects, or to enable automated gate decisions for some projects. Other studies also speak about modifications to stage-gate process (e.g. Cooper 2009, Grönlund et al. 2010). The value of having flexibility in the stage-gate process can be seen from Cooper and Edgett (2012) study in which from the best performing companies 75% indicated having flexible stage-gate processes, meanwhile from the worst performers only 37% had such processes.

3 METHODOLOGY

3.1 Research method and design

This thesis is done following a constructive research approach (CRA). Kasanen et al. (1993) described CRA studies as studies that contribute to research by solving real life problems by building models, diagrams, plans etc. based on both academic literature and empirical data. This thesis builds a breakthrough innovation appraisal framework for a case company, and it also identifies other possible issues in the innovation context at the case company. The construct, meaning the breakthrough innovation appraisal framework, is the main object and contribution of the study so the study fits to CRA description.

Malmi (2016) defines managerialist studies in management accounting as "studies in which at least one of the aims is to directly support or help, in one way or another, organizational decision-making and control." He further divides managerialist research in management accounting to interventionist and non-interventionist studies, and he divides interventionist studies to action research and to studies applying constructive approach. The main difference between the two is in the objectives of the studies. In constructive approach the aim is to create a "theoretically novel and managerially helpful" construct and the construct itself is the intended contribution, whereas in action research the main objective is to develop a deep understanding of various forces in the case organization by participating and to theorize based on those insights. He further explains that from the theoretical standpoint, it is crucial that the constructive solution contains some conceptually or theoretically novel aspects, just applying existing tools and frameworks does not qualify as scientific research.

Kasanen et al. (1993) divided the CRA process to six phases, the order of the phases may vary from case to case:

1. Find a practically relevant problem which also has research potential.
2. Obtain a general and comprehensive understanding of the topic.
3. Innovate, i.e., construct a solution idea.
4. Demonstrate that the solution works.
5. Show the theoretical connections and the research contribution of the solution concept.
6. Examine the scope of applicability of the solution

Baard (2010) speaks about the validity and reliability of interventionist research (IR), which includes CRA studies. He says that for CRA studies, using the six-phase framework by Kasanen et al. (1993), or similar six-phase framework by Labro and Tuomela (2003), facilitates critical assessment and verification of the phases and steps related to the construct development, which

increase the validity and reliability of the construct itself. See table 3 for how the six phases of CRA were handled in this thesis.

Rautiainen et al. (2017) say that the success and the validity of the CRA are mainly assessed based on the practical relevance of the construct in the case organization and beyond it. They discuss how "market tests" have been used to describe the practical relevance of the constructs created in the CRA process as follow:

- Weak market test: the construct is adopted to use in the case organization
- Semi-strong market test: the construct is adopted also in other organizations / Rautiainen et al. (2017) alternative for this is proof of financial value to the case organization, where managerial perceptions may serve as an indicator of the expected benefits to the construct.
- Strong market test: financial benefits of the use of the construct apply to multiple businesses

However, other authors like Kasanen et al. (1993) have slightly more lenient view on the weak market test, describing the weak market test passed if any manager responsible for the financial results of his business unit has been willing to apply the construction in his decision making. They also note that even this weak market test is quite strict, and that tentative constructions cannot often pass it, iterating the construct with the case company is often required.

Rautiainen et al. (2017) note that the relevance of the construct is hard to measure, e.g. if the case organization adopts the construct and soon abandons it, and the adoption of the construct does not automatically mean that the construct is of high quality. If the developed construct is of high quality, the case organization might block the authors to share the construct, and semi-strong and strong market tests cannot be conducted. Also, analysing the contribution of the construct only from the market test perspective does not take into consideration the academic relevance of the construct. They suggest that the relevance of the construct could be analysed from several perspectives, analysing its potential relevance and the relevance over time. Therefore, the validity of this thesis also from other perspectives was kept in mind throughout the process. This was done by answering how the six phases of CRA by Kasanen et al. (1993) were handled in this research. This is summarized in the table 3 below.

Table 3: How the six phases of CRA were handled in the research

Kasanen et al. (1993) six phases of CRA	How this was this step handled in the research
1. Find a practically relevant problem which also has research potential	The author approached case company with a raw idea. The Idea was developed further together with the case company so that it had both business and academic potential.
2. Obtain a general and comprehensive understanding of the topic	Literature review, interviews at the case company, through informal discussion with different stakeholders at the company, and by studying benchmark companies
3. Innovate, i.e., construct a solution idea	Iterating together with the case company throughout the process
4. Demonstrate that the solution works	The case company will adopt a separate track to assess breakthrough innovations where some but not all of the of the aspects proposed by this thesis will be used. Process unification for breakthrough innovations will be part of said evaluation. The tier 2 issues received positive response but when and if any of these issues are discussed in more detail at the case company is not known at this point.
5. Show the theoretical connections and the research contribution of the solution concept	The construct was built based on both empirical findings and existing literature. Answer to Davila (2005) call for further research on how to structure the control process to get radical innovations to emerge and prosper.
6. Examine the scope of applicability of the solution	The scope of applicability for other organizations is not in the scope of this thesis.

3.1.1 Interviews

The data in this thesis was gathered mostly by interviewing different stakeholders at the company. The total number of interviews was 6, and the total number of interviewees was 7, meaning one of the interviews had two people participating in it. Table 4 below for the full list of interviewees and their positions in the company.

Table 4: List of interviewees

Role	Division	Date	Time
Director	A	19.2.2019	1.06
Vice President	B	21.2.2019	1.09
Specialist	B	21.2.2019	1.09
Head of Innovation	C	7.3.2019	0.58
Director	Group Innovation and R&D	13.3.2019	1.06
Manager	D	14.3.2019	0.58
Director	E	15.3.2019	1.22

The Case organization has decentralized innovation structure, meaning that different divisions have their own innovation functions. In addition to this, the company has group-wide "Innovation and R&D" function to supports innovation on company level, for example by financing projects that benefited more than one of the divisions. In this thesis people from five of those divisions were interviewed, and one person from the group-wide "Innovation and R&D" was interviewed. The interviewees held a varying set of roles at divisions' innovation functions, but they were all either the head of innovation of the division or the person(s) proposed by the head of innovation of the division. The people interviewed that were not the heads of innovations of their division had a strong role in the innovation process development of their division.

The interviews were semi-structured, meaning that the question sheet formed a base for the interview but also other interesting topics that arose during the interview were discussed. The interviewees received the question sheet at least two days prior to the interview to give them time to prepare. The question sheets varied based on the role and the division of the interviewee, and based on the issues raised in the previous interviews. The average length of the interviews was 1h and 6 minutes. All the interviews were recorded and transcribed. The answers of the interviewees were structured under questions in their question sheets. Finally, the answers of the questions that were comparable among different interviews were compared. See appendix 1 for question sheet used in one of the interviews

3.1.2 Other sources of data

Other sources of data include process description documentation (PowerPoint and Word) provided by the divisions' innovation teams and Group Innovation and R&D. Reporting templates (PowerPoint) used at different divisions were also examined. The detail of the process

description documents varied, some of the divisions provided PowerPoint presentations that were close to hundred slides and some were around dozen slides.

The author of the thesis was located at the case company, in the group-wide Innovation and R&D function, and the unofficial communication with the Innovation and R&D team helped to grasp the nature of the problem and provided clues where the potential pitfalls of the current processes may lie. This was especially so in the beginning of the project, when the problem that had both academic and practical potential was identified.

3.1.3 Triangulation and limiting factors

Pauwels and Matthyssens (2004) say that "Triangulation aims at the integration of multiple data sources in a multi-method design". The idea behind triangulation is that the weaknesses in single data collection source or method are compensated by counter-balancing strengths of other methods or sources (Jick 1979). Pauwels and Matthyssens (2004) say that triangulation can be accomplished in many ways. This can be for example interviewing various respondents on the same topic (synchronic primary data source triangulation), interviewing the same responded on the same topic more than once (diachronic primary data source triangulation), or by combining primary and secondary data sources.

In this thesis, the primary data source was the conducted interviews, and the secondary data sources were process description documentation and reporting templates. Synchronic primary data source triangulation happened as the interviews had mostly the same topics, different perspectives to the same problem were gathered in the interviews.

When it comes to the limiting factors, the amount of people interviewed from each division raises a question, are the found issues truly reflecting the overall situation at the division or are they merely a view that the single person (or in one case two persons) who was interviewed has? Another point to consider is that the innovation environment at the case company is very complex, all the divisions have their own innovation functions, and on top of that group has its own function to support innovation on a company level. Truly understanding the whole innovation environment in five months this thesis was written is a huge task, and it might be that some aspects were not noted enough.

Another limiting factor is related to core innovations. In the interviews the roles and challenges of breakthrough innovations were discussed in comparison to adjacent innovations. Core innovations were part of the question sheets but somehow, they were almost always left out of

the discussion in the actual interviews. Almost all the interviewees focused on the difference between breakthrough and adjacent innovations. Therefore, when it comes to the unique characteristics of breakthrough and adjacent innovations, there is credibility in the findings, but when it comes to core innovations this thesis will not make any grand claims.

Finally, there is the aspect of insider action research (IRA), which means doing research in your own organization (Coghlan & Holian 2007). In IRA studies a member of an organization takes a researcher role in addition to the functional role they hold in organization. This dual role may cause challenges for the researcher. First, the researcher needs to further draw closer to the organization and the phenomena he is studying, and at the same time try to distance himself to see things critically. The second challenge relates to the dual role as a researcher and as an organizational member, which may cause role confusion, role conflict or role overload. The third challenge is related to organizational politics. This may cause the researcher to balance between his future career plans at the organization with the requirements and quality of his academic research, "failed" organizational research problem may still be an excellent academic thesis, while at the same time it could limit the career opportunities of the researcher. (Coghlan & Holian 2007).

The writer of this thesis was on the payroll of the company but he did not hold any other functional role at the organization. Still, some of the challenges listed by Coghlan and Holian (2007) may apply to this thesis also.

4 CASE COMPANY AND FINDINGS

4.1 Case Introduction

4.1.1 Case company organization

The case company is a large forestry company based in Finland. The company has had to transform in recent years as the demand for paper has shrunk substantially and new demand has emerged for wood based products in other segments. The company has a strong desire to further increase the share of sales of new products as of the total sales of the company. The company has defined three groups of innovations, breakthrough, adjacent and core, that are closely a like with Nagji's and Tuff's (2012) definitions of three types of innovation (see table 5). The company wants to increase the share of breakthrough innovations. This thesis is written to support this initiative.

Table 5: Transformational / breakthrough, adjacent and core innovation definitions

	Transformational /Breakthrough Innovation	**Adjacent Innovation**	**Core Innovation**
Nagji and Tuff (2012)	Developing breakthroughs and inventing things for markets that do not yet exist	Expanding from existing business into "new to the company" business	Optimizing existing products for existing customers
Case Company	Developing completely new products for new customer segments	Further developing existing products to current customer needs	Efficiency in existing production processes

The case company has a divisional structure. In this thesis 5 of those divisions and group-wide "Group Innovation and R&D" were interviewed. The divisions are referred as division A, B, C, D, E to avoid revealing the identity of the case company. Innovation and R&D structure at the company is decentralized, all the divisions have their own innovation and R&D functions. To harvest possible synergies between the different divisions, the company had established a separate "Group Innovation and R&D" function that finances and screens innovation projects that benefit more than one of the divisions.

The divisions' innovation functions are vastly different in resources, some of them have a few dozen people working in them and some of them have more than a hundred. This factor was something that the divisions with smaller resources emphasized during the interview process. It also affects the needs, or at least perceived needs, for the framework used in innovation appraisal. Generally speaking, the divisions with higher resources had more complex and more detailed processes and used more templates than the divisions with smaller resources.

Another factor that affected the innovation processes at the divisions was the type of innovation they were conducting. One differentiator was how customer driven their R&D and innovation efforts were versus how R&D driven they were. Another differentiator was that the divisions had significantly different shares of breakthrough innovations in their innovation portfolio. These two factors affected two of the interviewed divisions the most. Division D has higher level of customer involvement in their innovation process than the other divisions, and division E has modified their innovation process to cater for breakthrough as they have around 90% breakthrough innovations in their portfolio, compared to less than 20% in other divisions.

4.1.2 Innovation stage-gate model

All the interviewed divisions and the group-wide Innovation and R&D follow a stage-gate model in their innovation processes. The stage-gate models differ slightly from each other due to the "unique nature" (e.g. resources, different levels of uncertainty in the innovation context, type of business…) of the divisions. The go / no-go decisions are made at each gate, where among other issues, the business plans and project specific KPIs are discussed.

The stage-gate models differ in at least five ways:

1. Terminology of the stages
2. Number of stages in the model
3. Described objectives of the stages
4. Required documents at the gates
5. Governance models / decision bodies making the go or no-go decisions

At the case company, there has been an attempt to unify the innovation processes some years ago. The divisions came together and developed a one-size-fits-all stage-gate model that was adopted in all the divisions. However, the constructed stage-gate model had a lifetime of a few weeks, with different divisions doing different modifications to the framework to better suit their needs. Director from Division A describes those events, and challenges of having one

framework that all the divisions would follow. He said the following when asked about the biggest challenges of having one framework for all the divisions:

> **"***We have in practice established this X years ago, one stage-gate model for innovation and research projects in the company. There was a workshop with head of innovations from the different divisions… there is a benefit to have one system for all divisions but the biggest challenge is that every small division, every big division, might have a different aspect and this needs to be reflected. And it is completely difficult, or it was in those days very difficult, to redefine one stage-gate model. We finally made it, but it had a lifetime of weeks."*

4.1.3 Decision making processes, forums and stakeholders

The innovation and R&D projects have multiple key stakeholders. Each project has:

- Project steering group: comprises of multiple senior decision makers. Responsible for steering the project to desired outcome and making go/no-go/hold decisions at the gates.
- Project manager: responsible for operational management of the project and reporting to the steering group.
- Project owner: responsible for monitoring the project, who is also a member in the steering group.

In addition to these, there are senior executives at division and company levels:

- Head of innovation: responsible for his/her division's innovation, one in each division
- Chief of Strategy: responsible for innovation on the company level

Moreover, the divisions had different division specific structures to assess innovation or sub-sections of innovation. These structures could be called for example flagship programs or innovation portfolio meetings.

4.2 Unique nature of breakthrough innovation

In the interviews breakthrough innovations were seen as quite different from adjacent and core innovations. They were seen as significantly riskier projects that needed a different perspective when assessed. However, it is fair to note that the interview questions were built to emphasize the unique nature of the breakthrough innovations, defining the different types of innovation (breakthrough/adjacent/core) in the beginning of the question sheet, asking questions how something affects different types of innovation, and dedicating a whole sub-section in the interview for breakthrough innovation related questions. See Appendix 1 for an example question sheet that was used in one of the interviews. Also, the topic of comparing breakthrough

innovations to adjacent and core innovations was active in the company before the thesis was conducted, and this terminological division to breakthrough/adjacent/core innovations was widely used.

Division B Vice President, when asked about what is hard when assessing breakthrough innovations compared to adjacent and core innovations:

> *"I think adjacent and core innovation, it is probably easier to predict the outcome and the potential market value as such and the potential success and the money related to it. But when you are in breakthrough innovation, as you are in completely new ground, you don't necessarily have or cannot gather all the figures to have absolute numbers or figures to estimate the success and the money related to it because you might be inventing something that doesn't even exist yet. So, in a way the risk involved in breakthrough innovations, in my mind, is always higher, and thus it requires you to take decisions with higher risk and uncertainty."*

Other interviewees also emphasized this riskiness of breakthroughs and that they are harder to estimate as you are in new area to the company. A couple of the interviewees even spoke about gut feeling when it comes to assessing breakthrough innovations, for example, director from Group Innovation and R&D said the following about breakthrough innovations:

> *"I think breakthrough innovation needs to be treated as it is. If you come up with something completely new, and you are supposed to estimate the market… you can look at reference products but how does your reference, your project idea stack up to the reference product… do you feel comfortable to bet on that idea vis-à-vis other ideas. Whether you shelf it until it becomes more certain. I think there is no silver bullet to selecting the key projects that you will take from ideation into concept. I think there is one portion that is based on facts and there is at least a portion that kind of comes with gut feeling or anticipation. Because you don't, you just don't have enough information at that particular point in time but you still need to make the decision."*

4.3 The seven principles of successful innovation in the case company context

In the next sub-sections the seven principles identified by Cooper and Edgett (2008) are gone through from the perspective of the interviews. It is important to note that the interviewer / author of the thesis did not push any of the seven principles to be the topic in the interviews, in fact he only read about the seven principles after conducting the interviews. Therefore, all the discussion related to the seven principles with the divisions' top level innovation managers occurred naturally when discussing about other factors, e.g. what is hard when assessing breakthrough innovations or how do they handle prioritization of projects.

4.3.1 Customer focused with voice of customer work

One aspect that became evident during the interviews was that the interviewees saw that listening to the voice of the customer (VoC) was seen as extremely important, especially in the beginning of the process and for breakthrough innovations. The reasoning behind was that if they were expanding to new markets to the company or new markets to the world, there will be a significant risk related to the market and the customers. There is a risk of not understanding that the market is not real for the developed technology that is otherwise working well, that the customers are interested in the technology but with modifications, or that they are not willing to pay enough to cover the costs. These aspects were seen as less important in adjacent and core innovations, where the company already has market experience.

Taking the customer perspective better into consideration was seen as an area where the case company could improve. Also, some of the divisions saw this as an area that they needed to improve. Director from division E said the following when asked about what he would do differently if he would design the whole framework from the scratch:

> *"One thing that I would start differently, and I think that's where we have tried to improve this year, is especially in these early stages, idea stage, idea scoping stage or the stage 1 that we call idea fit, I think I would focus more on understanding customer value propositions and bring this customer or consumer perspective more than anything else. So, put a more focus, more emphasis on that aspect, and less in everything else."*

Division D had just last year built a complete "commercialization framework" to run with the stage-gate model to tackle this problem of not losing the customer focus and keeping the commercialization aspect also in mind. The commercialization framework has been in use for a short time, but so far it seems to have a significant impact on this division´s NPD success. The commercialization framework is almost like a second stage-gate model running as an interlinked whole with the stage-gate framework at that division. Commercialization framework emphasizes also working or iterating together with the customer. Like the stage-gate model, the commercialization framework follows the stages of the stage-gate model, it has detailed set of deliverables and questions needed to be answered at each stage.

When asked about the strength of their stage-gate model, the manager who was developing the commercialization framework, said the following:

"I think the main strength is that we have added a commercialization lens to it, so that not only the sort of company overall innovation stage-gate model is followed but we also think how to commercialize innovations from the very beginning."

When he was asked to further explain what the commercialization framework is he explained:

"I think it started out with us looking at the innovation stage-gate model and sort of lacking a more commercial aspect to it. I mean in theory a lot of it is in place there (stage-gate model) but in practice what we actually have is supportive tools and templates to actually run sort of successful launches of innovations… We (at division D) can have quite short innovation cycles on product category X, so to develop product X doesn't always necessarily cost that much in investment but you need to think about the logic from a customer perspective, so to really work with the customer insights early on making sure that you get a good value proposition and how to actually sell it to a customer in the end and get that in quite early in the innovation process to not develop things that aren't sort of valid in the market or that there exists a market basically."

When asked if the commercialization framework should be adopted in other divisions as well he was not quite sure if it would fit the structures of the other divisions. The key strength in their division's innovation setup seemed to be that the sales and commercialization function is strongly linked with the innovation function. When discussing about the challenges of having the same or similar innovation processes between the different divisions he said:

"I think the biggest difference we have is how R&D heavy it is versus how commercially, how much is focused on commercialization and how much is focused on R&D. And I think for many of our divisions it's very long cycles, it's R&D heavy, it's intense in these sort of first parts that can span for years, and for others that is a quick thing and it's more focused on how do we actually execute and get money from innovations. So, I think that's the biggest challenge, that the business logic is quite different in different divisions."

Later in the interview he mentioned that the logic behind the stage-gate structure should probably come more from the customer side, divisions that have the same kind of customers could have more similar stage-gate models.

Director from division A had an interesting point related to the customers and innovation setups. He mentioned that overall the company is doing innovation activities too far away

from the customers. This topic came up when discussing about a completely different topic, how he sees the role of Group Innovation and R&D.

> *"We are very very much northern hemisphere centric. So, we have main focus in resources in Finland and Sweden but we have only minor amounts of customers in Finland and Sweden. All our customers are sitting more in central Europe or sitting in Asia, and we are not actually allocating research and innovation resources to those kinds of markets where our customers are active. This is a miss-match, a strong miss-match."*

Later he continued about the same topic

> *"We should be more focusing on where our customers are because if we could run research projects together with our customers for sure we would be much closer and much more successful in entering to new market segment and to new technologies, which are that customer driven and (that) customer relevant."*

4.3.2 Heavy-front-end loaded homework before development begins

Many of the interviewees saw that in breakthrough innovations a lot more time should be spent in the beginning of the process. Some indicated that they might have started projects too easily and this could be avoided with more comprehensive homework.

Heavy front-end-loaded homework was especially seen important for breakthrough innovations as the risks related to them were seen as higher than for adjacent and core innovations. One of the interviewees even suggested an "express stage-gate" for adjacent innovations skipping or gliding through some stages, the reasoning being that if you already know the market, if you already know the inputs for detailed financial calculations there is no reason to stay in the early parts as long as for breakthrough innovations.

Division C head of innovation said the following when asked if he thinks it is smart to follow the same stage-gate model for all innovation projects:

> *"…The other thing that I would say is important is that in the breakthrough innovations… you would probably need to spend more time in the first parts of the process rather than in the last ones. Because a lot of the testing a lot of the will this work or won't it work and so on will be discussed in the first parts of the process, while in the adjacent innovation a lot is already known… I would probably have different type*

of processes for different types of innovations, OR I would have the same one while doing adjacent innovation I would skip a couple of areas."

A bit similarly to this, division E director said the following when asked would he use the same framework for breakthrough, adjacent and core projects:

"When you are talking about core or adjacent you can have express stage-gate, maybe this is the name I'm going to call it, express stage-gate so, eventually you don't need to create new material in the lab and scale up to a small pilot, eventually you are adding features for an existing product that you can already pilot in a larger scale one step before launch for a commercial scale. So, you can skip some of those scale-up stages. But I would say that the thinking behind still is the same: You need to be addressing customer need, you need to understand your value proposition, you need to understand the market etc. all those things. If you already know wonderful, you just check the box, but you need to go through you know because otherwise you take the risk again to develop something that you eventually find out nobody wants."

Third example of the importance of the early stages comes from the director from Group Innovation and R&D. He said the following when asked about if he would modify the stage-gate model for breakthroughs:

"I think the stages would look slightly different but I think the ideation to concept, concept creation and proof of concept, will be a lot more iterative and from a time perspective that stage would be prolonged. And I think as you are coming to more of defining that concept I think then feasibility would be a lot easier. Then you kind of tag into the feasibility as it is today."

Further question about where he would focus in this "prolonged" early stage was asked and he answered:

"I think typically for breakthrough you would really like to partner up with someone. Someone that is in that industry or adjacent industries, and that kind of trial and error if it's (with) the end customer… … that iterative work will be most important. And at the same time, yes you will look at the market research, yes you will look at the true customer need. But I think it is a lot about taking kind of wild idea into something that you haven't even thought about and that will happen through iterative trial and error process."

4.3.3 Spiral development – information loops with users through-out the development process

Information loops were seen as important factor where the company or the division could improve. These loops were especially related to the early parts of the stage-gate process. Also, some sort of loops usually came to the discussion when speaking about breakthrough innovations and their needs as can be seen from the section 4.3.2 (p.45 head of innovation division C, p. 46 director group innovation) above. Information loops with the customers were also a part of commercialization framework (p. 43-44). Another interesting point to note is that the loops usually came into discussion when speaking about the early parts of the breakthrough innovation assessment, and when asked about what the iterative first stages would include, the customer perspective came into discussion. The first three principles are strongly interlinked. Answer from the director from division E to a question, what is the weakness of the stage-gate model they use highlights this interlinkage perfectly:

> *"So the weaknesses is especially when you are dealing with breakthrough type of projects which is the majority in our portfolio for division E, the early stages, the early stage before you have a product definition or when you are still trying to find out exactly what will be fit for a customer, it's a lot of uncertainty as such, and therefore you need a lot of interaction in this process both with the customer, iterating with the customer to find out exactly what is needed and what is valuable for the customer, but also in the technology side, iterating, prototyping to see if we can make something. And these initial stages they are not a linear processes they are quite iterative, think about like a circular picture where you test something and then you validate with the customer or not and you get feedback and then you come back and you prototype again and you have this loop until you get to a point that okay, we have identified something that is valuable for the customer that eventually we think we can make money for us, but that we also have confidence that we can develop... So this very early stage is not linear as I said, it's very iterative and so the stage-gate doesn't really address that. If you think about only using the stage-gate for that we would end up in very linear process and this can take much more longer to work."*

Other divisions spoke also about the iterative nature, testing, or loops when breakthroughs came to discussion. For example, specialist from the division B said the following when asked about if he would modify the stage-gate model for breakthrough innovations:

> "*We divide the innovation… we have these strategic projects (includes breakthrough) that are longer… with bigger budgets (than) the product development projects. So, we*

have the same stage-gate model for this too but it doesn't have so structured and so well established process description than in the product development side. So yeah, I would do that completely out, do that completely out from scratch and focus more on the iterative part on the projects than following the stage-gate funnel like it is always presented… even though it is good to have the gates still to be able to say that okay this project is going at this stage now. But it should be kind of loop more than a pipe for the breakthrough ones, and for the strategic ones."

4.3.4 Holistic approach driven by effective cross-functional teams

The topic of team composition did not really arise during the interviews. However, there were some traces to be found that one area that could be developed further regarding teams in innovation functions was the role of sales and marketing perspective. Director from Group Innovation and R&D function said the following when asked if there are any cross divisional problems in the innovation process:

"I think problems will typically not lie in the model itself. It has more to do with availability of resources. By that I mean for instance having enough project leaders... That becomes a bottle neck, and I think the amount of marketing intelligence is another bottle neck that typically slows down the process."

Another trace from this came from division E:

"In our case we have a very strong R&D team, a lot of technical people, very specialized, a lot of PhDs and etc. We don't have yet too much of the marketing people…"

On the other hand, division D had sales and commercialization strongly linked with the innovation function. Moreover, the topic did not arise at all in some of the interviews. Explanation for this is that it was not specifically asked in any of the interviews. Therefore, it is hard to make any sort of judgements based on the limited discussion on the topic.

4.3.5 Metrics, accountable teams & continuous improvement through post launch reviews and continuous learning.

For breakthrough innovations, the role of financial indicators in the beginning of the process, was seen as it should not be that important. In the beginning other aspects of the project such as strategic importance, customer perspective and learning potential were seen as important.

The reasoning behind is that there are so many unknowns, and that the estimates would be wrong anyway. Some of the interviewees rather spoke about "potentials" and "orders of magnitude" The view was that the role of financial indicators should increase as acquired information increases throughout the process.

When asked would he treat the KPIs for breakthrough innovations differently than for adjacent or core innovations, division E director highlighted other aspects than hard figures:

> *"Yes, and that is what we were trying to do especially in the early stages since you don't know a lot of things, it's so uncertain, you cannot handle the same way… it's less financial, it's less accounting, it's much more about other aspects, it's about understanding the strategic importance of the project and understanding future potential in terms of markets of learning, understanding if we can differentiate ourselves in the market to understand what is the business case for the customer with this opportunity, understand what type of business models we can operate with, what is the market attractiveness, if it's a growing market or if it's not, what is the competitive landscape. So, a lot of, hundreds of aspects that you try to evaluate to come up with this conclusion okay this makes sense for us to continue or not."*

When it came to using financial figures in the beginning he spoke about using ranges at this early stage and avoiding pinpointing exact numbers that were deemed to be wrong anyway.

> *"At the end of the day they will of course have a financial impact but at this very early stages it's very hard to pinpoint, so I prefer to work with potentials and trying to work when required to have some order of magnitude in terms of the financial, then I work with ranges, ranges for the sales, ranges for the profitability, range for the NPVs of the business case. But I avoid, or try to avoid at least, pinpointing this NPV is 122 and the other one is 127 when by the end of the day we know that it's wrong at this stage you know."*

However, as the project progresses, more information is gathered to support financial calculations. This way the detail in the calculations, and the value of the calculations increases later in the process. When asked if the financial calculations are made in more detail in the later stages he responded:

> *"Exactly, so as you scale up, as you go further in the funnel I would say that this detail in calculation increases because of what happens is that a lot of the assumptions you were now learning and proving, and as you learn more then you refresh the business case, you update the calculations and you have more aggregated view."*

Director from Group Innovation and R&D responded similarly to the question "How do you see the role of financial indicators when assessing breakthrough innovations?":

> *"It's a way of coping with the uncertainty. And I think it's wrong. The financial indicators are lagging indicators. And if we talk about this great level of uncertainty, financial indicators should be treated very carefully because there is huge caveat to most of the numbers that it depends on this, it depends on that, it is assumption of this or assumption of that... I would most likely push for customer, market indicators, technical indicators until you come to a point where the idea is as it would be a product ready to move forward with, when you have most of that information collected and analyzed. Then you can look at the financial indicators… the best way to kill a breakthrough innovation is to stamp financial indicators on top of it."*

The head of innovation from division C had similar thoughts regarding the role of financial indicators, that their importance should be greater at the later stages of breakthrough innovations, and at the beginning other metrics could be more important. He proposed focusing on different metrics in different stages of breakthrough development.

> *"Well when you proceed it's of course the financial figures. But before you have all these financial figures the KPIs should be you know, how many customers have you interviewed, how many customer meetings have you had in regards to this potential (project) or whatever. More of quantitative things that to gather the information rather than what would the financial impact be. Financial impact would definitely come but that would come at a later stage in my mind"*

A bit similarly to this, vice president from the division B described being more flexible with the financial indicators in breakthrough innovations in order to let the projects "fly" and not kill them too early. The metrics might be the same, but the way you treat them differs. When asked about does the nature (metrics and the way they are used) of KPIs differ for breakthrough innovations compared to adjacent and core she responded:

"This is a valid point because we know that for example the KPIs are the same, but the way that the KPIs are treated might be different… if we talk about breakthrough, we take the risk, we understand that this is something that will come… So even if we follow these KPIs, we need to understand that this something we want to foster, we believe in it, meaning that it might take a bit more to achieve the profitability figures that we have been expecting but you are treated differently due to the fact that it is breakthrough and maybe the risk taking is different."

She later continued about similar topic, when asked about the role of financial indicators in assessing breakthrough innovations:

"You need to be able to accept higher level of risk maybe be a little bit be more flexible in what comes to the expected financial indicators or rates of return. Because otherwise if you go by the corporate standards, which are meant for.. for basically for core innovations or whatever, you will end up killing project before it has the chance to fly"

This previously mentioned difficulty of dealing with uncertainty and doing decision based on limited information, especially financial, was something that many of the interviewees mentioned as a challenge when assessing breakthrough innovations. However, it might be that this view is not shared with everybody at the company, and there might be a block in the company who might not want to cope with this uncertainty. Division C head of innovation said the following when asked about what is hard in breakthrough innovations compared to adjacent and core:

"I would say the unknown is so much bigger in the breakthrough... and in a company like we are with a lot of controllers everywhere, I mean my boss is a former controller for instance, it's figures and facts that rule, and if you don't have those figures and facts you don't know the true market, you don't know how big portion of the total market is available and those things. It is the unknown, and being able to take a decision based on, I wouldn't say a gut feeling, but closer to gut feeling than it is in these adjacent innovation projects. "

In the table 6 below thoughts about using financial indicators in breakthrough assessment are gathered.

Table 6: Role of financial indicators when assessing breakthroughs

Division	The role of financial indicators when assessing breakthroughs
A	The role seems to be high from the beginning of the project until the end
B	Harder to estimate for breakthrough innovations, so need for flexibility when assessing financial numbers. In the early stages of process needs to be given enough room to grow.
C	The role of financial indicators should be small in the beginning, and increase in later stages. The role of customer related indicators should be higher in the early stages.
D	Did not specifically answer to the question
E	In the beginning, it is more about other aspects than financial, e.g. strategy, learning potential, possibility for differentiation. Prefers to work with orders of magnitude and potentials in the beginning. The detail and importance of financials would increase as the project moves forward.
Group Innovation and R&D	The role of financial indicators is exaggerated currently. In the beginning customer, market and technical indicators should have more importance, and as you gather more information the financial calculations should be made in more detail

The KPIs seem to have more communicative / learning role in some of the divisions. A couple of division mentioned that the KPIs are used to find root causes for the problems if they are short of their target values. For example, at division B, they follow KPIs against targets. The vice president answered the following when asked about how they react if they do not achieve the targets:

> *"So, then we do… root cause analysis... if the KPIs are not there (close to the target values) then of course those are discussed in the monthly meetings, that first of all why are we delayed in the KPI and what is the issue… R&D's having their monthly management meeting where the KPIs gone through and then follow them up."*

At division B, they follow project specific KPIs with traffic lights, with green meaning all good, yellow meaning slight deviation and red high deviation from the target. Some project specific KPIs are for example outcome, cost, schedule, resources and business case based measures. In addition to these project specific KPIs, that are used to identify possible project level problems, division B also has portfolio level KPIs that are used to monitor the whole innovation portfolio, and they are used in similar manner (comparing against target values). These include KPIs like sales of new products and services, and lead times between gates.

The learning aspect of projects came into discussion in other areas than project KPIs as well. When asked about what are the most important factors when assessing breakthrough innovations, director from division E brought up, among other things, the fact that many of them fail, but there is a learning aspect even in the failed projects.

> *"Most important factors. I think it's what I said, it's about strategic fit if this fits on what we are trying to do as a company and as a division, that is first. If there is market potential in here you can draw different things like what is the value proposition, what is the differentiation for the customer, what is the size of this market and the growth to understand if this is interesting or not to pursue. Then you need to evaluate the technical capability, meaning do we have already the skills, do we already have the capability to develop this technology or this product… And then finally maybe is the learning potential in the initiative, not everything that we do in breakthrough will go through all the stages on the contrary, right? The hit rate is I don't know, one to I don't know, one to eight, maybe. One to ten, I don't know in the markets out there, meaning just a few of the products will really come through all the way but in a lot of those you learn as you go and this will help us to make the other projects come through. And that is also how we try to evaluate a bit, what is the learning potential of each project."*

Director from Group Innovation and R&D brought up the same thing, learning aspects of all projects, even the killed ones. His response when asked about killing projects, if the company is doing it enough:

> *"I'm not so concerned about killing projects, I'm more concerned about how do we document. Because there is learning in all projects. How do we systematically capture and catalog the learnings and make them available to our own research and development community? So there is organizational learning for all the projects."*

Next, he was asked if this documenting should be done with a post-project review or continuously throughout the project:

> *"I think If it is not done, some do it some don't, that there should be a log kept by the project leader where the research findings are logged as they appear. So, it's not only when you summarize the project, you might miss some of the findings that you learned along the road. Kind of come to the conclusion at the end, go back to your level one hypothesis and you say well it did work, what did not work because of, but there was a lot of learnings in between, how do you make sure to capture those because they can be the next one, the next trigger for an adjacent innovation. I mean take 3M for instance and this post-it story, the failed glue, right? That could just have been*

discarded so it failed. But someone actually saw that this could be potential for another use. What is our post-it-note story? … Systematically documenting without taking up too much red tape, really quickly just get it up and get it searchable. That is the most difficult thing of all I think, how do you make it searchable."

The formal post-launch reviews were not specifically a topic in the interviews but it seems there might be a lack of formality in the process. Some of the divisions indicated having a post launch review of projects in their process descriptions, some did not. If the processes are structured and constantly used, or if they are just in the process description documentation remained an open question for the thesis writer. In the interview with division B (division that has a formal process according to the process description), the interviewees found that they were lacking formal process for post-project evaluation and learning, currently they have no criteria to define if the project was successful or not.

4.3.6 Focus and effective product portfolio management

Portfolio management was a topic where there were quite a lot of differences between the divisions. Generally speaking, this was seen as a problematic area in many divisions. Some of the divisions even indicated that they did not have any sort of formal portfolio management system, that they did not do any prioritization between different areas of innovation.

Division C head of innovation said the following when asked how do they prioritize between projects today:

"We don't prioritize today. This is the reason why I brought up this that we have so many different streams as well. Some (streams) are being steered or governed through IT steering board, others through XXX business line steering board, others through business line heads etc. etc. So we don't really, we have a portfolio of projects, but the correlation between these projects are not steered in anyway today."

With the different streams he refers to innovation projects emerging from different sources within the division or within the rest of the company. Projects from the different kinds of streams are not compared in anyway, each stream having its own steering body and decision processes for prioritization. When further asked about how he thinks this prioritization should be done he said the following:

"I do like the idea of having the responsibility very close to the market… …But then we need to have governance above that to steer between those steering teams… especially when it comes to prioritization and where should we put the money and where shouldn't we put the money. Because today we don't compare a IT innovation project with X business unit innovation project but we do it within IT or we do it within X for instance… And I think it is also needed to have it (higher level prioritization). Otherwise you are prioritizing your own babies all the time."

Other divisions spoke that they were building up the portfolio in the last few years, and only now started to think about project prioritization. Division E director said the following when asked how they do project prioritization at the moment:

"We don't… At least not in a very structured way as of now because we have been in a phase of building the portfolio ramping up the organization so the last two years have been basically hiring a lot of people and creating the projects, creating the portfolio… we reach the capacity of things that we can do, and then during this year we start having some prioritization. But we didn't have that yet."

On the other extreme, division B had formal scorecard in place to compare the projects in case of resource restrictions, and formal processes who makes the decision in different cases of resource conflicts. However, this scorecard structure was in place only for product development projects which in their case are adjacent and core innovations. The breakthroughs in this division were handled separately in strategic projects portfolio, which has strategically important innovation projects including breakthrough projects in it. In this portfolio, similar scorecard system was not in place, at least not yet.

The divisions have vastly different resources in their innovation and R&D functions and this was visible also in the interviewees' answers related to portfolio management. One of the divisions (A) interviewed said the following when asked about if they would like to add a scorecard (weights assigned to different financial and non-financial factors) type evaluation method for project prioritization:

"The situation is so that we have reduced in the last 10 years from whatever 200 people working in research, more than division B has today, to this 20-22… if we would still have this 180 maybe we would also do something like scorecards and making other evaluations of the projects, but we are so lean and mean that we can't do this anymore and it does not make sense to put focus on this. We have our clear

priorities, we have clear decision body about the projects... We have let's say 1/14th, of that, so 2.5% of maybe what division B is spending we spent for research, so we have to be very very different in our ways of working and that is also reflected for instance in this kind of selecting the projects and the project activities."

Also, the criteria to make the go / no-go decision seems to be lacking in some divisions. For example, division D manager said that they were lacking a formalized structure on how to move on from the different gates. When he was asked if the formal processes at the gates are related to the go / no-go decision and decision criteria standardization, he answered the following:

"Yeah exactly. So, when you approach like gate one go/no-go who makes that decision, what is actually used to qualify if someone is able to pass or not"

Director from Group Innovation and R&D rose a few interesting points, one is that key stakeholders might get infatuated by an idea, and another one is some projects might be kept alive simply because the company has already invested a lot of money into the project. However, it is fair to note that he had previously mentioned that he is not so concerned about killing the projects, indicating that the company is doing it adequately (section 4.5.5 p. 53). It might be that he just wanted to point out that getting infatuated by an idea or keep investing because you are not willing to accept sunk costs might be something that could happen. He answered the following to a question "Have you seen any common reason why you start some projects that you shouldn't start or you continue some projects that you shouldn't continue?":

"I think you can get infatuated by an idea. It could be a current market trend that you want to catch on to either because competitor is doing it or maybe wrong stakeholder pushes the idea. That could be a pitfall for selecting ideas that maybe the market is not ready for or the technology is not mature for or the production technology is not ready for. I think there is always the inherent risk of keeping a project alive too long because when you have invested a lot of money in it… I think sometimes it could be if you allow a project (to continue) because you think you are really really close to solving it, that to keep investing is something (you do), consuming more money than intended because you think you already spent enough money, otherwise all of this money will be wasted. That is of course always the risk. On the other hand then that typically is always balanced by a very optimistic outlook on what the market could be if we succeed. It doesn't happen if it is smaller market or market potential."

So, the only thing that can be said about the innovation portfolio management at the case company overall is that the processes, governance models and resources behind the processes vary substantially. Therefore, the problems the different divisions have also vary substantially.

4.3.7 Next generation Stage-Gates

Stage-gate models were both seen and not seen as something that should be modified to different types of innovation. In this case, the question asked was "should there be a separate stage-gate "track" for breakthrough innovations than for adjacent and core?" Four out of the six functions (5 divisions and Innovation and R&D) said there should be a separate model to assess breakthrough type innovations. See table 7 below for function specific reasoning behind supporting or not supporting the separate stage-gate track for breakthrough.

Table 7: Separate process or same process to assess breakthrough innovations

Division	Breakthrough innovations need a separate process	Clarifying comments
A	No	Wants a process that fits all types of innovation projects. However, said that one thing should be reflected earlier for breakthroughs, how to make the market entrance and sell the product
B	Yes	Currently have separate process for strategic projects (includes breakthrough innovations). The process is not as well established as the process used for other product development projects. Would want to do that from scratch and focus more on iterative part of the projects.
C	Yes	Different processes for different types of innovation. In adjacent innovations, some parts could be skipped, meanwhile for breakthrough and core, more time should be spent in the first parts of the process rather than the last ones.
D	No	Did not see a need for a different process, while saying he might be overlooking something
E	Yes	Would use the same process for all innovations, but would skip some parts for adjacent and core innovations. For example, for adjacent and core innovations, it could be possible to start the project already at stage 3, meanwhile breakthrough innovations would go through the whole process.
Group Innovation and R&D	Yes	Early stages of the breakthrough process should be prolonged and much more iterative. The current stage-gate models work well for adjacent and core innovations.

What the track for breakthrough would comprise of has been discussed in the earlier parts of the thesis. The biggest issues identified are: higher focus on the early parts of the process (4.3.2), the iterative nature of the early parts (4.3.3), customer focus from the beginning of the project (4.3.1), and not relying on financial numbers early on in the process (4.3.5).

For adjacent innovation projects, some of the interviewees recommended express stage-gate model, in other words skipping some stages, or relying on checklists and going through the stages fast (4.3.2). Some of the divisions also ran less detailed processes for low budget projects. For example, specialist from division B said that one of the weaknesses of their stage-gate model was that it is quite big package, and some saw it as too slow. In small projects, they did not run the full stage-gate model. He said the following when asked if they run the whole stage-gate process for also the small projects:

> *"For product development projects, we have a limit of 20k€ of product development costs or if the specification changes then it should be a project and it should follow the same process. So, the smaller than that are called assignments and then it is a lot lighter model"*

One aspect that some of the divisions emphasized was that their division had such a unique nature in their business and therefore their stage-gate model had to be different compared to other divisions. However, it seemed that the problem was not that the stage-gate models should vary between the divisions, but between the different types of innovation projects (breakthrough and adjacent). The biggest differences in the stage-gate models were in divisions E and D when compared to the other divisions that had quite similar stage-gate models. Division E has mostly breakthrough innovations, around 90% of their portfolio. Division D does not really have breakthrough innovations in their portfolio. However, many of their product development projects are modifying the existing products for new customers. The interviewee did not classify these types of projects as breakthrough, as the technology risk in these types of projects is not that high and the developed product is somewhat similar to the existing ones. Still, because the projects are for new customers, they had added this previously mentioned commercialization framework to tackle this problem. The other three interviewed division were mainly doing adjacent innovations and their stage-gate models reflected this.

So, the divisions have modified their processes to suit their type of innovation projects. If there were separate tracks for breakthrough and for other types of innovation, it could be that the

divisions would not have as strong a need to differentiate their stage-gate process. When asked about why do the divisions' stage-gate processes differ, the director from Group Innovation and R&D had this answer:

> *"The inherent perception that their business is unique. I don't, honestly, I don't see that there is an articulated need to have difference because the content looking at it for adjacent innovation should not have to trigger any differences in the gate process. What I have seen and speaking into division E is this imperfection what you have with breakthrough and you try to push that through adjacent innovation funnel and that of course doesn't really work so it is better to have a side track that caters for that need, and then keep the adjacent innovation stage-gate locked and ready in this current format."*

Support for having similar processes across divisions came from divisions side too (see table 8 at the end of this section). One common argument for having same or similar processes was that the principles behind the innovation matter more than the actual innovation you are developing, it does not matter if you are developing a chair or a table if you are still developing breakthrough innovation. The head of innovation of division C said the following when asked about the biggest benefits of having same or similar processes:

> *"I think that if you have a process and you follow a process then you can develop a process. If you don't have a process or if you have 10 different processes, and then 10 different governance, and 10 different everything, then it's harder to develop them all in the same direction... If you are talking about for instance breakthrough innovations, it doesn't matter if the end-product is going to be a chair or a table. You still need to go out there looking to who are the customers, what are the pain points that the customers have today, what do they want to sell etc. etc. it doesn't matter what you actually produce. So, having a process, then you can develop it. Having 10 processes then you will never ever be able to develop it to perfection."*

One complicating factor regarding adopting cross-divisionally used innovation processes is that the level of documentation required differed significantly, even between the adjacent innovation models. For example, director from division A mentioned a couple of times during the interview that they needed to be lean and mean to work with the resources they have. The quote in section 4.2.6 highlighted that they would not want to adapt similar scorecard method as division B has, and later during the interview he mentioned again how the resources restrict them to adopt more detailed processes:

> *"We will be very very careful with extending our work or running gate-decisions or preparing gate-templates as for instance division E is doing like this. If we would need to do this like E, we can't do this. Then we run not anymore 39 projects in the year, total year maybe 50-60 projects, then we just run 10 projects. If at all because we don't have the resources to make all this nice and shiny reporting templates and we don't have the people for doing this."*

This raises some important questions, on whether it is justified to run that many projects with leaner documentation, and does it result in suboptimal project selection? This thesis will not discuss this issue in detail but for the case company it would be wise to try to answer the question: Have the divisions with more detailed adjacent innovation processes and more documentation been more successful in their project selection? This of course works both ways, if the divisions have not been more accurate in the project selection, what justifies the heavier process? Another question this raises is, would the divisions with smaller resources be able to cope with as comprehensive processes as the larger divisions even if more comprehensive processes would result in better project selection?

From the interviewed functions three clearly indicated that the processes used at different divisions should be similar for all types of projects, one indicated that the processes should be similar for strategic projects, one indicated that similar processes would be beneficial but not possible, and from one function it was not possible to interpret the answer as a clear yes or no. The function specific answers and clarifications for those answers are listed in table 8 below.

Table 8: Unified or differentiated processes between divisions

Division	Should the processes be unified?	Clarifying comments
A	Would be beneficial but nearly impossible without deviations	Every division might have different aspects that need to be reflected in the stage-gate model. For example, resources of the divisions are different and therefore the detail of the documentation can be different.
B	Not for normal product development, yes for strategic projects	Hard to make structured and detailed processes for product development projects as the organizations are not similar. However, for the strategic projects (includes breakthrough and other long, strategically important projects) and the ideation, for those it would make more sense to have the at least very similar processes.
C	Yes	There should be different processes for breakthrough/adjacent, but within e.g. breakthrough no need to have different processes between divisions. Group innovation and R&D could have a role in unifying the processes and helping to foster process improvements.
D	Cannot tell based on answer	In theory, yes, but in practice it might be challenging. The business logics of different divisions are quite different, how much is focused on commercialization and how much is focused on R&D. The divisions with similar type customers could have similar stage-gate models.
E	Yes, but with a little bit flexibility	It is more about the principles behind, if there are different processes for different types of innovations, it should be alright to unify the processes. The processes should be similar but not the same, the divisions should have some flexibility to adapt for the different realities.
Group Innovation and R&D	Yes	As long as there are different processes for breakthrough and adjacent, there is no need to have different processes between the divisions.

5 DISCUSSION

Based on the data from the interviews, some of the seven principles identified by Cooper and Edgett (2008) seem to be related more to breakthrough innovations than to adjacent innovations. Listening to the voice of the customer, heavy front-end loaded process, and iterative nature of the development came to discussion often when speaking specifically about breakthrough innovations. Moreover, the first three principles came into discussion as one larger theme rather than three individual topics. The interviewees emphasized the importance of early parts of the process and the iterative nature when assessing breakthrough innovations, and when asked what these iterative early parts would include, the answer most often was a strong customer emphasis and iterating with the customers. This finding of importance of iterative front-end is in line with previous research, Veryzer (1998), Herstatt et al. (2008) and Bertels et al. (2013) all highlight the importance of iterative front-end loaded development for breakthrough type innovations.

To get the customer and market perspectives in for breakthrough projects in the early parts was a key issue identified in the interviews. Herstatt et al. (2008) found that the market size and customer price sensitivity were harder to identify for radical innovations than incremental innovations. Bertels et al. (2013) state that understanding the market is vital for both incremental and radical innovations, but in radical innovation projects quantifying the sales and market numbers were not beneficial. It might be that the desire to truly understand the market and the customer were a reaction to hope to decrease the uncertainty in the breakthrough innovation project assessment at the case company. In the interviews the respondents emphasized things like understanding customer value proposition and customer needs, is the market attractive, and what the competitive landscape is like. These things are not necessarily quantifiable factors, they are questions where you will get qualitative answers to. It seems that at the case company, at least the interviewed people do not want to cope with the uncertainty by asking for specific numbers but by asking questions and learning from these questions. However, this might not be the case in the case company overall, as the previously mentioned "the facts and figures rule at the company" comment indicate.

Another interesting point related to the fuzzy front-end was that some of the interviewees proposed for adjacent innovations "express stage-gates", or skipping some steps in the fuzzy front-end, or relying on check-lists and going through some of the first steps fast. The academic literature does not seem to back this suggestion. For example, Herstatt et al. (2008) found that fuzzy front-end work is beneficial for both incremental and radical innovation projects. It seems to be more that the activities within the fuzzy front-end should be different (Bertels et al. 2013,

Veryzer 1998). In adjacent innovation projects estimating business cases are more beneficial than in breakthrough innovation projects (Bertels et al. 2013), and it is easier to estimate market sizes (Herstatt et al. 2008). On the other hand, breakthrough type projects rely more on iteration and learning in these early stages (Veryzer 1998, Bertels et al. 2013). Also, Souder et al. (1998) explain that as uncertainty increases, typically more design change frequency is needed. However, opposing view comes from Cooper and Edgett (2012) who mention that for low-risk, low-budget product enhancements, shorter and streamlined stage-gate model could be used. The key word here might be low-budget, there might not be reason to run extensive and time consuming stage-gate process for small projects that will have a small effect. In the interviews, some of the divisions told about running leaner processes for projects below certain budget.

Four out of six functions (see table 6 in section 4.3.5) indicated that the use of financial indicators required flexibility, or they are inadequate at evaluating breakthrough products in early stages. Only one interviewee clearly indicated that their importance for this type of projects should be high from start to finish, and from one interview, clear view regarding this question could not be interpreted. The interviewees who said that the role of financial should be smaller in the beginning all indicated that the role of these figures, and the detail of the calculations, would increase after the early stages, as more information is acquired. Findings are in line with Nagji and Tuff (2012) view that financial indicators assess this type of innovations poorly.

When it came to what type of indicators these four functions wanted to emphasize in the early stages, customer and market aspects were mentioned by all of them. Herstatt et al. (2008) indicates that it is harder to estimate market size for breakthrough type innovations, and Bertels et al. (2013) study indicates that in the early stages, understanding the market has a significant impact on success of breakthrough innovations, but the quantification of the business case does not hold significant importance. In line with these studies, the interviewees did not seem to push for market size type indicators. They rather spoke about indicators or aspects related to learning about the project. For example, one of the interviewees mentioned indicators related to *"how many contacts have you had with a customer"* or *"quantitative things to gather information"*. Another one emphasized things like "*understanding if we can differentiate ourselves in the market", "understand what is the business case for the customer",* or *"understand what type of business models we can operate with".* These aspects cannot be even called indicators, but they are worth mentioning in this context, as they came to discussion as alternatives for financial indicators in the early stages of breakthrough projects. Also, other topics than customer and

market indicators arose. E.g. strategy fit, technical capability match with the company, and the learning potential of the initiative.

When it comes to the topic of portfolio management it is impossible to make any generalizations from the case company as the processes vary substantially based on the interviews and the documents provided by the divisions. Cooper et al. (1999) study indicates that the best performing companies have more formal processes and the processes are used systematically for all project evaluations. This kind of systematic process is not happening at the case company company-wide, and in some divisions not even within the divisions themselves. A newer study from Cooper and Edgett (2008) say that a good practice for portfolio management is setting aside "strategic buckets of resources" for different types of projects, which includes projects that are in different market segments. In the case company context setting aside resources for different types of projects can mean resources for different divisions or for different types of projects within divisions. However, setting aside resources does not mean that the portfolio management processes should not still be formalized and used systematically.

Cooper et al. (1999) study indicates that relying on financial methods, like NPV or IRR, in project prioritization results in poorly performing portfolios, meanwhile relying more on strategic approaches and scorecards resulted in better performing portfolios. Relying on more methods resulted in better performing portfolios than relying just on few methods. In the case company, it can be said that all three of these method groups were present at varying levels. Some divisions had scorecards and some did not, some process templates had more emphasis on strategic fit than others, and financial factors seemed to have different weight in different divisions based on the interviews, with some emphasizing non-financial aspects much more than others.

Some of the divisions indicated that they did not have clear Go / kill criteria in place at the gates. Cooper and Edgett (2012) study indicates that having clear criteria to make the go / kill decision at the gate is a clear best practice, with 85% of best performers employing this compared to only 25.9% did. Actually making the go / kill decisions at the meetings was another clear best practice, with 60% of best performers having this practice compared to 25.9% of the worst performers. At the case company, some interviewees indicated that their divisions do not do these decisions, at least not systematically. This was for example due to "ramping up the

portfolio" in one division, and in another division, they had so many different "streams" of innovations that it was hard to systematically prioritize the projects.

Four out of six interviewed functions indicated that breakthrough innovations need a separate process (see table 7 in section 4.3.7). In Cooper and Edgett (2012) study 75% of best performers (top 25%) indicated having flexible stage-gate models that are modified for different types of projects (e.g. risk level, scale of the project), meanwhile from the worst performers (bottom 25%) 37% indicated so. Having flexibility in the stage-gate process seems to be a best practice, which also has relatively high amount of support in the case organization.

The topic of process unification across divisions is a challenging topic both in terms of information from the case company (see table 8 in section 4.3.7), and based on the lack of academic studies. Process unification refers to having same or similar processes across divisions to run innovation projects, different types of innovation could still have different types of processes. Four out of six functions clearly indicated that cross-divisional process unification would be a good idea, from which one indicated that it would make sense only for strategic (includes breakthrough) projects. From the remaining two, one said unification would be beneficial but not possible, and from the other interview a clear opinion about process unification could not be interpreted. Two out of four functions that supported process unification said that the processes should be the same, and two said the processes should be similar but maybe not the same.

Main argument supporting process unification was that it is more about the principles behind the innovation rather than what the innovation is, and that it would be beneficial to have similar innovation processes. Arguments against having similar processes were that the divisions have such a unique nature in their businesses that common processes cannot capture the reality of their businesses. One division also emphasized that the different resources of different divisions make running similar processes impossible, the smaller resources divisions simply cannot run the process that larger resources divisions do. See table 9 below for benefits and challenges of having similar innovation processes identified in the interviews.

In academia, it is argued that different types of innovations require different processes (e.g. Cooper and Edgett 2008 & 2012, Bertels et al. 2013). However, whether the same types of innovations require different processes in different contexts is a question that has got less attention. It is still an open question if it is beneficial for companies to have the same, or at least

similar, processes for similar types of innovations in different divisions of the company, or are the realities of different divisions so different that similar processes are not beneficial.

Table 9: Benefits and challenges of having similar innovation processes

Benefits of having similar innovation processes	Challenges of having similar innovation processes
This would enable the development of one process further rather than having to develop many parallel processes.	Divisions or individual people may want to reflect some aspects in the process more than others, this may cause the process to be too generic or diluted.
This would enable to find the best practices and share them transparently within the company, and to speak the same language.	Resources of different divisions may cause the process to be too heavy for smaller innovation functions, or other way around it could end up being too light for the innovation functions who currently have strict processes.
Eventually, this could enable people (e.g. project managers, market intelligence) to transfer between divisions based on need, enabling sharing of best practices through physical interaction of the people.	
This would enable to see how the innovation projects are progressing on a company level. For example, how many projects are at stage 1.	

Lastly, an interesting point related to breakthrough innovations and Cooper and Edgett's (2008) seven principles of successful NPD is the fact that many of the principles came into discussion in the interviews specifically when speaking about breakthrough innovations. This would suggest that the principles are more related to breakthrough innovations, and this would further indicate that best performing innovators have processes built more fore breakthrough innovations than for adjacent innovations. The best performers are top 25% of companies based on NPD productivity, which is calculated by dividing last 5 years' sales or profit from new products with R&D spending as a percentage of total sales of the company. Nagji and Tuff (2012) say that around 70% of returns in high-performing companies come from transformational innovations. These factors could indicate that the best performing innovators are separated from the rest mainly by the way they handle breakthrough innovations, as their share of the returns is so large.

6 CONSTRUCTION

In the process of analysing the data, several areas of improvement were identified. The construction section is structured so that in the first part two larger "Tier 1" issues are discussed in more detail and in the second part other "Tier 2" issues that were identified are brought up but with limited discussion. The division to Tier 1 and Tier 2 does not imply the importance of the topics, nor does it mean that they would be harder to implement. They are Tier 1 simply because more material related to these changes were found during the interviews with the divisions.

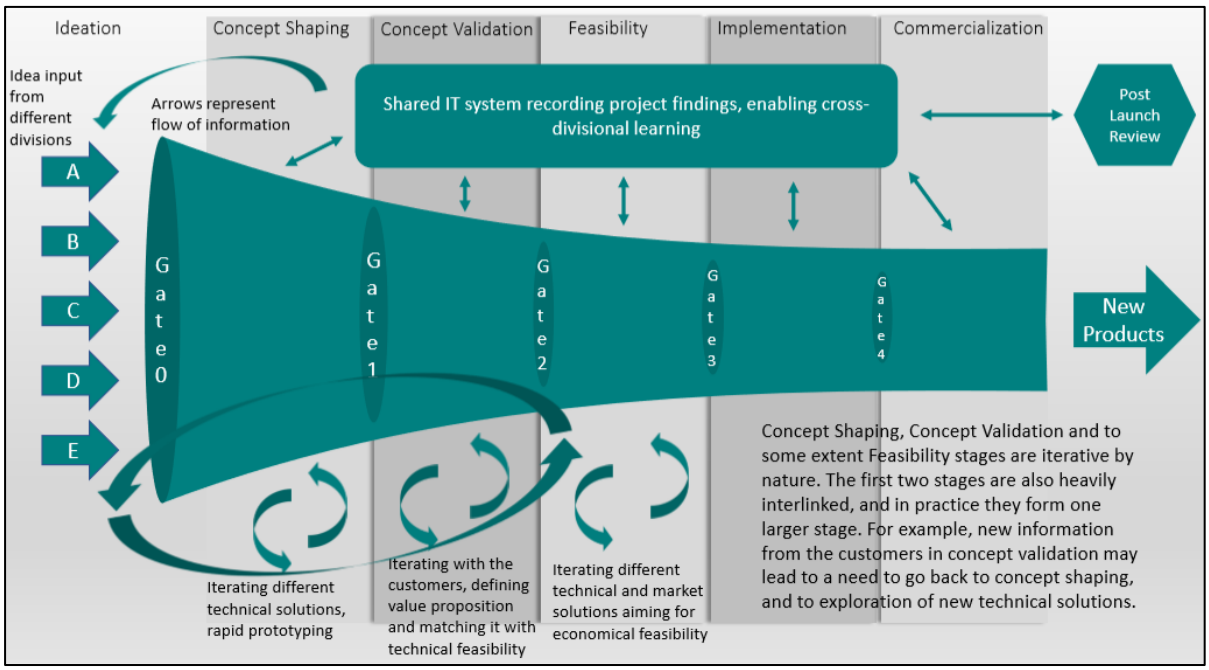
6.1 Tier 1: Breakthrough side-track & why to unify the processes

Breakthrough innovation side-track:

It became quite evident that there is a huge difference when assessing breakthrough innovations compared to adjacent and core innovations. Most critical differences are related to the role of risk, role of hard figures (e.g. financial and market figures), and to the role of iteration and learning. These differences are discussed in more detail in later parts of this chapter. At first, the author pondered if it would be possible to still have just one way to conduct the process (same process for core/adjacent and breakthrough) but soon abandoned the idea because of these huge differences. Therefore, this thesis proposes having a separate track in the stage-gate model modified for breakthrough innovations. Having flexibility in the innovation processes to cater to different types of innovation is widely used among the best performing companies, from whom 75% indicated that they do not have one-size-fits-all stage-gate model (Cooper and Edgett 2012).

The separate track model continues to have a model that would be similar with the model currently used in divisions that have mostly adjacent innovation projects, this model however should be unified as discussed more in section "why to unify the processes". The proposed separate track would be used for breakthrough innovations and it could be used also for other major strategic projects, that are not breakthrough but involve a high risk and uncertainty. See the proposed side-track model in the figure 5 below.

Figure 5: Proposed framework for breakthrough innovations



First three stages in the breakthrough model are iterative by nature, and especially the first two stages are heavily interlinked. In "Concept Shaping" stage the aim is to prototype different technical solutions to see which work for the idea, and to avoid potential technical pitfalls. In the "Concept Validation" stage, these different technical solutions are iterated with the customers, test-feedback-revise loops for the different technical solutions are gone through to build the perfect value proposition. It is quite evident that information acquired in concept validation stage might result in a need to go back to concept shaping stage (or need to kill the project). For example, if the company found several technical solutions for the idea in the concept shaping stage, and in concept validation stage it tested those ideas with the customers and got feedback that the product does not match any of the potential customers' needs due to product characteristics X, Y, Z, the company should be able to go back to the concept shaping stage if it believes those X, Y, Z could be changed. Concept shaping and concept validation stages aim to build the knowledge base to pick up the best ideas for the more expensive later stages and to allow smooth progress of the product development process later for the products that get through.

As mentioned above, the activities done in the first two stages may overlap. There also might be a need to do concept validation stage activities already in the concept shaping stage. Because of this natural linkage, three different options on how to handle these first two stages were

identified. This thesis recommends adopting either one of the first two options, or to try them both and test which one works better.

The first option is to treat the stages separately, requiring the gate 1 go-decision, technical proof that the product might be possible to produce, to “unlock” more resources for the project. The project team could do the activities of both these two stages even prior the gate 1 decision. Also, after the gate 1 decision, the team could still do concept shaping activities if there is a need for it. This would enable the flexibility for the project team to choose to which of the activities in these highly interlinked first two stages it focuses on, keeping the project work more flexible. Still, it would incentivise the project team to find tangible technical results to unlock further resources for the project, giving a clear goal for the early stages of the project work.

The second option would be very similar with the first one. The stages would be separate and there would be the gate 1 decision to unlock more resources for the project. The project team would still be able to choose which of the activities from the first two stages it focuses on. The difference would be in the gate 1 decision. In this decision, the project team could present either found technical solutions with a proposed potential value proposition, or more detailed customer validated value proposition with a technical plan on how to reach it. The strength of this option would be that it enables the process to cater to ideas that originate from different sources, either from the customer validated pains or from more technical origins. This way the process would take into consideration both the divisions that are more R&D heavy and the divisions that are more customer oriented. However, it would leave an open question, how to fairly assess projects that are at the same gate but whose gate material is focused on different topics? A weakness of this option would be that it does not give as clear goal for the project team to focus on as the first option would.

The third and the last option would be to treat the stages as simply one larger stage that would prepare the project for the gate 2 decision. You would get a go-decision at the gate 0 for this larger single stage, and it would be up to the product development team to choose which of the activities they focus on. This option would enable the highest amount of flexibility for the project team. However, this would cause the gate 0 decision to be very large in monetary value compared to what is known about the project at that time. It could also lead to small “chaos” if the project team tries to do too many activities at the same time, and it would not give a clear goal on what to focus on.

All the proposed options lead to similar gate 2 decision process. The gate 2 decision would be based on similar factors as it currently is at the case company's processes. Among other things, main points are if the product seems to be technically possible to produce at a reasonable price, and that there is customer validated value proposition for the product. After this comes the feasibility stage that would also be similar in all proposed options. In the "Feasibility" stage first small scale pilot plant is made to test the technical feasibility to produce the product in small numbers, and to test the market with initial sales. At this feasibility stage, first information from the sales can be used to still alter the product characteristics if the market response indicates a need for it. Therefore, this stage includes "looped arrows" in the figure 5, even as its nature is not as iterative as in the first two stages. At the end of feasibility stage, detailed business plan with a focus on financial figures can be finally made for the breakthrough innovation.

After the feasibility stage, the process follows typical linear stage-gate model. Implementation is a ramp up stage to larger scale pilot plant, testing the market further, and commercialization is a ramp up to industrial sized plant and integrating the product to existing business functions. It is important to note that even as the implementation and commercialization are relatively straight forward steps in the process description, most of the costs are accumulated in those steps. On the other hand, most of the information that results in the success of these steps are gathered in the fuzzy front end (concept shaping, concept validation, and to some extent feasibility).

So, the proposed breakthrough stage-gate model differs from the typical adjacent stage-gate model in the early parts. It is more iterative and the detailed financial calculations are done the first time for gate 3. This leaves open questions, such as, what to focus on in the early parts, and what is the main input for the gate decisions if not financial numbers?

The proposition for the focus is learning. Why learning? As one person from the interviews said, the hit rate of breakthrough innovations is maybe 1/8 or 1/10, but there is learning potential in all projects, even in the failed ones that the other projects may benefit from. Herstatt et al. (2008) study indicates that in radical innovation projects, the organizations learn more than in incremental innovation projects. Why not try to embrace these characteristics and build a process that tries to capture every last drop of the potential learnings and share them

transparently within the innovation community in the company? Bertels et al. (2013) study indicated that more iterative learning approach results in better performance for breakthrough innovations. Evans et al. (2013) speak about similar a thing, proposing that the number one reason for new products to fail is not spending enough time in the beginning of the process building the knowledge base and therefore picking suboptimal projects to be continued.

Therefore, learning should be the key criteria when developing breakthroughs in the early parts of the process. What could be learned if we continue this project and how do these activities benefit the project going forward, should be key questions to be asked. This should be reflected in the stage-gate process as well, asking questions that may benefit the project and the people working with the projects. Examples of these could be:

- What is our unique value proposition to the customer and why this is a good value proposition?
- How is the changing environmental legislation going to affect this product in X years?
- Why our company is the best place to develop the product?
- Could the developed technology have other areas of usage?

These kinds of questions should have higher priority than asking detailed numbers early on that are deemed wrong anyway. There is a time and a place for detailed financial analysis but it should be done later, just before gate 3 decision as more information about the market and technical aspects has been acquired.

One aspect that was emphasized for breakthrough innovations in the interviews was to bring the customer perspective in earlier in the process. Partnering with customers in innovation context is both common (Enkel and Gassmann 2008) and it has been proven to have a significant effect on innovation performance (Brettel and Cleven 2011).

However, how bringing in the customer perspective early in the process relates to breakthrough innovations' success is a trickier question. Veryzer (1998) proposes that for discontinuous innovations, partnering with customers is not beneficial as the customers do not understand the discontinuous innovations due to their very nature, they break the logical chain of incremental innovations that the customers are accustomed to. The customers do not know what they need. Herstatt et al (2008) on the other hand found that taking the customer perspective into consideration in the fuzzy front-end had the highest effect on reducing uncertainty, and that the

companies that were in frequent contact with the customers understood relatively well the needs of the customer. However, translating those customer needs to technical language was a large issue in radical innovation projects. This indicates that a common pitfall may not be the communication with the customers but rather within the company itself. Herstatt et al. (2008) also found that it was significantly harder to estimate the market size and the customer price sensitivity for radical innovations compared to incremental innovations. Bertels et al. (2013) concluded that understanding the market was a critical factor for success for both breakthrough and incremental innovations, but quantifying the market and sales early were important drivers of success only for incremental innovation projects, the quantification did not have significant impact on breakthrough innovation projects.

Based on the academia cited above and the interviews, it seems that learning should take its place also in the market assessment rather than trying to figure out quantifiable factors, like detailed market size and sales forecasts. “How large is market X?” is less important question than “how can we penetrate market X?”. Similar to financial forecasts, detailed market calculations should take place later in the funnel. Of course, this does not mean any type of market size estimation should not be made in the very beginning. There needs to be understanding that the market is big enough but does it really matter at this early stage if the market seems to be 200M€ or 250M€ if both scenarios would be extremely lucrative business opportunities and it is more about if this product can be made?

How to make the go and no-go decisions for the breakthrough innovations is a question there is no easy answer to. It is easier to answer what should not be major input in the decisions making process than what should be. Cooper et al. (1999) concluded that relying on financial indicators like NPV and IRR result in poorly performing new product portfolios, Nagji and Tuff (2012) suggest that traditional financial metrics assess transformational innovation efforts poorly, especially in the early stages, Berteles et al. (2013) explain that quantifying markets do not have effect on breakthrough innovation performance, and Herstatt et al. (2008) say that quantifying market size is significantly harder for radical innovations than for incremental innovations. Also, the interviewees emphasized how hard it is to get meaningful numbers for breakthrough innovations. Some of the interviewees even spoke about partly relying on gut feeling when assessing breakthroughs. Hard figures seem to clearly not be the answer how to make the go / no-go decisions for breakthroughs.

Denning (2005) speaks that stories complemented with traditional analytical approaches are in the centre of persuasion when transformational innovations gain ground in the company. That may be true in practice, but it can be argued that the process and the gate decisions cannot be built as competitions who tells the best stories.

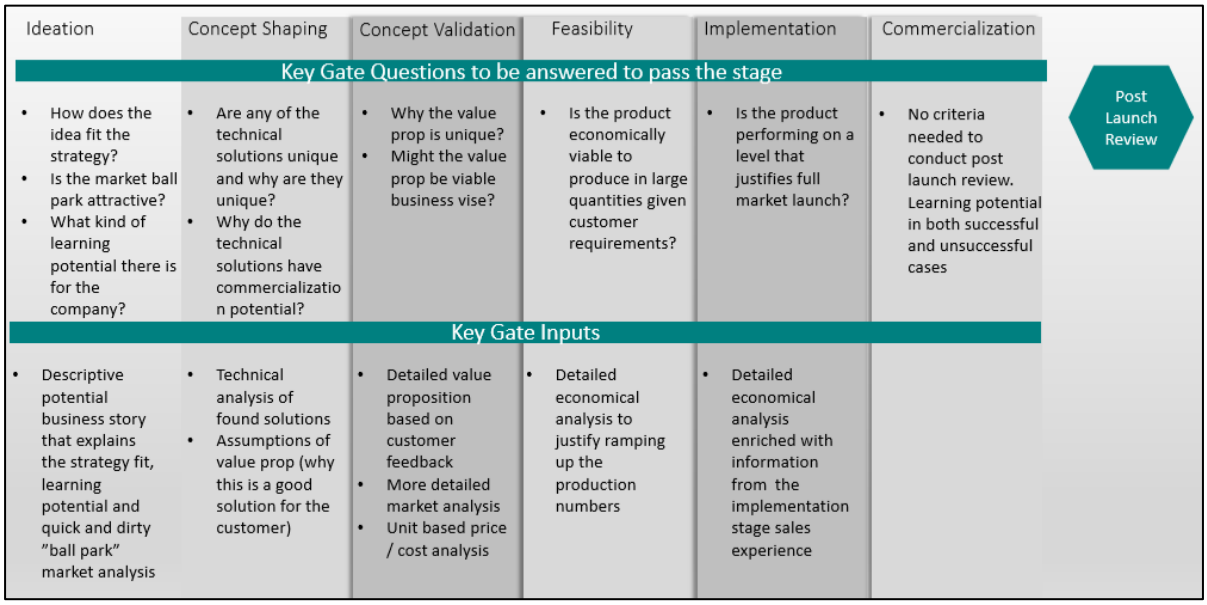
Cooper et al. (1999) concluded that using multiple decision making methods resulted in better performing new product portfolios than using fewer methods. As far as methods are concerned, their study indicated that strategic approaches (business's strategy is the basis for money allocation) and scoring models (scorecards, where the projects are scored based on multiple criteria) resulted in the best performing portfolios. A bit similar to this, Sanchez and Robert (2010) propose that companies should develop KPIs for the project portfolio to take into consideration the strategic perspective and the objectives of the portfolio. Another key finding from Cooper et al. (1999) study was that the best performing companies had more formal processes and the processes were used systematically for all project evaluations.

Another point to consider is should the scorecard criteria differ for breakthrough innovations compared to adjacent and score? This is a question where there is limited amount of studies available. There are studies that speak about the different aspects to consider when assessing breakthrough type innovations. Nagji and Tuff (2012) speak about how financial figures are not appropriate to evaluate transformational innovation efforts early on in the process, Bertels et al. (2013) found that quantifying the market does not have a significant effect on breakthrough project success, and Hertstatt et al. (2008) found that it is significantly harder to estimate market size for radical innovations than for less risky innovations. This would indicate that the scorecard should be different to take into consideration the different aspects of the breakthroughs. However, how companies actually design these scorecards for breakthrough innovations is an area where there is limited research. This may be due to the sensitive nature of the topic for organizations.

The proposition of this thesis for the main input in gate decisions (early on) for breakthrough innovations is combination of strategic approach and scorecard, meanwhile the financial aspect in the beginning would be just to get an idea that the project is big enough to have financial potential. Learning potential of the project would be key ingredient in the gate 0 decision, similarly to Nagji and Tuff (2012) example about Google, who have learning potential as the only initial hurdle at the beginning of the project for transformational innovation efforts. After

that its importance would shrink. From gate 3 onwards the gate criteria could be relatively similar to adjacent and core innovations. Proposed key gate questions and key gate inputs are listed in the figure 6 below.

Figure 6: Proposed key gate questions and key gate inputs



There is currently a process of developing scorecards happening at the organization on at least three different fronts, at two of the divisions and at group level. According to Cooper et al. (1999) the best performing businesses employed much more formal and explicit methods to assess their portfolio, and consistently for all the projects. Therefore, these development processes should be unified under one development process. However, as discussed above, breakthrough innovations cannot be judged by the same criteria as adjacent and core projects are judged, especially early on. Cooper and Edgett (2008) mention that some high performing businesses set up strategic buckets of resources for different types of innovation projects, e.g. depending on market segment or technology. One option for the case company would be to set up a fund for only breakthrough innovations and develop separate scorecard for the breakthrough projects. Moreover, this fund could be used to fund just the fuzzy-front-end part of the breakthrough development, as after the fuzzy-front-end, the difference to adjacent and core innovations is not as high.

What about the strategic approach? Strategy aspects should of course be an aspect of scorecards, whether they are developed for breakthrough projects or adjacent and core projects. However,

in innovation projects, especially breakthrough projects, there is a part that cannot be presented easily, especially in a single number as it would be in scorecards. The part that is based on "gut feeling" as some of the interviewees put it, or to storytelling as Denning (2005) put it. This part cannot be captured by scorecards, but it might be possible to be captured through rigorous, more descriptive, business cases and when pitching the idea to the innovation board, or whatever the name of the decision-making body at gate decisions is. Therefore, complementing scorecard with more descriptive business cases in the decision making is justified.

Why unify the innovation processes between divisions?

Many of the divisions justify having different frameworks by the nature of their business. However, this problem might not be so evident if there were unified processes for different types of innovation. There was the attempt to unify the processes at the company some years back but the end-product was one-size-fits-all solution. After that, some divisions have modified their processes, for example to suit more breakthrough innovation due to the fact that breakthrough plays a huge role in their innovation portfolio. If different tracks for breakthrough and adjacent innovation will be applied, the change process should be easier to accept for divisions that mainly have innovation processes for certain type of innovation. Divisions with mostly adjacent innovation will continue to use mostly the adjacent process and divisions with mostly breakthrough innovations do not have to use the adjacent model that much. Still, the structures would be in place for both types of divisions if and when they encounter type of innovation project not so common for them. Minor modifications (additions) could be allowed if deemed necessary. The common framework should act as a minimum standard for all innovation processes within the company. Table 9 in section 5 summarizes the benefits and challenges of having similar innovation processes that were identified in the interviews.

This thesis will not go into precise detail of what the process for adjacent innovations should be like. However, there are some reasons why the breakthrough model should not be used for the adjacent and core innovations as well. First, there is less uncertainty in the market as well as in the technical development. Therefore, the financial figures and market figures can be estimated relatively accurately earlier. Their role in the decision-making process can be higher also in the beginning. The second point is the fact that overall the adjacent models used at the company are working well for adjacent innovations. Therefore, small changes the small changes

need for unification are justified but there is no need to break apart and rebuilt the whole process.

6.2 Tier 2: Other issues identified during the work

Tier 2 section discusses other issues that arose during the thesis work which will be discussed in lesser detail. This does not indicate that the issues would be less important than the tier 1 issues, they have simply been studied in less detail during the thesis work.

Software tool for communication & communication overall:

The communication between the divisions seems to be poor. The innovation community needs a software tool that would be used to document project findings and share them transparently for all the innovation community within the company. The usability of the tool, and the searchability of the project findings would be important factors to get the benefits out of this tool. Therefore, the innovation community should play a big part in the development of the tool. This tool could also be used to make Stage-Gate processes, meaning which gate you are on and what activities have you conducted etc., visible in real time. The proposed project findings documentation software tool is also a part in the proposed breakthrough innovation framework (see figure 5), as without proper documentation the learning emphasis in the framework cannot properly work in practice.

The overall communication between the divisions innovation units should increase. Innovation day, where people from the innovation community were invited to spent a day together and share ideas, was mentioned as a great initiative by one of the interviewees. Other forms of collaboration could also be encouraged. One possibility would be to invite different divisions' R&D people to work with other divisions innovation projects. Troy et al. (2008) study indicates that integrating teams (different background people working on a single project) had much higher effect on new product success than collaborating higher up on organizational level. This should be taken into consideration when discussing collaboration possibilities within the company.

Governance of innovations and clear go / no-go criteria:

The governance structures of innovation management are not standardized, different divisions rely on different structures to do the project prioritization. One interviewee was speaking about

how his division was relying on different "streams" where innovations come from, and that the prioritization was not done on higher level, meaning between the different streams. Another one said that they did not have clear criteria to decide what projects are eligible to pass from gates. Third one said that there might be a risk of getting infatuated by an idea, or keep spending just because you have already spent a lot on the project. Relying on different streams, and not having clear go/no-go criteria at the gates, might lead to the problems the third one said, getting infatuated by an idea and spending just because you are not willing to accept sunk costs. This can also lead to "protecting your own babies" as one interviewee put it.

According to Cooper and Edgett (2012), simply having go / no-go criteria defined is a strong differentiating factor between the best performers (85%) and the worst performers (25.9%). The clearly defined criteria might have a link with "objectivity and fact base for the decisions", from the best performers 57.9% said they do decisions objectively and based on facts, meanwhile from the worst performers only 14.8% indicated so. Therefore, the case company should set up more clear decision criteria and clear governance models, to avoid getting infatuated by ideas or to avoid "protecting own babies". Also, truly making the go / no-go decisions at the meetings is a clear best practice, 60% of the best performers systematically do this, meanwhile 25.9% of the worst performers do this. The decisions meetings should not be only information sessions about project progress, but decision forums. The comment regarding keeping projects alive and not accepting sunk costs might indicate a need for more systematic go / no-go decisions at the meetings.

However, when it comes to what governance structures the case company should employ, there seems to be no "silver bullet". There is no evidence of which governance structures work best in practice (Cooper and Edgett 2012). Therefore, this thesis cannot suggest any concrete solutions for this. Identifying what of the varying governance models work best in practice at the case company, and applying those best practices systematically at the case company could be a good starting point.

Home for the breakthroughs:

At some of the interviews different kinds of organizational structures were discussed related to the breakthrough innovations. One interviewee mentioned supporting small homes inside a big corporation where the breakthroughs are given time and room to flourish. Similar to this, Evans

et al. (2013) proposed using incubators to foster the higher-risk, long-term projects in safe space. Another interviewee spoke about a similar thing related to a study he was conducting for a breakthrough project at the case company. The conclusion of their study was that breakthroughs should not be included into normal business, they should be treated separately. One of the reasons behind this was, that if you have it in the existing structure, if you need to prioritize and to show good figures short term, you will probably cut down on breakthrough innovations and prioritize the current production.

The breakthrough innovation development is a risky process and the profits from the projects may come several years after the first costs. Divisional profit and loss statements provide a risk for the breakthrough projects as there might be too short focus. Therefore, it would be wise to explore organizational structure options where breakthroughs would be treated separately. This could happen in a completely separate unit outside of the divisional structures, or in separate structures within divisions, where shorter term profit targets are not the main drivers.

Do not kill the fuzzy-front end in adjacent innovations:

Even as this thesis will not go into detail what the adjacent unified model should be like, there is one point related to the adjacent model that caught the eye of the thesis writer, and which should be carefully thought of at the case company. Some of the interviewees suggested express stage-gate models or skipping some early steps for adjacent innovations. This could be related to for example already knowing the market well enough and just ticking the boxes and moving on. The author of the thesis does not recommend this approach. In the adjacent projects, the market and the customers are already better known, or at least they should be, in the beginning of the project. This does not mean that the company should take their knowledge of the market as an absolute fact. The market may have shifted or the needs of customers may have shifted. Moreover, Cooper (1998), Evans et al. 2013), Bertels et al. (2013) all discuss the importance of fuzzy-front-end development for all types of innovation. Case example from Toyota, also indicates the importance of the front-end and keeping the customer perspective as a key decision criteria in this front-end for adjacent type innovation projects (Balle 2005). Moreover, as the customers are already known and the relationships have already been built, testing the ideas and getting customer feedback should be easier than for breakthrough innovations. Therefore, the applicability of the Commercialization Framework as a key ingredient in the company-wide adjacent stage-gate model should be studied further.

Sometimes using the “express stage-gate” could still be possible, in case of low-budget and low-risk projects, as Cooper and Edgett (2012) propose. Using the “Express stage-gate” processes is only partly related to the question if the project is adjacent innovation. Adjacent innovation projects can still be expensive, and include relatively high amount of risk, and therefore need the fuzzy-front end to de-risk the process.

7 CONCLUSION

7.1 Main findings and academic contribution

This thesis discusses already identified methods in the academic literature that the best performing companies have been using to manage their innovation processes, with a key emphasis on breakthrough innovations. It follows constructive research approach (CRA) by Kasanen et al. (1993), CRA studies contribute to academic research by solving real life problems by building models, frameworks etc. that are backed by academic literature. This thesis builds and proposes a framework to manage the breakthrough innovation process for the case company.

Previous studies have identified individual aspects that have been proven to be beneficial for breakthrough projects success, or in some cases aspects that based on intuition could be thought to be beneficial but have proven not to be. However, there is a lack of studies about more comprehensive framework to manage breakthrough innovations. Davila et al. (2005) called for further research on how to structure the control processes to support radical innovations to emerge. In addition to the academic studies, other key source of data used in this thesis were interviews with the heads of innovations at different divisions, and with other people linked to the innovation community at the case company. This constructive research thesis eventually proposed several areas that could be improved at the case company. “Tier 1” issues that were discussed in more detail were the constructed framework for breakthrough innovations and process unification at the case company. Other issues that were identified during the thesis work, but were discussed in lesser extent were labelled as “Tier 2” issues, and included cross-divisional communication and a lack of software tool to document and share the project findings, governance of innovations and setting clear go / no-go criteria, identifying a home for breakthrough innovations, and discussing the fuzzy front-end for adjacent innovations.

The area where this thesis contributes to academic research is proposing a stage-gate framework for breakthrough innovations. The proposed stage-gate model would be different than the typical linear stage-gate model in the first stages of the development, and it would be similar in the later stages. The first stages would rely less on financial factors and hard numbers related to market or customers, and the main focus would be on learning potential of the whole project and learning through iteration aiming to benefit the projects progress. The idea of not having one-size-fits-all stage-gate solutions is not in itself new, Cooper and Edgett (2008) propose this, nor is the suggestion that the front-end of the development is different for breakthrough type

innovations compared to other types of innovation (e.g. Bertels et al. 2013, Veryzer 1998). The suggestions of financial figures not working in breakthrough innovation project assessment is not new either (e.g. Nagji and Tuff 2012), nor is the suggestion that learning has a key role in breakthrough innovations (Nagji and Tuff 2012, Herstatt et al 2008, Bertles et al. 2013). The unique part and the contribution of this thesis is not in the detail of the constructed framework, but in gathering the details and constructing a single framework from the scattered details (see figure 5).

Other key finding, and an area where this thesis relies less on academia and more on empiric evidence from the case company, is regarding innovation process unification and the perceived barriers to process unification. There has been an attempt of innovation process unification at the case company that resulted in one-size-fits-all solution. This solution had a life time of a few weeks before the divisions started to modify it to their needs. The interviewees justified having different processes based on the uniqueness of their business. However, the differences of the stage-gate models used at different divisions seemed to follow the role that breakthrough plays in the division innovation portfolio. The divisions that had more adjacent innovation projects in their portfolio had a process that was built mostly for adjacent innovations, and the division with mostly breakthrough had breakthrough focus. The only major difference from this trend was the division which had recently added a commercialization framework to run parallel with their stage-gate model. Therefore, the author of this thesis assumes that the big mistake was to try to build the one-size-fits-all solution, which caused the need to modify the stage-gate model to different types of innovations. If different stage-gate models are indeed built for adjacent and core, and for breakthrough innovations, there might not be this strong a need to differentiate from other divisions.

The initial response from the case company indicates that they will seriously evaluate implementation of a separate process to assess breakthrough innovations in the future. This process should take into consideration the findings of this thesis and is likely to have many similarities with the proposed solution. In the same context the case company will include the evaluation of unifying breakthrough innovation processes across divisions. The tier 2 issues received a positive response at the case company but at this stage it is hard to analyse what the future holds for these topics

7.2 Limitations and possibilities for further research

Limitations

There are several limitations for this thesis, and they are related to the acquired information from the interviews, complexity of innovation environment, insider role of the author, and to gaps in the academic literature.

The amount of people (1-2) interviewed from each division is small, and it raises a question if the acquired information truly reflects the reality in that division, or if it is simply an opinion of the interviewee.

The innovation environment at the case company is also very complex, with hundreds of people working in different divisions, and in different countries. Truly understanding the whole innovation environment in the five months this thesis was written in, is a huge task, and it might be that some aspects were not seen at all or not considered enough.

The role of core innovations is another limiting factor. Core innovations were part of the question sheets, but somehow the interviewees emphasized more the differences between breakthrough and adjacent innovations. Some left them out of the discussion all together. When it comes to breakthrough and adjacent innovations, there is credibility in the findings, but when it comes to core innovations, this thesis cannot make any grand claims how these types of projects should be run.

The author of this thesis was on the case company's payroll, but he did not hold any other functional role at the case organization. Still some of the three challenges of insider action research listed by Coghlan & Holian (2007) that the dual role as both researcher and organizational member may cause, may apply to this thesis also:

1. The researcher has to simultaneously distance himself from the phenomena to be able to see things critically, while also drawing himself closer to the phenomena to understand it.
2. The dual role as a researcher and as an organizational member may cause role confusion, role conflict or role overload.
3. Organizational politics may cause the researcher to balance between his future career plans at the organization with the requirements and quality of his academic research. Excellent academic thesis may be considered as "failed" organizational research problem which could limit the career opportunities of the researcher.

Finally, there were gaps in the literature that affected the detail of which the author was confident of proposing solutions to the case company. These gaps are discussed below.

Possibilities for further research

This thesis was exploratory in nature, and due to this, four possibilities for further research arose during the thesis work.

Two possible research questions were identified when clear missing topics were spotted in the literature review section of the thesis. The author could not find answers to the following questions:

1. What type of factors should be included in project prioritization scorecards for different types of projects in different stages of the project?
2. What type of factors should be included in project templates for different types of projects in different stages of the project?

Cooper and Edgett (2012) study indicates that simply having clear go / kill criteria defined is a strong differentiating factor between the best performers (85%) and the worst performers (25.9%). They mention that the go / kill criteria are often in scorecard form. But what the scorecard should include is a trickier question. Should the content change depending on the stage of the project, or depending if we are speaking about breakthrough or adjacent innovation? What about if the company operates in certain industry, or if it simply depends on the strategy and competences of the company? The author of this thesis assumes that the answer to all the questions listed is yes, the content should vary. If this is indeed the case, then it becomes a question of how should the content vary. All the questions mentioned above can also be asked about project templates. Cooper and Edgett (2012) found that 90% of the best performing companies have clearly defined deliverables (usually templates), meanwhile from the worst performers 46.2% did. Clearly defined deliverables are clearly a best practice but what type of factors in the templates are the most important in which situations should be studied further.

Two more possible research questions were identified when the data from the case company was compared to the existing literature:

3. Are the best performing innovators indeed separated from the rest mainly by the way they handle breakthrough innovations?
4. Should companies have the same or similar processes to run innovation projects in different divisions within the company, and what factors are most critical when thinking about how similar the processes should be?

Many of the seven principles identified by Cooper and Edgett (2008) came into discussion in the interviews specifically when speaking about breakthrough innovations. The seven principles were identified by looking at what practices the most productive innovators use. Moreover, Nagji and Tuff (2012) say that 70% of the returns in the best-performing innovator companies come from transformational innovations (highly similar with the breakthrough description). This would indicate that the best performers are indeed best performers due to the way they handle breakthrough innovations.

This thesis proposes innovation process unification for the case company, but it does not suggest that the processes should be the same for all the divisions. However, this proposition was based on the interviews, where 4/6 interviewed functions supported process unification at least partially, rather than the academic consensus around the topic. The author of this thesis could not find a single study that would either justify or oppose having similar innovation processes for similar types of projects among different divisions of companies. Do the same types of innovations require different processes in different contexts is a question that has got less attention. Are the realities in different divisions indeed so different that similar processes regarding similar types of innovation (breakthrough / adjacent) are not possible? The natural assumption is that it depends on the context, or how different the contexts are. This raises a new question, what are the most important drivers behind how similar or different the processes should be? The interviewees of this thesis proposed reasons why they should vary, for example different business logics of the divisions, and how R&D heavy versus how customer driven the innovation processes are, while others proposed that there is no reason for the processes to vary.

8 APPENDIX

Appendix 1: Example question sheet for the interviews with head of innovations

Definitions for different types of innovation		
Breakthrough Innovation	**Adjacent Innovation**	**Core Innovation**
Developing completely new products for new customer segments	Further developing existing products to current customer needs	Efficiency in existing production processes

Background:

a) Can you briefly describe your personal role and duties with the company, and what the function you are part of does?

Stage-Gate model:

a) What are the biggest strengths of stage-gate model that **you use**?
b) What are the biggest weaknesses of stage-gate model that **you use**?
c) Do you use the stage-gate model with all innovation projects, or do you exclude e.g. projects below certain budget?
d) Would you change the stage-gate model used at your division in any way?
e) Would you modify the stage gate model in any way for Break-through innovations?
f) Why does your division's stage-gate model differ from the other division's stage-gate models?

KPIs:

a) Can you briefly describe the ways you use KPIs in innovation project management?
b) Do you use the KPIs in the Go / no-go decision?
c) What aspects you take into consideration when deciding KPIs? E.g. financial aspects, strategy aspects…

Break Through Innovations:

a) What is the share (% ball park) of Breakthrough innovations out of your innovations?
b) Do you have a separate framework to evaluate breakthrough innovation projects at the moment?
c) Does the nature of KPIs, meaning what KPIs you use and how you use them in decision making, differ for breakthrough innovations compared to adjacent and core?
d) How do you see the role of financial indicators when assessing breakthrough innovations?

Start and Go / no-go decisions for the projects:

a) What are the biggest factors when you decide to start a project?
b) What about the go / no-go decisions when you have already started the project? Do any other new factors come into play in this?
c) Do the start and go / no-go decision processes vary depending on the nature of the project (break-through/adjacent/core)?
d) Do you think that sometimes projects that shouldn't be started get started, or project that shouldn't be terminated get terminated?
e) Do you think you kill enough projects?

New Framework for Innovation Appraisal:

a) If you would design a new framework from the scratch, what would you do differently than in the framework you use now or would you do anything differently?
b) What would you take from your current framework to the new one? Would you leave any parts out?
c) Would you use same or different frameworks for breakthrough / adjacent / core innovations?
d) What do you think would be the biggest challenges if CaseCompany would adapt a single framework for innovation processes for all the divisions?
e) What would be the biggest benefits if all the divisions would have the same or similar framework/processes?
f) Should the divisions have the same or similar frameworks/processes?

Ideation Process:

a) What are your typical sources of ideas?
b) Do you see a need to develop the idea sourcing process further?
c) Do you think you have adequate amount of high quality ideas?

Other:

a) How do you see the role of Group Innovation and R&D function?
b) How do you assess group financed innovation projects in your project portfolio?
c) Do you assess the projects from portfolio perspective?
d) What could be something that other divisions could learn from your innovation process?

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