



**OPPORTUNITY EXPLORATION IN THE DEVELOPMENT OF FRONT-END  
INNOVATION IN A GLOBAL MANUFACTURING COMPANY**

Lappeenranta–Lahti University of Technology LUT

Industrial Engineering and Management Master's Thesis

2023

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Examiners: Professor Ville Ojanen

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## ABSTRACT

Lappeenranta–Lahti University of Technology LUT  
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Master's thesis

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88 pages, 17 figures, 10 tables and 4 appendices

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Keywords: front-end innovation management, opportunity exploration, opportunity identification, opportunity analysis, competitive advantage, manufacturing industry

Front-end innovation is the beginning of the innovation process, where ideas are generated. Innovation is a new or changed entity, realizing or redistributing value. Front-end innovation has a high effect on value generation because front-end innovation has a high influence on the innovation outcome as the direction of the process is set in the front-end phase. The first phase of front-end innovation is opportunity exploration, which aims to identify and analyze relevant opportunities and translate opportunities into business and technology opportunities. One of the most value-creating factors of innovation is that it generates and sustains competitive advantages, which are the abilities of the organization to succeed in the competition against current and potential future competitors.

This research aims to discover how opportunity exploration should be practiced in a global manufacturing company to sustain and develop competitive advantages. Relevant opportunity exploration frameworks, methods, and tools are also presented. This research generates a list of recommendations for actions in front-end innovation management to provide the case company with a concrete solution. The study is based on a literature review of front-end innovation and opportunity exploration and the interviews conducted for the case company employees.

Based on the literature review, opportunity exploration should be practiced in three steps: goals and planning, methods and tools, and analysis. Goals and planning define what is done, where, how, when, and by whom. Key performance indicators for opportunity exploration are also created in the goals and planning phase. The next phase is the use of methods and tools, which depend on the explored opportunities, and the final phase is analysis, where the opportunities are evaluated. In interviews, the importance of innovation activity was emphasized, and therefore, the opportunity exploration framework was adjusted by emphasizing the importance of innovation activities in the methods and tools phase. Five recommendations were generated: apply an opportunity exploration framework to the innovation process; create an innovation center with all innovation-related information in one place; create opportunity exploration guidelines and toolbox; arrange annual innovation day; and update the innovation strategy.

## TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT  
LUT Teknis-luonnontieteellinen  
Tuotantotalous

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### **MAHDOLLISUUKSIEN KARTOITUS INNOVAATION ALKUPÄÄSSÄ GLOBAALISSA VALMISTAVAN TEOLLISUUDEN YRITYKSESSÄ**

Tuotantotalouden diplomityö  
2023

88 sivua, 17 kuvaa, 10 taulukkoa ja 4 liitettä

Tarkastajat: Professor Ville Ojanen ja Associate Professor Kalle Elfvengren

Avainsanat: innovaation alkupää, mahdollisuuksien kartoitus, mahdollisuuksien tunnistaminen, mahdollisuuksien analysoiminen, kilpailuetu, valmistava teollisuus

Innovaation alkupää käsitteenä tarkoittaa innovaatioprosessin ensimmäistä osaa, missä luodaan ideoita. Innovaatiot ovat uusia tai muuttuneita asioita, jotka luovat arvoa. Innovaation alkupää vaikuttaa paljon arvon luomiseen, koska innovaation alkupäässä innovaatioille asetetaan suunta, millä on suuri vaikutus koko innovaatioprosessin tulokseen. Innovaation alkupään ensimmäinen vaihe on mahdollisuuksien kartoitus, jossa tavoitteena on tunnistaa ja analysoida merkityksellisiä mahdollisuuksia. Yksi innovoinnin eniten arvoa luovista tekijöistä on se, että se tuottaa ja ylläpitää kilpailuetuja, jotka ovat organisaation kykyjä menestyä kilpailussa nykyisiä ja mahdollisia tulevia kilpailijoita vastaan.

Tässä tutkimuksessa pyritään selvittämään, miten mahdollisuuksien kartoitusta olisi harjoitettava globaalissa valmistavan teollisuuden yrityksessä kilpailuetujen ylläpitämiseksi ja kehittämiseksi. Lisäksi tutkimuksessa esitellään relevantit mahdollisuuksien kartoittamiseen liittyvät viitekehykset, menetelmät ja työkalut. Tutkimuksen lopputuloksena syntyy luettelo suosituksista, joilla case yritys voi mahdollisesti parantaa innovaatiotoiminnan alkupään johtamista. Tutkimus perustuu innovaation alkupäätä ja mahdollisuuksien kartoittamista käsittelevään kirjallisuuskatsaukseen ja case-yrityksen työntekijöille tehtyihin haastatteluihin.

Kirjallisuuskatsauksen perusteella mahdollisuuksien kartoittamista tulisi harjoittaa kolmiportaisella prosessilla: tavoitteet ja suunnittelu, menetelmät ja työkalut sekä analyysi. Tavoitteet ja suunnittelu määrittelevät, mitä tehdään, missä, miten, milloin ja kenen toimesta. Tavoitteet ja suunnittelu -vaiheessa luodaan myös suorituskykymittarit. Seuraava vaihe on menetelmien ja työkalujen käyttö, joka riippuu kartoitetuista mahdollisuuksista. Viimeinen vaihe on analyysi, jossa mahdollisuuksia arvioidaan. Haastateltavat korostivat innovaatioaktiviteetin merkitystä, ja siksi mahdollisuuksien kartoitus viitekehystä muokattiin korostamalla innovaatioaktiviteetin merkitystä menetelmien ja työkalujen -vaiheessa. Tutkimuksen lopputuloksena annettiin viisi suositusta case-yritykselle: lisätään mahdollisuuksien kartoitus viitekehys innovaatioprosessiin; luodaan innovaatiokeskus, jossa kaikki innovointiin liittyvä tieto on yhdessä paikassa; luodaan ohjeet ja työkalupakki mahdollisuuksien kartoitusta varten; järjestetään vuosittainen innovaatiopäivä ja päivitetään innovaatiostrategia.

## ACKNOWLEDGMENTS

Firstly, I would like to thank my supervisor, Päivi from the case company, who has presented me with the practical perspective of front-end innovation management in a business environment. It has been an eye-opening experience to see how the theory of front-end innovation is applied in practice. Päivi has also contributed to the thesis by guiding me and thoroughly commenting on the work.

I am also grateful for LUT University and especially for all the professors and teachers in the industrial engineering and management GMIT program. In the GMIT program, I learned a lot of essential skills needed in working life. Thanks to the GMIT program, I also discovered that innovation management is the area I want to focus on in industrial engineering and management.

Lastly, the greatest thanks go to my family, which has encouraged me to study this far and has supported me during my studies. The support of my girlfriend, Roosa, has been an enormous help during my Master's studies and this thesis project.

Espoo, 15.9.2023

Ilmari Korpivaara

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# 1 Introduction

This introduction chapter presents the background, research gap, research questions, objectives, methodology, and work structure. The background and methodology information are deepened through the thesis. After reading the introduction, the reader should have a clear picture of the subject, objectives, and structure of the research.

## 1.1 Background

Why are innovation management and, in this case, opportunity exploration important? Innovation is one of the centric ways when it comes to value creation. Innovation definition by ISO 56000 (2020) is “new or changed entity, realizing or redistributing value”. ISO (2020) defines innovation management as “management with regard to innovation”, which is a systematic and proven way to generate innovation efficiently. Ideas are the roots of innovation, and opportunities must be explored and identified wisely to create practical, high-quality ideas. (Herstatt & Verworn, 2003; Idris & Durmuşoğlu, 2021; ISO, 2020; Tidd & Bessant, 2021, p.251-252) Successful opportunity exploration leads to efficient resource allocation in idea generation and innovation in general (Tidd & Bessant, 2021, p.251-252). On their own, opportunity exploration and idea generation do not guarantee innovations, as the ideas must be developed and implemented successfully also later in the process. (Tidd & Bessant, 2021, p.22-23) A closely related concept for innovation is the innovation process, which is a “process with regard to innovation” (ISO, 2020, p). The innovation process is a systematic way to model how innovation is practiced.

This thesis is done in cooperation with one of the business areas of a global manufacturing company aiming to develop an innovation management process. The company has already implemented some parts of the innovation framework, such as idea management, but further development is still needed. The company's objective is to expand innovation management from idea management to both back and front-end innovation activities like concepting and opportunity exploration.

Traditionally, manufacturing companies have been very product-based, but nowadays, service-based thinking has gained a strong position next to product-based thinking

(Kohtamäki, Einola & Rabetino, 2020). Innovation activities and management cover not only research and development but also services, processes, business models, etc. By focusing on the services, in addition to products, benefits can be gained. A manufacturing company focusing on products, services, and customers can achieve higher profitability and revenue than a company focusing only on products. More revenue can be generated, for example, because more business potential of the installed base can be utilized by providing maintenance and services for it. The predictability of the business improves when service sales balance product sales during times of lower demand. Other perspectives than just business can also benefit, such as environment, because higher degree of servitization is associated with less consumption of physical goods. (Baines & Lightfoot, 2013, p.49-50) This thesis emphasizes that innovation does not relate only to products. For example, service innovations are one example of how innovation's full potential could be released. Another example could be human resources, where innovation is needed when competing for a skilled workforce.

## 1.2 Research gap

Innovation, innovation management, and innovation-related processes have been studied broadly in the 21st century. The number of innovation-related publications has been rising constantly from year to year. Front-end innovation is one of the key concepts of innovation, and therefore, it has got a lot of attention. Opportunity exploration is part of front-end innovation, but it is necessarily not the key concept in front-end innovation, as idea generation is often seen to be more centric. (Floren & Frishammar, 2012) Opportunity exploration itself is not often the focus of front-end innovation management, but it is often included and mentioned as part of the process. As opportunity exploration is not the most researched area of front-end innovation, the amount of research is limited, especially when the context of the work – a global manufacturing company – is considered. When the topic, context, and specificity are taken into account, there is a research gap and a need for this research. The previous studies and topic statistics are presented more broadly in the literature review.

### 1.3 Research questions and objectives

The main research question of the study is to find out how opportunity exploration should be practiced as part of front-end innovation management in a global manufacturing company to sustain and develop a competitive advantage. The hypothesis is that competitive advantage is tightly related to innovation activity, and therefore, it is included in the main research question. The case company also emphasizes that innovations are one of the key factors behind business success as it is one of the main source of competitive advantages. The objective of this study is to identify and list recommended actions for the opportunity exploration phase, including both internal and external innovation sources and considering products, services, and other types of innovations. The main and sub-research questions and objectives are presented in **table 1**.

Table 1. Research questions and objectives

Research question	Objective
<p><b>Main.</b>  <i>How should opportunity exploration be practiced as part of front-end innovation management in a global manufacturing company to sustain and develop competitive advantages?</i></p>	<ul style="list-style-type: none"> <li>- Listing of opportunity exploration actions that support next steps in front-end innovation.</li> <li>- Wide scope in opportunity exploration. For example, in addition to product focus and internal innovation sources, service and business model innovations and external innovation sources are included.</li> </ul>
<p><b>Sub-1.</b>  <i>What kinds of frameworks and tools are suitable for opportunity exploration?</i></p>	<ul style="list-style-type: none"> <li>- Both opportunity exploration specific and more general frameworks and tools are presented so that the main research question can be answered</li> </ul>
<p><b>Sub-2.</b>  <i>What actions in front-end innovation management are needed to ensure the success of global manufacturing company in the future as well?</i></p>	<ul style="list-style-type: none"> <li>- Show evidence for the hypothesis that innovation generates a competitive advantage that supports business success.</li> <li>- Give recommendations for innovation management that creates business value.</li> </ul>

The first sub-research question is to find suitable frameworks and tools for opportunity exploration. The first step is to find how opportunity exploration is advised to be practiced in the literature and how it is now done in the company. The company's best practices and culture also need to be considered when generating new science-based recommendations for opportunity exploration. The second sub-research question focuses on finding evidence for the hypothesis that innovation generates competitive advantages and that competitive advantages support business success. The objective is to show evidence for the hypothesis and give recommendations for innovation management that creates business value. The second sub-research question is based on the concern that a successful global manufacturing company can lose its competitive advantages – and with that, the business success too – if no remarkable innovation and development is made.

After the research questions are answered, the outcome is recommendations of actions in innovation management to accelerate innovation and opportunity exploration activities and to create business value. The implementation of recommendations is described briefly.

#### 1.4 Methodology and data

The thesis consists of two main research methodologies: literature review and interviews. The literature review begins prior to the interviews, and it answers partly to the main research question. However, the main focus of the literature review is to answer both sub-research questions, which are more theory-based. Half of this research consists of the literature review, and the other half is interviews. Interviews are done in parallel with the literature review to get directions for both interviews and the literature review. The interviews are collected from the case company, which is a global manufacturing company. The focus of interviews is to understand how opportunity exploration is done currently in practice and what kinds of expectations there are for it. The interview question topics support all the research questions as they ask how opportunity exploration is and should be practiced, what kind of frameworks and tools are suitable, and what actions in front-end innovation are needed in general to generate value. The interviews will provide ideas for the recommendations that are an output of the work.

## 1.5 Structure of the thesis

The work consists of nine chapters. Firstly, in the introduction chapter, the background, context, and input of the work are set, which include the research questions. In the second chapter, the company and global manufacturing company as a concept are presented in more detail. The next step is to use research methodologies, literature review, and interviews to answer the research questions. Finally comes the results, opportunity exploration framework and recommendations, discussion, and conclusions, which answer the questions that were set in the introduction. Each phase is built on the foundations of the previous phases, and the final output is the reasoned result of the whole research process. The writing method used is iterative process writing. The thesis structure and chapters are visualized in **figure 1**.

1. Introduction	<ul style="list-style-type: none"> <li>• Background, research gap, research questions, objectives, methodology, and work structure are presented</li> <li>• The main output is research questions that are carefully reasoned</li> </ul>
2. Global manufacturing company and innovation management	<ul style="list-style-type: none"> <li>• To define and understand the context of the research, the case company and a global manufacturing company as a concept is presented</li> </ul>
3. Literature review	<ul style="list-style-type: none"> <li>• A literature review is done to answer the research questions and to gain information about the topic to be able to conduct successful interviews</li> <li>• The output is how opportunity exploration should be practiced based on the literature</li> </ul>
4. Theoretical framework	<ul style="list-style-type: none"> <li>• The theoretical framework is the main output of the literature review</li> <li>• It helps to understand how different concepts and theories are linked</li> </ul>
5. Methodology	<ul style="list-style-type: none"> <li>• The methodology chapter presents how the research design and how the interviews are conducted</li> <li>• Interview questions are presented and reasoned</li> </ul>
6. Results	<ul style="list-style-type: none"> <li>• Interview data is analyzed in seven categories that were defined in the methodology chapter</li> <li>• The output is how opportunity exploration should be practiced based on the interviews</li> </ul>
7. Opportunity exploration framework and recommendations	<ul style="list-style-type: none"> <li>• Findings and result of literature review and interviews are merged to form opportunity exploration framework for the company</li> <li>• Recommendations of actions in front-end innovation management based on this research are listed</li> </ul>
8. Discussion	<ul style="list-style-type: none"> <li>• The similarities and differences between literature and interview findings are discussed</li> </ul>
9. Conclusions	<ul style="list-style-type: none"> <li>• The research is summarized, and conclusions are drawn</li> <li>• Answers for the main research question and two sub-research questions are provided</li> </ul>

Figure 1. Thesis structure

## 2 Global manufacturing company and innovation management

The context of front-end innovation and opportunity exploration in this work is a global manufacturing company that has a decentralized organizational structure. The case company has an annual revenue of over 10 billion euros. The company is divided into four business areas, and this work focuses on the second-largest business area defined by the size of the revenue. The selected business area will be referred to as the *company* in the future. The company holds a high market share, and it manufactures relatively mature technology products that have been on the market for over 50 or 100 years, depending on the specific product. The technology has diffused well and is used in various applications. The development of technology can be considered to be on a plateau if the technology is observed over its whole history. Development of the products consists mainly of the incremental improvements or replacements of the existing product families. The industry has begun tapping the undiscovered business potential by transforming from a “take-make-dispose rationale” to a more sustainable rationale that emphasizes services and circularity (Pollard et al., 2023). However, the transformation demands innovation in all areas of business, which might be somewhat challenging to a company that has previously been focusing mainly on the product-oriented business model.

The case company has a small innovation team that is responsible for fostering and supporting innovation by developing and offering ideation and concepting methods and tools. Building innovation capability and systematizing front-end innovation is also in the scope of the team. The company has a partly established innovation process that is based on ISO 56000 (2020). Recently, the focus has been on the idea generation phase of the innovation process. Now, the objective is to develop processes for earlier and later parts of the innovation process: opportunity exploration and concepting. The objective of this thesis is to clarify how opportunity exploration should be practiced. For product development, which is not the same as innovation activities, the company has defined its own processes, as the business is and has been product-based. Now, there has been growing interest to focus on services, other development, and innovation.

The ISO 56000-based innovation process is a universal process that can be used for any innovation. ISO standards are a “formula that describes the best way of doing something”

and they are internationally agreed upon by experts – people who have high expertise on the subject matter of the standard (ISO, 2023). There seems to be a growing understanding in the company that innovation activities can be practiced and be valuable for all functions of the company.

Manufacturing on a global scale is a significant contributor to the global gross domestic product. Manufacturing accounted 2020 for 16 % of global GDP, while agriculture accounted for 4 % and services 65 %. (The World Bank, 2021) The shares of each sector for global GDP are shown in **table 2**.

Table 2. Structure of global gross domestic product by sector (The World Bank, 2021)

<b>Sector</b>	<b>% of GDP in 2020</b>
<b>Agriculture</b>	4,4
<b>Industry</b>	26,2
<b>Manufacturing (part of the industry)</b>	16,0
<b>Services</b>	65,3

The Industrial Revolution started over 200 years ago, and since then, manufacturing has developed a lot (ERIH, 2023). The efficiency of manufacturing has increased when new innovations and inventions have developed. In the history of the manufacturing, there have been two main production systems: mass production and lean production. Mass production in high volumes can be considered starting in the 1920s by Henry Ford, whereas lean production was developed in the 1940s in Japan by Toyota. Mass production aim to produce good enough products in a simple way and in high volumes. Lean focuses on high quality and value-add by developing production that is capable of producing products that might vary a bit depending on the customer needs. The key concept of lean philosophy is that waste is eliminated in the process. (Melton, 2005) In lean manufacturing there is typically eight types of different waste: over production, over processing, waiting, motion, transportation, inventory, defects, and underutilized people. In lean waste is defined to be something that adds cost but does not add value for the outcome. By removing the waste, the quality and efficiency of manufacturing can be increased. Lean philosophy can be applied to areas other than manufacturing as well. (Mulyana et al., 2023)

Modern manufacturing is a combination of older trends enhanced with new trends like digitalization. The current industrial and manufacturing trend called Industry 4.0, which is upgraded and transformed by the cyber-physical systems from the past industry versions. The new industry can include elements like machine learning, big data, digital twins, the Internet of Things, and cloud computing. Industry 4.0 impacts value chains and business models by adding more intelligence to manufacturing. Flexibility and dynamism increase and enable higher value-add for manufacturing. (Zhong et al., 2017) Increased intelligence, flexibility and dynamism provided by Industry 4.0 enable more sustainable manufacturing in the future, which is supported by the current sustainability megatrend (Stock & Seliger, 2016).



### 3 Literature review

The literature review focuses on both sub-research questions, which are: *What kind of frameworks and tools are suitable for opportunity exploration?* and *What actions in front-end innovation management are needed to ensure the success of global manufacturing company in the future as well?* In the empirical part, the sub-research questions are also answered, and the answer to the main research question will be formed.

Firstly, in the literature review, the literature review methodology and initial data statistics are presented. To begin with it is reviewed why front-end innovation management is important in a global manufacturing company and how it should be practiced. The focus will be on the effects of innovation capability on competitive advantages. The context is a successful global manufacturing company that is aiming to do continuous business renewal and adaptation to maintain business performance. The front-end innovation is presented in the beginning of the literature review, and after that the focus is on the opportunity exploration.

The end part of the literature review focuses on the existing tools and frameworks for opportunity exploration in innovation management. Later in this research the identified tools and frameworks are used in combination with the empirical study to outline a new opportunity exploration framework for a global manufacturing company.

#### 3.1 Literature review methodology and statistics

The main literature search tool is Web of Science and Scopus as the writer is most familiar with them, and the usability and coverage is good on both. LUT Primo database is used as well to access non-Open Access documents. If some topics are limited, other alternative sources and tools, such as Google Scholar, will be used. The literature review aims to define the subjects unambiguously and consistently. Most often cited literature is prioritized as it is one indication of high quality (Patterson & Harris, 2009).

This literature review answers sub-research questions 1 and 2, which are about front-end innovation, competitive advantages, and opportunity exploration frameworks. In the

literature screening, the main topics of the research questions, such as front-end innovation management and opportunity exploration, are searched. Trends and popularity of different research subjects for this literature review were searched in Scopus with six different and relevant search words, which are in **table 3**. The search is done within article title, abstract, and keywords.

Table 3. Literature review subject screening results for documents published 1983-2023  
(Scopus, 2023)

Year	Documents in Scopus
"opportunity exploration" AND innovation	23
"front-end innovation"	86
front-end AND innovation AND framework	178
front-end AND innovation	1188
"innovation management"	6033
"competitive advantage" AND innovation	8654

The results indicate that innovation itself has been a popular topic in scientific literature. When the search word “innovation” is combined with other words such as “front-end” or “management” in the search, the results get more limited. Competitive advantage and innovation have been researched a lot as it has most documents in this search. Anyhow the three searches with the least results are valuable, as well as they are about more specific subjects. Against the writer’s expectations, “front-end innovation” got a relatively low number of results. The reason for the low number of results is partly because front-end and innovation are not used that often sequentially. “Front-end” is instead sometimes combined with the word “fuzzy” to form “fuzzy front-end” which is closely related to “front-end innovation”. Front-end innovation covers a slightly broader part of innovation than fuzzy front-end, which is about the very front-end of the process (Herstatt & Verworn, 2003). Front-end innovation is often only written “front-end”. The terminology is not fully established, and for example, it has been suggested that the term fuzzy front-end would be changed to front-end innovation to avoid negative misconceptions caused by the term “fuzzy”. People outside innovation management and new product or service development might find fuzzy to be “indefinable, uncontrollable, impossible to manage, and a continued drain on corporate resources what it should not be”. (Koen et al., 2001)

As the initial search with the relevant search words finds thousands of documents, it can be assumed that there will be plenty of usable information to analyse in the literature review. As innovation management as a topic is relatively new, there is a lot of recent research papers available. In **figure 2**, the number of publications by year of the three most published search words from Table 1 is visualized. From approximately the year 2000, the growth has been steady in the annual count of documents published containing search words “*innovation management*” and “*competitive advantage*” AND *innovation*. Documents containing search word *front-end* AND *innovation* have been published constantly over 50 documents in a year for the last 15 years, but the growth is significantly slower than on the two others.

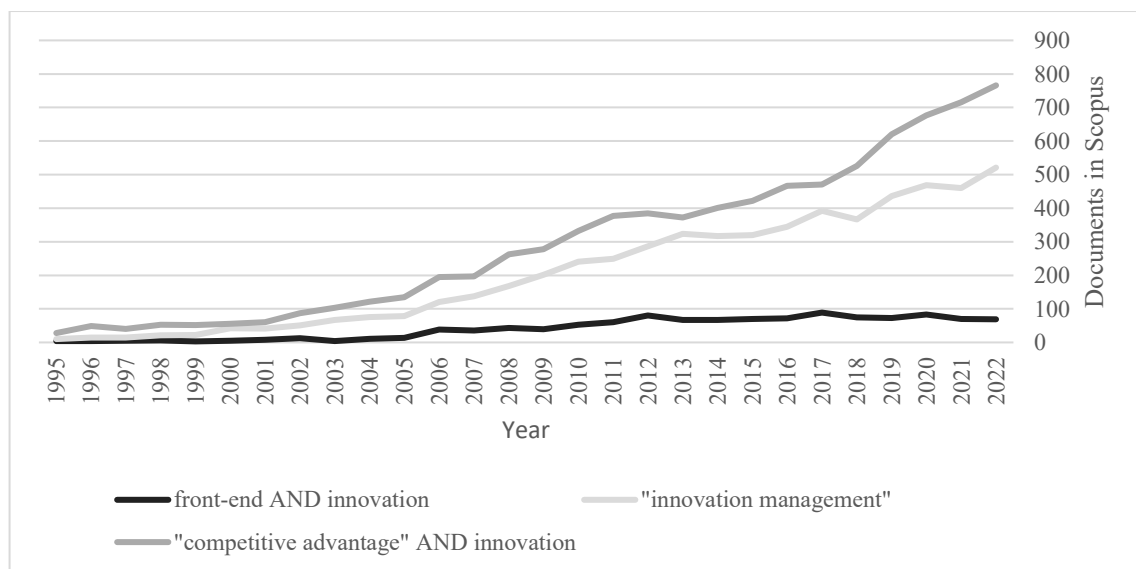


Figure 2. Documents published by year with the three most popular search words from the initial screening of the literature review (Scopus, 2023)

In Scopus, the most active authors for search word *front-end innovation management* are Aagaard, A., Poskela, J., and Frishammar, J. by the number of publications. The authors by number of publications matching the search word *front-end innovation management* are listed in **table 4**. The ranking does not necessarily mean that the authors would be the most known and approved, but it is a good starting point. One way to start an initial literature review is to get familiar with highly cited publications, and another is to get familiar with the authors who has been actively publishing about the topic. In the next chapters of the literature review, the usability of highly cited publications and top authors that were found in the initial literature search will be evaluated for each subtopic. The initial literature search and getting familiar with the topic build the ground for the literature review.

Table 4. Authors having more than three publications in Scopus with search word *front-end innovation management* (Scopus, 2023)

Author	Publications in Scopus	Author	Publications in Scopus
1. Aagaard, A.	7	14. Clausen, C.	4
2. Poskela, J.	7	15. Cooper, R.G.	4
3. Frishammar, J.	6	16. Crubleau, P.	4
4. Berg, P.	5	17. Ferreira, J.J.P.	4
5. Brem, A.	5	18. Kortelainen, S.	4
6. Gassmann, O.	5	19. Phaal, R.	4
7. Herstatt, C.	5	20. Pu, Y.	4
8. Lecossier, A.	5	21. Reid, S.E.	4
9. Nagahira, A.	5	22. Richir, S.	4
10. Pallot, M.	5	23. Salomo, S.	4
11. Verworn, B.	5	24. Shi, C.	4
12. Attar, R.	4	25. Thoben, K.D.	4
13. Boly, V.	4	26. Tuominen, M.	4

### 3.2 Value creation through front-end innovation management

This chapter presents the literature review search of front-end innovation management. The literature review of front-end innovation management focuses on the basics of front-end innovation management, but it also emphasizes the value of innovation management. Front-end innovation management is presented to set the context for the opportunity exploration and to better understand why the opportunity exploration is needed.

#### 3.2.1 Front-end innovation management

Front-end innovation is the phase of the innovation process that comes before New Product Process Development (NPPD). NPPD can vary depending on the company and the subject. NPPD phase can contain, for example, product, service, process, or concept development. Front-end innovation management differs from NPPD by being often more chaotic, unpredictable, and unstructured. (Koen et al., 2001)

To simplify, front-end innovation is the process when ideas are generated. In front-end innovation useful ideas for the specific purpose are generated resource efficiently by setting context, limits, and objectives for the idea generation process. After idea generation, the

ideas are then evaluated and improved in the NPPD phase, which is not any more front-end innovation. Front-end innovation also includes the work where it is decided what kind of ideas are generated and for what need. The objective of front-end innovation is to generate, screen, and evaluate ideas and concepts before the ideas are developed further (Dziallas & Blind, 2019). The purpose of the front-end innovation management is to facilitate and lead the organization in front-end innovation.

Table 5. Key differences between front-end innovation and NPPD (Koen et al., 2001)

	<b>Front-end innovation</b>	<b>New product process development</b>
<b>Nature of work</b>	Experimental, often chaotic. Difficult to plan. Eureka moments.	Structured, disciplined, and goal-oriented with a project plan.
<b>Commercialization date</b>	Unpredictable.	Definable.
<b>Funding</b>	Variable. In the beginning phases, many projects may be “bootlegged”, while others will need funding to proceed.	Budgeted.
<b>Revenue expectations</b>	Often uncertain. Sometimes done with a great deal of speculation.	Believable and with increasing certainty, analysis, and documentation as the product release date gets closer.
<b>Activity</b>	Both individual and team to minimize risk and optimize potential.	Multi-functional product and/or process development team.

As the nature of front-end innovation differs from the following process, which is NPPD, there are also differences in areas such as commercialization date, funding, revenue expectations, and activity. The differences are listed in **table 5**. The level of predictability is low in the front-end innovation phase, which leads to unpredictability in the commercialization date. Most of the ideas or concepts in the front-end innovation phase will not be commercialized at all. In NPPD, the path to commercialization is clearer, and the commercialization date can be defined at some point. Unpredictability in commercialization affects also the funding. In NPPD, when a project plan can be made, the project can also be budgeted. As the work is not that goal-oriented with each idea or concept in the front-end

innovation, budgeting is more difficult. Funding models and methods in the front-end innovation phase often varies. For example, the funding of front-end innovation can be fixed and shared between different parts of the innovation process and ideas, or then it could be dependable on some metric. According to Dziallas & Blind (2019) variability in the funding of front-end innovation does not mean that there could not be a responsibility for budget and performance as front-end innovation can and should be measured, and the funding can be dependent on that. To manage and control front-end innovation successfully, indicators are indispensable.

The funding and budgeting can be, for example, dependent on the number of generated ideas, idea challenges completed, or workshops arranged. Uncertainty and unpredictability are also present in the revenue expectations. Front-end innovation might include a great deal of speculation and uncertainty in the revenue expectations when NPPD has more certainty. To control the risk of uncertainty and to optimize the potential, front-end innovation is often executed by individuals or small teams. NPPD activities are done in larger multi-functional teams to maximize the knowledge and skills in concept development to achieve commercialized results. (Koen et al., 2001)

Both the front-end innovation and NPPD are part of the innovation process, which can be defined and visualized in various ways depending on the case. One recent and well-recognized process description of the innovation process is a simplified model of the innovation process by Joseph Tidd and John Bessant, which is shown in **figure 3**. (2021, p.22).

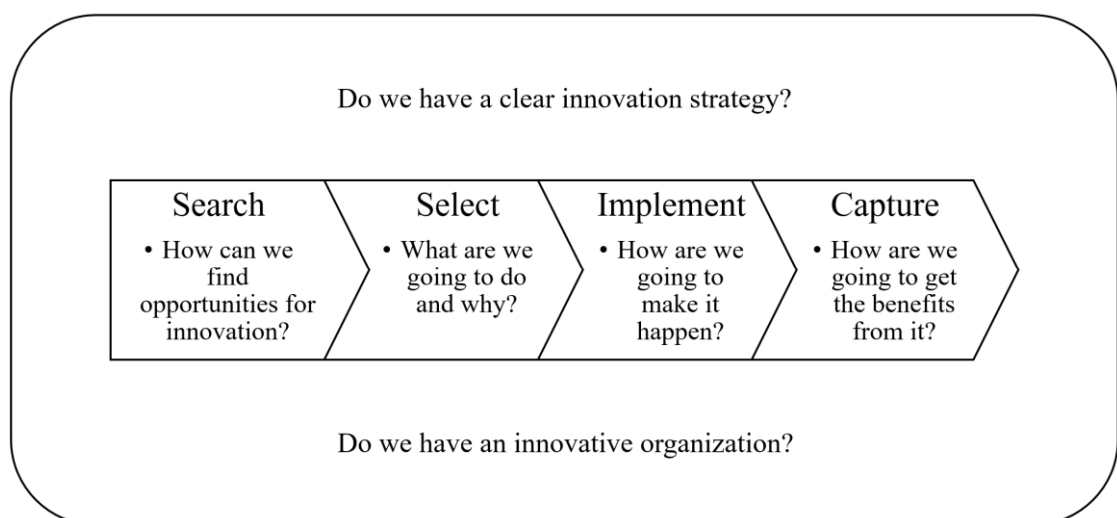


Figure 3. Simplified model of the innovation process (Tidd & Bessant, 2021, p.22)

In the simplified innovation process, the process is divided into four parts: search, select, implement, and capture. In the search part, opportunities are searched and identified. In opportunity identification, potentially useful opportunities are listed. In the next part, the most promising opportunities, ideas, or concepts are selected. At this point, the ideas are still in a very early stage, and it is useful to filter them now to avoid excessive work in the future steps. The third part after the idea selection is implementation. The ideas need to be developed to make it possible to implement them. Finally, after implementation is capture, which emphasizes the value that should be captured from innovation. (Tidd & Bessant, 2021, p.22-23) The simplified model of innovation is not that usable in practice as such, but it can be applied with some alterations and modifications to almost any need as the basic process is usable in all kinds of innovations.

Koen et al. (2001) front-end innovation concept includes search and select parts, and NPPD includes implementation and capture parts of the simplified innovation process. The simplified model of innovation considers the environment around the process by including innovation strategy and organizational innovativeness in the environmental factors. Innovation processes and activities do not operate in a vacuum, and therefore, other relevant factors need to be considered in the organization to succeed in innovation. For example, high innovation competence in personnel and a clear strategy are likely to promote success when carrying out innovation processes and activities.

The simplified innovation process is a new and generic model of innovation management, but there exist many older frameworks as well. One other well-recognized model is the New Concept Development Model (NCD), which focuses more on front-end innovation. NCD, shown in **figure 4**, models the front-end innovation process before New Product Process Development, which was defined earlier in the chapter. (Koen et al., 2001)

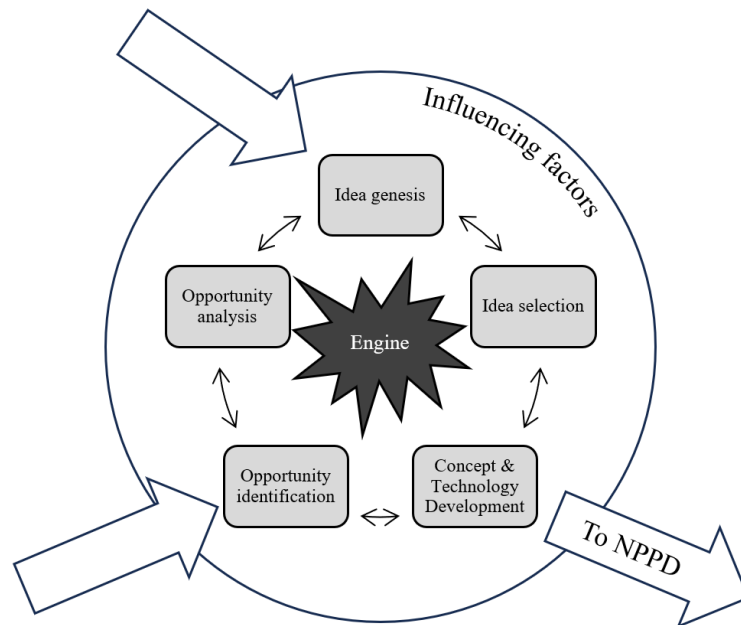


Figure 4. The New Concept Development Model divides front-end innovation into five elements (Koen et al., 2001)

The New Concept Development Model has three areas: five front-end innovation elements, an engine, and influencing factors. The five front-end innovation elements, opportunity identification, opportunity analysis, idea genesis, idea selection, and concept and technology development, define the key steps in front-end innovation. The elements are in a circle rather than in a linear process form as they are not necessarily used in an exact order, and all the elements are not always needed. The circle also visualizes the iterative characteristics of the process. The model reflects the experimentality, chaoticity, and unpredictability of front-end innovation as it allows users to use the elements in different orders and in an iterative nature. (Koen et al., 2001)

In the center of the model is the engine, which is about the leadership and culture of the organization. The engine is important in new product development, but the link to front-end innovation success is complex. However, leadership and culture affect front-end innovation. The third and outer area of the model is influencing factors, which affects the innovation process and activities. Influencing factors can be for example, strategy, competition, organization, and technology. All business operations or processes are somehow affected by the environment. In front-end innovation, the influencing factors are highly influential as ideas and opportunities come mainly from the environment. (Koen et al., 2001)



Table 6. Five Front-End Elements of NCD model (Koen et al., 2001)

Element	Description
<b>1. Opportunity Identification</b>	<ul style="list-style-type: none"> <li>- Typically driven by goals</li> <li>- Sources and methods are essential</li> <li>- Creativity tools, problem-solving techniques, and informal opportunity identification activities such as ad hoc sessions or individual insights</li> <li>- Often before idea genesis</li> </ul>
<b>2. Opportunity Analysis</b>	<ul style="list-style-type: none"> <li>- Translates identified opportunities to business and technology opportunities</li> <li>- Competitive intelligence and trend analyses can be used</li> </ul>
<b>3. Idea Genesis</b>	<ul style="list-style-type: none"> <li>- From opportunity to idea</li> <li>- Can be entered without steps 1 and 2</li> <li>- Ideas are reshaped, modified, combined, and upgraded</li> <li>- Brainstorming and idea banks can be used</li> <li>- The output is developed and described an idea or concept</li> </ul>
<b>4. Idea Selection</b>	<ul style="list-style-type: none"> <li>- The phase when, from abundant ideas, the one having the highest business potential is chosen</li> <li>- Selection can be based on individual choice, fit to strategy, fit to portfolio, financial return, or risk assessment</li> </ul>
<b>5. Concept &amp; Technology Development</b>	<ul style="list-style-type: none"> <li>- The idea or concept is developed and prepared before NPPD</li> <li>- Development of business case</li> <li>- Market potential, customer needs, investment requirements, competitors, and overall risk is considered</li> </ul>

In **table 6**, five elements of front-end innovation in the NCD model are presented in more detail. Opportunity identification is often the first element used. In opportunity identification, business and technology opportunities are identified to optimize efficient resource allocation in the organization. Strategy and goals set the scope for the opportunity identification as they define what the organization is supposed to do. Many tools and techniques are needed in opportunity identification, but on the simplest level, it can be based on, for example, individual insight or water cooler discussions. More formal tools are, for example, mind mapping or process mapping. Next, the identified opportunities are analyzed. Opportunities are translated into business and technology opportunities, and the potential of the opportunities is initially checked. For example, trend analysis is a useful tool in opportunity analysis when analyzing the potential. (Koen et al., 2001)

The third element, which is idea genesis, can be entered without the first and second elements, but opportunity identification can help to generate more useful ideas. In idea

genesis, the ideas are generated by using, for example, brainstorming, crowdsourcing, or idea banks. In this element, the ideas can be easily reshaped, modified, combined, and upgraded, as in this phase, the ideas or concepts are not yet precisely defined. Idea genesis generates described and defined ideas or concepts for idea selection, where the best-fit ideas are selected for the last element, concept, and technology development. After concept and technology development, there is a ready business case for New Product Process Development or some other process depending on the concept or business case. (Koen et al., 2001)

Front-end innovation has also other characteristics than the main characteristics that it is experimental, chaotic, and unpredictable (Koen et al., 2001). The least-well-structured part of the innovation process is also called the fuzzy front-end, as in **figure 5**. Other major characteristics of front-end innovation are high influence on the innovation outcome, low cost of changes, and low information density. Front-end innovation significantly impacts the innovation outcome as it defines the ideas and the number of ideas. Ideas are the basis upon which the innovations are built. In front-end innovation, all the changes to the idea or concept are cheaper than in later stages of innovation, which emphasizes the importance of front-end innovation management. The amount of information is also low at the beginning of the innovation process as only some information has yet been generated. (Herstatt & Verworn, 2003)

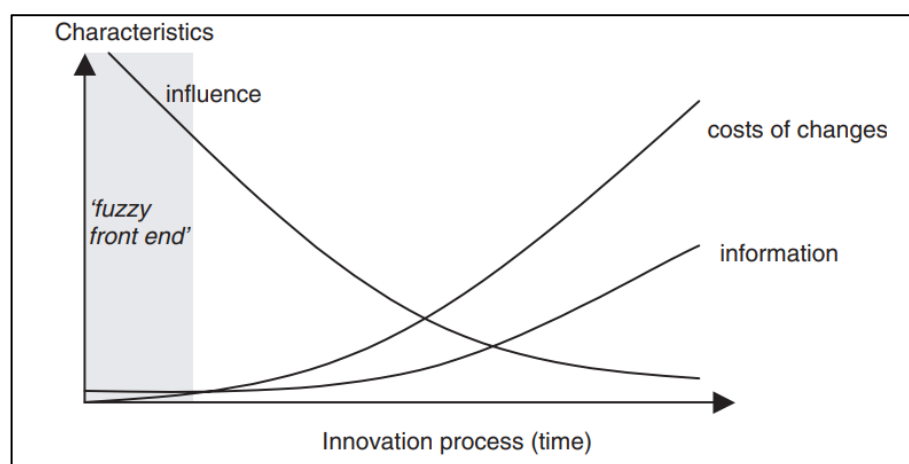


Figure 5. Fuzzy front-end characteristics as a function of time (Herstatt & Verworn, 2003)

### 3.2.2 Value of innovations and front-end innovation management

Front-end innovation significantly influences innovation as it is the source of ideas, and it defines the number and quality of ideas. But why innovations are important? What is the business value of innovations? To succeed in the competition where others are also developing and innovating, it is vital to have the ability to create and launch new products, services, and processes. (Herstatt & Verworn, 2003) The term *manage* in this context does not mean that complex innovation would be designed and run by the management. Rather it means that suitable conditions within an organization are created so that people can practice innovation. (Tidd & Bessant, 2021, p.94) Innovation management is needed to set and support procedures and practices for innovation. Innovation can happen in informal ways or by accident, but innovation management “can boost various types of innovation, and that it can increase innovation capabilities and value creation through innovation activities, thus eventually creating more value for the organization”. (Idris & Durmuşoğlu, 2021)

Based on the ISO 56000 (2020) standard, the purpose of innovation management is to realize value. The value that should be realized is both financial and non-financial, and for example, for sustainability improvements, the realization of the value of innovations are vital. The standard states that innovation management has many key benefits. Firstly, innovation management contributes to competitive advantages and sustainable growth. Secondly, when innovation is properly managed, the scope and objectives are often more clearly defined, which supports the legitimization of innovation activities. Thirdly, innovation management sets more focus on the innovation activities which improves the reputation of organization as an innovative organization, and it also enables innovation positive culture. Finally, innovation management also generates more output value of the innovation activities compared to the innovation activities practiced without innovation management.

One of the most value creating factors of innovation is that it generates and sustains competitive advantages (Tidd & Bessant, 2021, p.9-10). Sustained competitive advantages can only be accomplished through innovation (Rothaermel, 2016). Competitive advantage is an ability of the organization to success in the competitions against current competitors and potential future competitors.

The uniqueness of the strategy is part of the gained and sustained competitive advantage:

*“A firm enjoys a competitive advantage when it is implementing a value creating strategy not simultaneously implemented by large numbers of other firms”.* (Barney, 1991)

Competitive advantages can come from, for example size or location of the company or from possession of assets. The importance of innovation compared to other factors for competitive advantage has grown in the technology intensive world. (Tidd & Bessant, 2021, p.5) Innovation is a broad topic that touches almost everything the company is doing. It is an opportunity as there are a lot of potential sources for competitive advantages that are crucial for the company's success.:

*“Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things”* (Porter, 1990)

The ways the competitive advantage can be achieved through innovation varies a lot. In simplicity it can be a new product which no one else has or can offer on the market, or then it can be something even simpler new idea that generates value. New products can lead to increased sales and market performance if there is demand for the product. Another common competitive advantage generating innovation is new processes that, for example, enable speed, lower costs, or higher quality. Some innovations might be more revolutionary, like upgrades from typewriters to computers, which can totally rewrite the rules. Even though innovation generates new value it is not obvious that all the value can be converted to business or financial value in a company. List of mechanisms of innovation that can lead to strategic advantage is on the next page. The mechanisms, strategic advantages through innovation, and examples are listed in more detail **appendix 1**. (Tidd & Bessant, 2021, p.21-29)

List of mechanisms of innovation that can lead to strategic advantages (Tidd & Bessant, 2021, p.14-15):

1. Novelty in product or service offering
2. Novelty in process
3. Complexity
4. Legal protection of intellectual property
5. Add/extend range of competitive factors
6. Timing
7. Robust/platform design
8. Rewriting the rules
9. Reconfiguring the parts of the process
10. Transferring across different application contexts
11. Others

In a longer time span the competition and the need to have competitive advantages can be demonstrated with historical development. In the past innovation has typically developed in waves. In a closer look to the near history six waves of innovation can be found. The six waves of innovation are industrial revolution, age of steam, age of electricity, mass production, information and communication technologies and networks, and the consensus is that the current wave is sustainability. The companies, organizations, and institutions that have been able to transform through innovation have most likely been able to get the benefits from more than one wave of innovation and stayed in the competition. (Silva & Di Serio, 2016) In **figure 6** are the six waves of innovation.

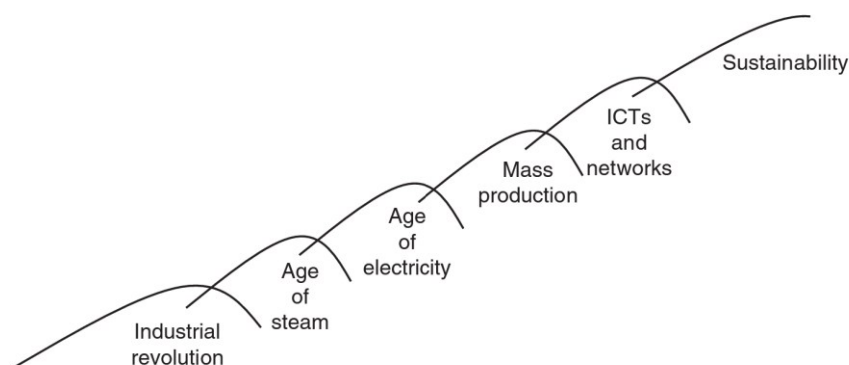


Figure 6. Six waves of innovation (Silva & Di Serio, 2016)

As competitive advantage is defined as ability to success in the competition it is useful to have a closer look at competition and its forces. Competition between companies can come from various sources, not only from the current main competitors. The extent of competition emphasizes the importance of innovation as it is one key factor when gaining and sustaining competitive advantages. Porter's Five Force Model (1979) in **figure 7** demonstrates the diversity and types of most common forms of competition.

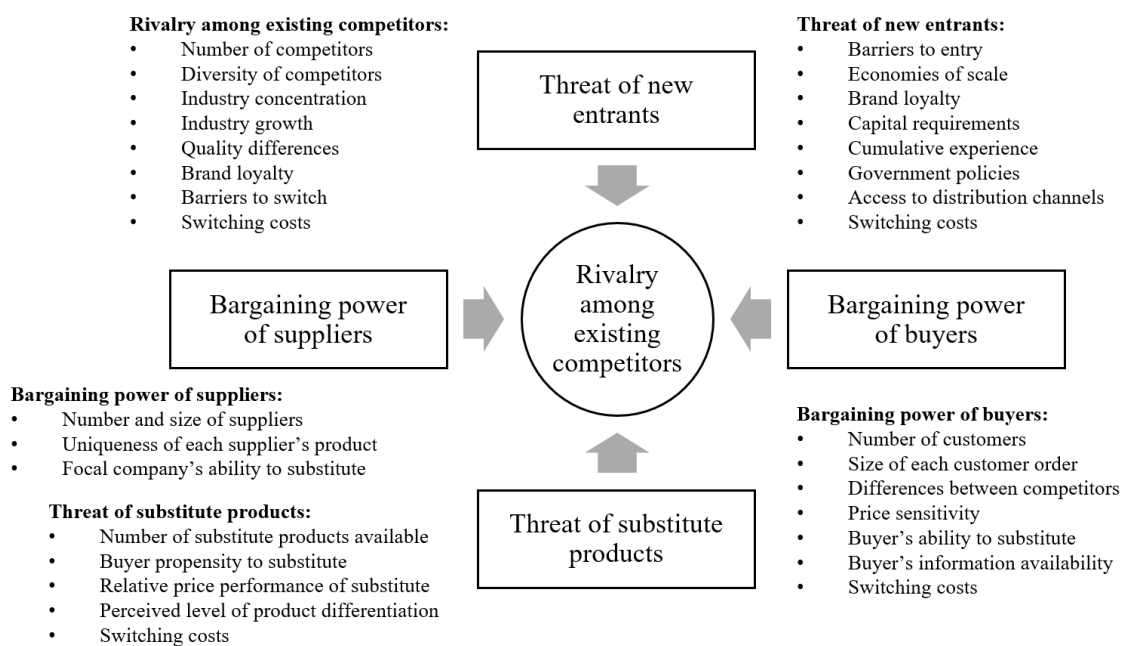


Figure 7. Porter's Five Forces Framework (1979) that demonstrates the competitive operating environment in a business with force factors (Porter, 2008)

Based on the well-known Michael Porter's (1979) Five Forces Framework there are five forces in competition: threat of new entrants, bargaining power of buyers, threat of substitute products, bargaining power of suppliers, and rivalry among existing competitors.

### Threat of new entrants

New entrants in the market generate competition by, for example, increasing the production capacity or having some new competitive advantages. Threat of new entrants can be limited with barriers in the market or industry. At least six major barriers have been identified: economies of scale, product differentiation, capital requirements, cost disadvantages independent of size, access to distribution channels, and government policy. For example,

innovation can be used to success in product differentiation and to build barriers of cost disadvantages independent of size. Innovation can be used versatily and can even be used to adjust to or even develop more favorable regulations and government policies.

### **Bargaining power of suppliers**

Suppliers are often important stakeholders and an essential part of supply chain for companies. Suppliers often enable success for both parties, the buyer, and the seller but in a situation where the bargaining power of the supplier grows too strong the competition begins to be harmful. If there is not much competition between suppliers and if there are only few of them, suppliers can start to define the price and other factors. If the company is competent to innovate in a case when the supplier starts to have too much bargaining power the ability to defend against the competition is better. Innovation can, for example, help to vertically integrate in the market which means that the company starts to do the work of suppliers like producing components.

### **Threat of substitute products**

Substitute products or new ways of doing things are the third competitive force where the number and quality of substituting products are main factors of the threat. If the substituting product can outperform the existing products on many different areas or it is dominant on one area the position of the existing product is severely threatened. For example, in heating technology heat pumps were a substituting product for many other heating technologies. The companies that were able to improve and innovate their existing products to answer the competition or even start to use the new technology probably survived better.

### **Bargaining power of buyers**

Supply and demand are the main factors that define the trade and the price. Buyers are on the demand side, and if somehow the demand falls it is probable that volumes or profitability or both decreases. The company has an opportunity to affect the demand by making the product meet the demand as well as possible. Considering the customer's needs thoroughly the product itself becomes better and the buyer has less bargaining power. Innovation is important part of making the product attractive for the buyers, but it also helps to understand customer needs better. For example, innovative organization structure and management innovations can lead to better information transmission in the organization that maximizes the understanding of customer needs. Strategic choices also affect the bargaining power of

buyers as, for example, high differentiation and high number of customers are less likely to be lost in a short time than one large customer buying less differentiated products. The risk can be managed by taking care that the bargaining power of buyers does not grow too much.

### **Rivalry among existing competitors**

The most obvious force is rivalry among existing competitors as it is often constant and there are typically several competitors. Competition with price, product, promotion, and place are constantly present on the market even though the impact of the factors varies depending on the market situation. To succeed in the competition among existing competitors, it is beneficial to be a market leader. Market leader with high market share and high brand loyalty has a strong position in the market. Factors like number of competitors, diversity of competitors, industry concentration, and industry growth cannot be easily changed by one company, but by being innovative and generating new better concepts, products, services, and other value creating subjects', a better position in the market can be achieved, which in turn reduces the competitive opportunities of competitors.

To conclude, innovation is a way to succeed in the everlasting competition in the markets. Competitive advantages can be achieved through other ways than innovation, but innovation is a powerful and lasting source of competitive advantage that companies can utilize widely. Innovation can be effectively used regardless of the size, location, or background of the company. Only ability to innovate is needed. The value that can be achieved with innovation through competitive advantages is multidimensional and can benefit the whole company and its stakeholders. Innovation can be used to sustain competitive advantages and defend the company from different forms of competition as listed in Porter's Five Forces Framework, but innovation can be also a great source of new competitive advantages that can become threats for other companies and can create value for the company itself.

### **3.2.3 Recommended actions in front-end innovation management to achieve and sustain competitive advantages**

The outcome of front-end innovation management is ideas and concepts that will serve the organization later in the innovation process. The number and quality of the ideas and concepts are one centric measure of the success of front-end innovation even though they do



not guarantee that in the end successful innovation will happen. Stephen K. Markham (2013) discovered the impacts of front-end innovation activities on product performance. The results of the study can be generalized with some caution and limitations to other than product innovations as well. The study found out that the percentage of ideas or concepts moving from front-end to NPD, which is the next phase after front-end innovation, does not predict NPD performance. That finding does not automatically mean that the number of ideas would not matter in the front-end. It only states that the percentage of selected ideas does not count. Still the number of ideas before the selection of ideas might matter. The finding supports a hypothesis that quality of ideas is the more important factor than the number.

The second finding was that more established front-end programs are more successful than the ones that are less established. This means that to some extent more resources in front-end innovation results to more usable ideas that can be used later in the innovation process. The third main finding was that front-end success predicts product performance better than the success of NPD process. In practice, when the third finding is combined with the first and the second, it means that a successful front-end leads to better product performance, and the front-end should be structured and established to achieve that success. (Markham, 2013) The findings are summarized in **figure 8**.

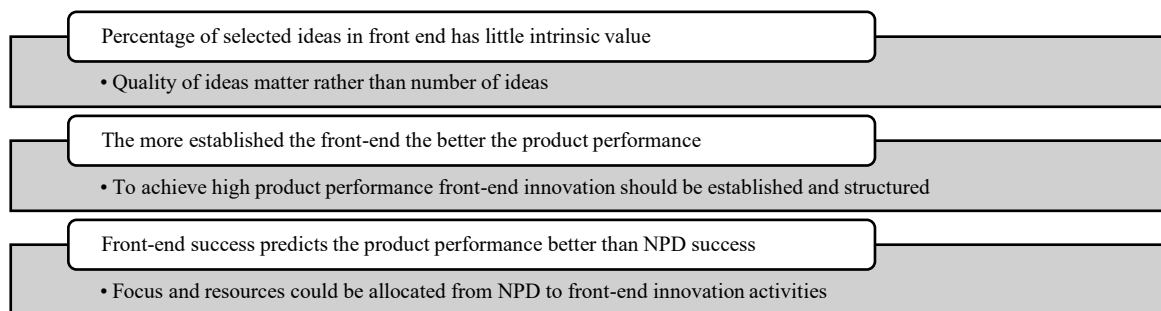


Figure 8. Key factors in front-end innovation predicting product performance (Markham, 2013)

In addition to increased resources in front-end innovation management, culture has a major role. Positive innovation culture fosters good front-end innovation performance. The link between the performance and positive culture is complex but it has been proven that positive innovation culture decreases the fear of failure and makes decision making more comprehensive. Decreased fear of failure encourages people to participate to innovation

activities. It also enables more comprehensive, versatile, and numerous idea generation. Decision making is easier when the decision makers are provided with better input data due to decreased fear of failure. The fear of failure also affects the decision makers, and it is for the benefit of the whole organization if the decision makers are also allowed to fail in the process. (Mohan, Voss & Jiménez, 2017) The impact of failures can be minimized with systematic innovation process.

The focus for innovation culture and allocation of resources for front-end innovation alone are not enough. To succeed in innovation the organization should also focus on the strategy. The business and innovation strategies should be inline, and they should support each other as innovation and innovation activities are not a separate part of the organization. Innovation is a core process of an organization. Organizations that are not innovating systematically but are innovating simply on impulse are performing worse than the organizations that do innovation based on planning and strategy. (Tidd & Bessant, 2021, p.70-71) The innovation strategy does not need to be too thorough. It is enough if the basics are defined in the strategy: what is done, why and how? Most of the companies does not even do innovation management systematically (Tidd & Bessant, 2021, p.1-4), which means that even by making a simple innovation strategy and following it competitive advantage can be achieved. The field of innovation is that broad that without defining the objectives the resources are probably not used efficiently.

There are many ways innovation management and front-end innovation management can be practiced. The literature does not point out one way that would fit all needs. For the different ways the key point is that enough resources should be allocated on the front-end to do successful innovation. Innovation strategy is one way to manage resource allocation effectively. The other key point is the culture which should support innovations. Innovation strategy supports the development of positive innovation culture. With a coherent strategy, well allocated resources, and positive innovation culture throughout the organization it is likely that innovation will be more successful and generate and sustain competitive advantages in the end.

### 3.3 Opportunity exploration in front-end innovation management

This chapter presents opportunity exploration as a concept, as well as the existing frameworks and tools for opportunity exploration in front-end innovation management. Both frameworks designed for opportunity exploration and more general frameworks are presented. More generic tools which can be used in opportunity exploration as well are often tools used in strategy work.

#### 3.3.1 Opportunity exploration

Opportunity exploration is often in literature called as opportunity search, identification or analysis. The terminology depends on the author and time. Koen et al. (2001) has divided opportunity exploration into two parts: identification and analysis. In **table 6** are short descriptions of both opportunity identification and analysis. For successful opportunity identification it is essential to have sources of opportunities and an ability to identify opportunities that would fit the company goals and objectives. The purpose of the analysis phase is to evaluate the business or technology potential roughly. In both parts of opportunity exploration tools can be utilized. In identification the method can be, for example, brainstorming and in analysis trend analysis. (Tidd & Bessant, 2021, p.115-125)

When the proficiency level between the five elements and engine of Koen et al. (2001) front-end innovation framework in **figure 4** is compared between high, medium, and low innovation level companies', opportunity identification stands out. Highly innovative companies are relatively more proficient and focus more on the engine, which is the leadership and the culture of the organization, and opportunity identification than medium and low-innovation companies. In less innovative companies there is less proficiency and focus on the beginning of innovation process and more on the end. In the Koen et al. (2001) study innovativeness of a company was measured as the number of new products introduced each year. The finding of this study points out the importance of the beginning of front-end innovation where opportunity exploration is mainly practiced.

To know where to explore opportunities it is useful to know where innovations typically come from. Typical sources of innovation are internal, for example, own employees and R&D, or external such as suppliers, customers, market, competitors, universities, investors,

entrepreneurs, or scientists. In **table 7** innovation source differences between internal corporate resources, customers, competitors, and science and technology are presented. Each source fits to different need and they have their own advantages and disadvantages. For example, customers tend to have bias towards the existing offering, but their ideas are highly desirable as they are grounded in actual demand. (Demircioglu, Audretsch & Slaper, 2019; Wyrcki, Röglinger & Rosemann, 2021)

Table 7. Definitions, advantages, and disadvantages of different sources of innovation  
(Wyrcki, Röglinger & Rosemann, 2021)

Source	Definition	Advantages	Disadvantages
<b>Corporate resources</b>	This source refers to capabilities as well as tangible and intangible assets in terms of internal and human capital.	<ul style="list-style-type: none"> <li>• Unique resource configuration represents competitive advantage</li> </ul>	<ul style="list-style-type: none"> <li>• Bias towards existing products, services, processes and business models</li> </ul>
<b>Customer</b>	This source refers to existing and new customers and focuses on customer needs.	<ul style="list-style-type: none"> <li>• Highly desirable ideas</li> <li>• Grounded in actual or future demand</li> </ul>	<ul style="list-style-type: none"> <li>• Bias towards existing offerings</li> <li>• No ideas that disrupt common behavior</li> </ul>
<b>Competitor</b>	This source refers to established and emerging companies of the same and other industries.	<ul style="list-style-type: none"> <li>• Evidence of feasibility</li> <li>• Evidence of customer attraction</li> <li>• Partnering across industries</li> </ul>	<ul style="list-style-type: none"> <li>• No first-mover advantage</li> <li>• Risk of imitating instead of innovating</li> </ul>
<b>Science and technology</b>	This source refers to scientific research as well as established and emerging technologies.	<ul style="list-style-type: none"> <li>• Highly disruptive ideas</li> </ul>	<ul style="list-style-type: none"> <li>• “Technology first, needs last”</li> <li>• Uncertain market adoption</li> </ul>

In the United Kingdom Innovation Survey 2021 companies answered that internal sources are the most important source whereas the second and third important are the suppliers and private customer. Other commonly used sources in the survey were competitors, public customers, technology and service standards, conferences and exhibitions, and professional and industry association. (UK Department for Business, Energy & Industrial Sector, 2022) The most important sources in the UK Innovation Survey are averages of the answers and the importance for each industry might differ a lot. It is essential to understand that the sources where innovation can come from vary a lot as innovation touches all areas of the

organizations. Wide variety of innovation sources in turn means that opportunity exploration needs to have diverse approaches.

The opportunity exploration is not only about active exploration as there is many stimuli and triggers that can reveal opportunities, ideas, and innovation. In addition to internal and external categorisation, innovation can also be categorized to technology or knowledge push and to demand pull (Di Stefano, Gambardella & Verona, 2012). In technology push there is already the knowledge or technology, which then generates demand when the innovation diffuses. Technology push has been behind a great share of innovations. For example, microwave, fibre optic cable, synthetic rubber, digital imaging, and transistor considered to be examples of knowledge-push innovations. Example of demand-pull innovation is, for example, many products of Procter & Gamble: candles for domestic lightning, soap, nappies, and toothpaste. (Tidd & Bessant, 2021, p.216-217) Arthur (2007) emphasizes that both factors technology-push and demand-pull are needed to explain innovation, and that both factors do not necessarily contribute as they can also be interacting.

Tidd and Bessant (2021, p.214-248) have analysed sources of innovation and have come up with twelve sources or triggers for innovation, which are listed in **figure 9**. The sources are from both internal and external, and from both push and demand side. These sources are a great starting point for the opportunity exploration. The first source is crisis-driven innovation which is a consequence of some event or change that changes the world. For example, coronavirus pandemic forced people to work remotely which increased the demand for remote work tools. Another example of world changing event is, for example, energy crisis, which appear time to time which leads to demand for energy efficiency. Both of those examples probably increased the demand-pull for innovation.

Second source is accidents. Accidents and luck play sometimes a major part in innovations. One famous example is penicillin, which was discovered by accident. Accidents are more likely to turn to valuable innovations in an innovation friendly environment that successful innovation management can achieve. Third source is watching others which is closely related to competitors as an innovation source. By watching others, it is possible to benchmark, reverse engineer, and copy ideas. For example, in Asian economies watching others has been a widely used innovation source as the strategy has been “copy and develop” from Western ideas. Fourth source is recombinant innovation. Innovation is something novel that creates value. The novelty can relate to a specific purpose, so it does not need to be novel for the

whole world or for all applications. For example, electric motor in a car or industrial machine is an old innovation. When electric motor is implemented to something new and creates value it is recombinant innovation. Recombinant innovation has typically many advantages, for example, it can reduce learning costs as the learning has already been done when it was invented earlier to another application. Recombinant innovations can also open new innovation space as the recombination can be possibly made to other applications and there might be need and room for more innovation. Fifth innovation source is regulation. For example, in history and currently different environmental regulations has guided many industries how they should operate. Both regulation and deregulation shape the innovation environment. (Tidd & Bessant, 2021, p.214-248)

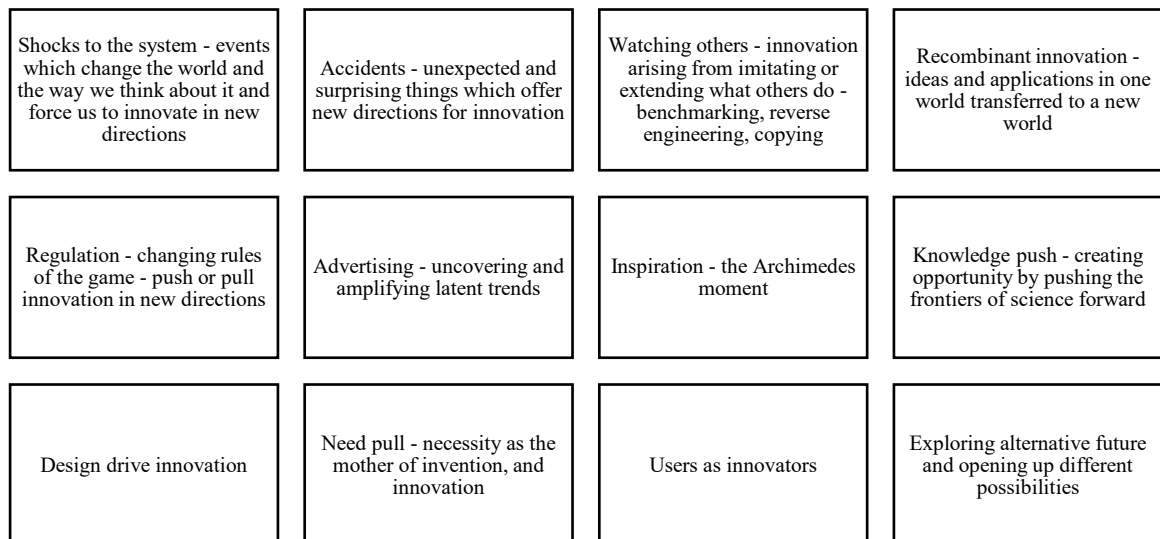


Figure 9. Innovation sources and triggers. Where do innovations come from? (Tidd & Bessant, 2021, p.215)

Sixth source of innovation is advertising which can uncover and amplify latent trends. In different markets different products, services, and ways to operate works differently, for example, due to their maturity as it might take some time to get innovation diffused in a new environment. In new markets an innovative solution might need some recombination or slight adjustment so that it would be accepted. Seventh source is inspiration which means that ideas or opportunities come to mind when they are in front of us. Example of inspiration is when Newton saw an apple falling and started to think about the of gravity. Eighth source is knowledge-push which is related to earlier mentioned technology-push. Ninth source is design-led innovation which in turn emphasizes the analysis of user needs and thorough thinking about design that gives the product or other object meaning and form. For example,

Apples iPhone is an example of design-led innovation as the starting point of the product has been customer needs. By using superior design, it has also changed how people sees and uses their phones. Change of the meaning of the object of innovation is part of design-led innovation. The point is to focus on the user instead of the product. The product is for the user not vice versa. (Tidd & Bessant, 2021, p.214-248)

Tenth source is need pull which was already mentioned earlier in this chapter by Di Stefano, Gambardella, and Verona (2012). Eleventh source of innovation is users. Users by themselves might know their needs and suggests how the products or services could be improved. The improvement based on user needs are often incremental whereas in more radical ideas it takes a long time the innovation to diffuse. For example, foldable umbrella can be a user innovation. When an umbrella user realised that is not practical to carry an umbrella which does not fold the innovation of foldable umbrella begun. Finally, the last and twelfth innovation source on this list relates to alternative futures and opportunities opening with them. Imagining how the future could look like might raise ideas and opportunities for innovation. Futuristic thinking can be stimulated with various tools and techniques to imagine new possibilities in innovation. Most of the innovations have many sources and can be different combinations of above listed sources. (Tidd & Bessant, 2021, p.214-248)

As there are varying sources of opportunities and innovation, it is important to focus on finding useful opportunities and ideas efficiently. No organization has the resources to carry out all potential opportunities and ideas. Therefore, the quality of opportunities and ideas matters, and prioritization is needed. There are five key questions in **figure 10** that should be considered before opportunity exploration: *what, where, how, who, and when*. By having answers to the five questions, the opportunity exploration is more systematic and planned. (Tidd & Bessant, 2021, p.251-252)

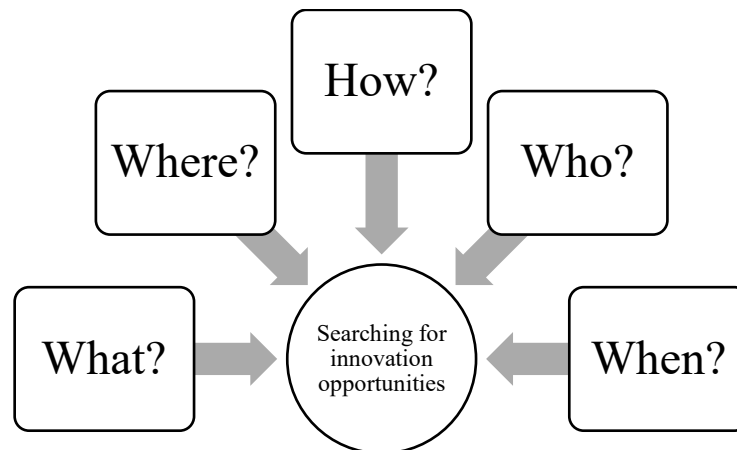


Figure 10. Innovation opportunity search framework outline (Tidd & Bessant, 2021, p.252)

When searching for opportunities the search need needs to be defined more specifically. *What* is searched for? The question can be approached from the different characteristics and nature of innovation, like push or pull innovation, incremental or radical innovation, or are we exploiting or exploring? For example, by defining that the search is for incremental knowledge-push innovation, that is a familiar type of technology on a familiar market, the search project is much more doable. (Tidd & Bessant, 2021, p.252-254)

After defining *what* will be searched, a decision on *where* the search will head is needed. The type of innovation that is searched for affects *where* it should be searched. *Where* refers to innovation search space. There are many frameworks to define the search space, for example, the 4Ps of innovation space framework, which has four dimensions that could be searched: product innovation, process innovation, position innovation, and paradigm innovation. Also, the question of *when* affects *where* the search should be done. There is a difference if the opportunity that is searched for is in the beginning of innovation diffusion or if it is already well-established innovation. Innovations that are in the beginning of their diffusion might find new opportunities better from areas that provide more experimental ideas that are still in the early stage of innovation easier to implement. (Tidd & Bessant, 2021, p.254-260)

In addition to *what*, *where*, and *when* it needs to be decided *who* is participating in the search. Every individual has a lot of ideas and views of possible opportunities from his own perspective and based on his own knowledge. By involving several people in the search, the findings will get richer. Also, when a group's ideas and views are combined there is enormous number of ideas that could be filtered to the ones that fit the need – *what* is



searched for. It is essential to understand that innovation is mostly a social knowledge intensive process which depends on the knowledge and ability to communicate. Stronger knowledge network and information flow correlates positively to more productive innovation. (Tidd & Bessant, 2021, p. 255-256) *How* is the last question in the innovation opportunity search framework and it will be discovered more in next chapter as it is the main activity of the search process.

### 3.3.2 How to: opportunity exploration

This chapter presents how opportunity exploration should be practiced based on the literature. *How* defines the practical activities that are needed to find opportunities. Before the activities the earlier mentioned *what*, *where*, *when*, and *who* need also to be defined. The *how* summarizes the earlier defined questions and combines those with methods and tools. To systematically practice opportunity exploration, it would be beneficial that the participants are aware that they are working in an innovation process as then the understanding about the topic can improve and learning can happen.

To practice successful – by nature – experimental, often chaotic, and unpredictable front-end innovation, careful planning is needed to guide the activities to the right direction. The key is to provide the organization with suitable conditions to practice innovation successfully. (Idris & Durmuşoğlu, 2021) To avoid inefficiencies in opportunity exploration the alignment of business strategy and innovation strategy is important. Using the resources effectively, opportunity exploration demands an innovation strategy backed up by the business strategy. (Terwiesch & Ulrich, 2008)

When the planning is done properly, and the opportunity exploration activity follows strategic objectives it is time to start the practical part of opportunity exploration. The practical process depends a lot on the type of opportunities that are explored. There is no one framework that suits all solutions and therefore it is better to build a universal toolkit for the versatile needs of opportunity exploration. The *how* part will be presented as collection of methods and tools that are suitable for different needs and situations. The first example is related to new products management.

## **New product management**

In new product management context Crawford & Di Benedetto (2014, p.1-24) present opportunity identification and selection framework for development of new products. The new product process consists of five phases: opportunity identification and selection, concept generation, concept/project evaluation, development, and launch. The process is comparable to the generic innovation process, and it is an example of product innovation process. The objective of the opportunity identification and selection in new product management is:

*Generate new products opportunities as spinouts of the ongoing business operation, new products suggestions, changes in marketing plan, resource changes, and new needs/wants in the marketplace. Research, evaluate, validate, and rank them (as opportunities, not specific product concepts). Give major ones a preliminary strategic statement to guide further work on them. (Crawford & Di Benedetto, 2014, p.29)*

New products process is found to be very similar as new services process. The difference is that services tend to take less time to develop than products and due to the different characteristics of services, when compared to products, some small changes to the process might be needed. The opportunity exploration phase of the new products process can be applied to services as well. (Crawford & Di Benedetto, 2014, p.43-46)

Opportunity identification and selection starts in new product process from collecting suggestions from marketing plans, special opportunity audits, market audits, resource audits, and corporate plans. After the suggestions are collected product innovation activity can start where the focus is on resources and mandates. Resources are divided into two groups. The first group is exploitation of underutilized resources such as technical, financial, product, and market resources. The second group of resources is the exploitation of potential new resources. The mandate is also divided to two groups external and internal mandate. The response for the external mandate is, for example, analysis and use of quality studies, customer needs, competitive threats, and regulation. The response for the internal mandate focuses on owners, top management, and unit plans, for example. After the four product innovation activities, the findings are evaluated and studied, and the unsuitable ones are rejected if they are not in line with the product strategy or are economically or technically not viable. The last step of opportunity identification and selection in new product process

is to create each opportunity a product innovation charter which defines the initial plan, objectives, and boundaries for the product. The opportunity identification and selection part of new product process is in **figure 11**. (Crawford & Di Benedetto, 2014, p.1-22)

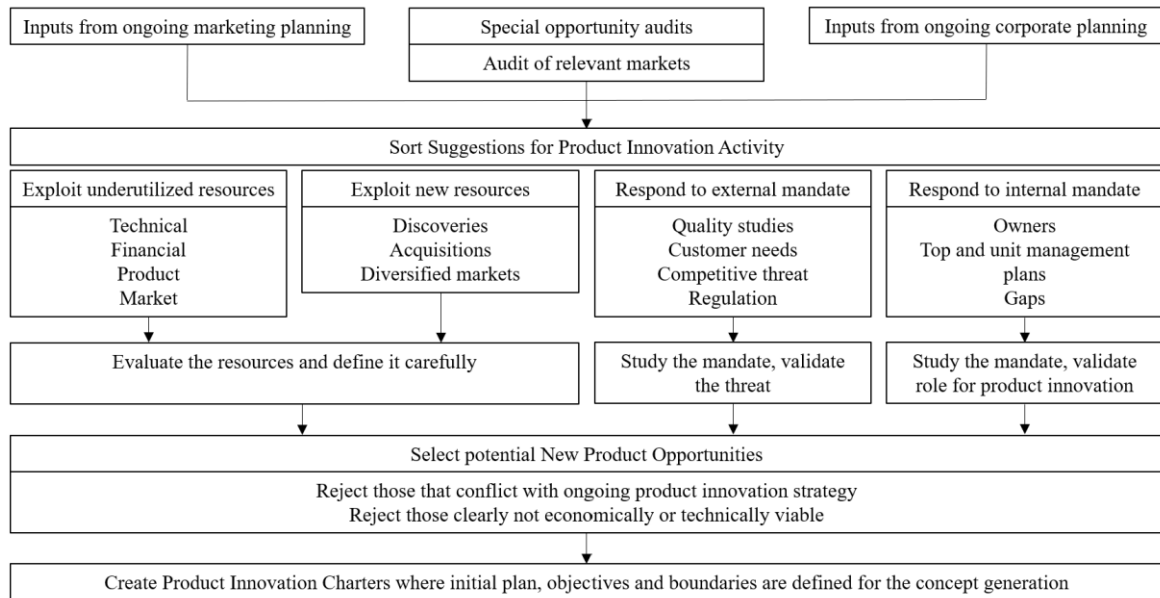


Figure 11. Opportunity identification and selection of new product process (Crawford & Di Benedetto, 2014)

### Opportunity identification in fuzzy front-end of innovation

There are many ways to model the process of innovation and new product, service, or concept process. Koen et al. (2001) separates front-end innovation process from new product and process development process which emphasizes more the innovation as part of the whole process. The model in **figure 12** suggests that first the goals for the opportunity identification are set and then methods are used. To promote creativity, tools and techniques such as brainstorming, mind mapping, and lateral thinking are suggested. For problem solving there are also suggested techniques such as causal analysis, fishbone diagrams, process mapping, and theory of constraints. The mentioned methods are formal ones, but also informal opportunity identification activities may be used such as ad hoc sessions, water cooler/cyberspace discussions, individual insights, or senior manager opinion or views.

After the opportunities are identified they are analysed further. In analysis, for example, competitive intelligence, trend analysis, focus groups, market studies, or scientific

experiments can be used. At analysis phase the fit to business strategy and culture, and the level of risk are also checked. (Koen et al., 2001) When the opportunity exploration in the front-end innovation is compared with new product development, the used templates and tools in front-end innovation are broader and less quantifiable. An example of quantifiable template and tool is quality function deployment model which is used to develop and design products in new product development (Chan & Wu, 2002).

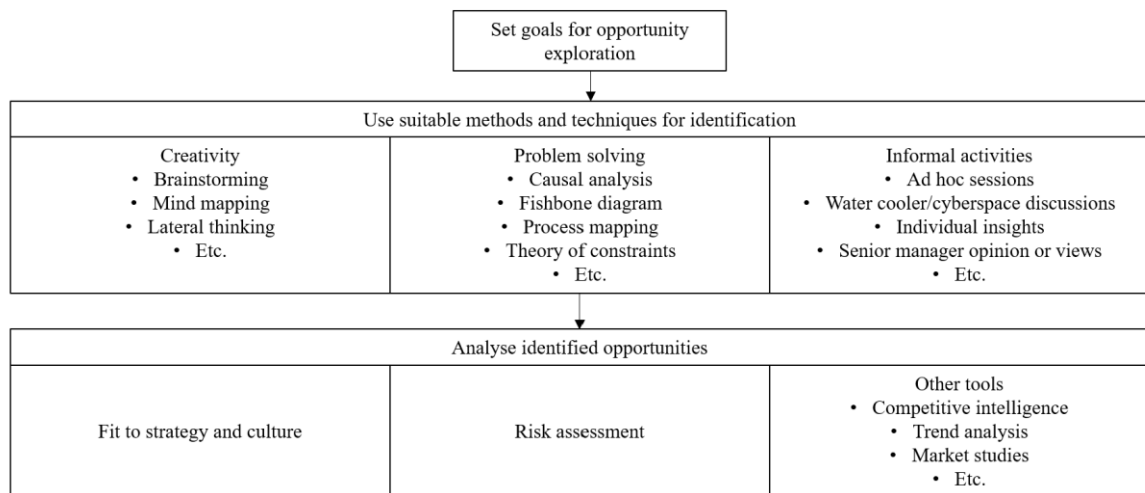


Figure 12. Opportunity identification and analysis in the fuzzy front-end of innovation  
(Based on Koen et al., 2001)

### Opportunity-led ideation

Opportunity exploration precedes idea generation in the front-end innovation process. Organizations that focus more on opportunities in innovation process instead of problems have higher innovation performance. (Verheul & Linda, 2008) Wyrcki, Röglinger & Rosemann (2021) present how the opportunities are taken into account in the innovation process properly. The idea generation of innovation process is divided to four activities in the model of Wyrcki, Röglinger & Rosemann (2021), which are initiation, immersion, investigation, and integration. The first three can be included to opportunity exploration and the last activity, integration, is focusing on idea generation. The presented framework guides how to generate big ideas and how to systematically narrow the number of ideas.

The tools suggested in the model of Wyrcki, Röglinger & Rosemann (2021) are in line with the literature mentioned earlier in this study. Examples of suggested tools in opportunity-led

ideation framework are trend analysis, scenario thinking, and ad hoc discussions. The sources of innovation are as well in line with the literature mentioned earlier in this study. The presented main sources are internal sources like corporate sources, and external sources like customers and competitors. When compared to other literature suppliers are not mentioned as an innovation source. The opportunity-led ideation framework guides to use source experts which are people that understand and know the specific source of innovation. For example, if the source is customers, then suitable source expert would be someone who deals with customers like salesperson or maintenance person. The role of moderator is also seen as important as it consolidates and generalizes the opportunities and the generated ideas. The opportunity-led ideation is presented in more detail in **appendix 2**.

### **Technology intelligence system**

In technology-based companies technology intelligence systems can be used to collect, analyze, disseminate, and utilize technology related information. The objective of the system is to ease the work in the rapidly changing technological environment. Typically, this kind of system consists of management, objectives, tools, and process. (Savioz & Tschirky, 2003) The tools that are typically used in technology intelligence systems are interesting from the point of view of opportunity exploration since they are used basically for the same purpose as the tools in opportunity exploration.

In technology intelligence systems the tools are used for strategy work, coping with complexity and uncertainty in the industry, and understanding the time dimension. Therefore, the tools in technology intelligence systems are also suitable for opportunity exploration, specifically for technology related opportunity exploration. The example tools are shown in **figure 13**. The tools and methods are shown in two-axis chart where the lateral axis is time focus of the tools and the vertical axis shows the characteristics of the tool from qualitative to quantitative. For example, brainstorming and roadmaps are tools which are used on shorter time span and qualitative aspects, whereas patent analysis and trend extrapolation could be used when quantitative aspects are needed in a shorter time span. For long time focus scenarios and Delphi method is suggested. (Savioz & Tschirky, 2003)

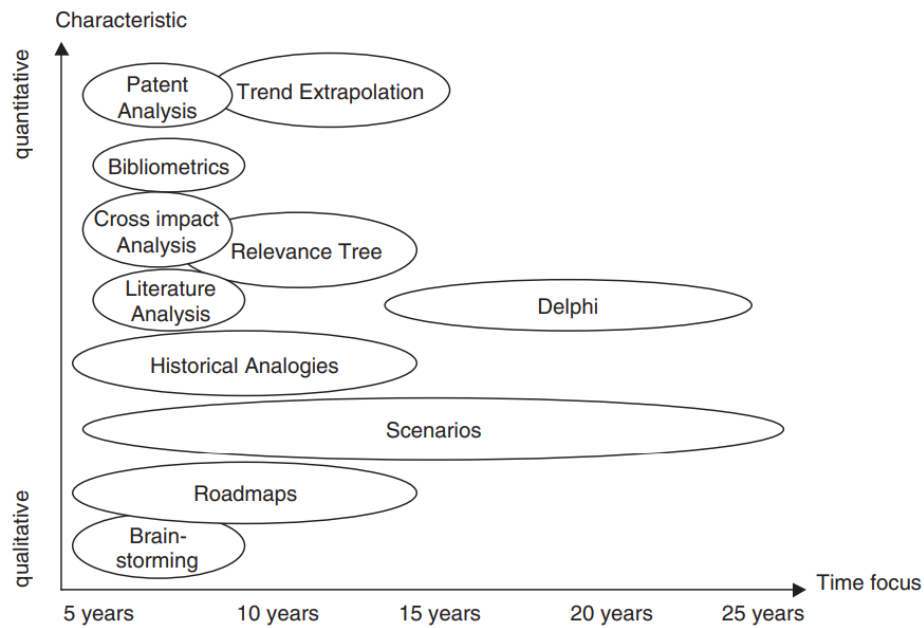


Figure 13. Technology intelligence system methods and tools (Savioz & Tschirky, 2003)

### Toolboxes such as Innovator's toolbox

Global innovation firm Board of Innovation (2023) offers the largest in the world open-source toolbox for innovation. According to Board of Innovation, companies such as Tata, Johnson & Johnson, Zeiss, Philips, ING, and Nestle are using the services and tools of the company. The tools vary from simple canvases to OpenAI artificial intelligence-based tools. There are on total 73 tools which are listed in **appendix 3**. Three of the tools can be used for exploration: future scan, tech & trends matrix, and ecosystem mapping. In the first tool, future scan, one future scenario from some sector in the tool is picked up and then the scenario is brainstormed. Next step is to pick more future scenarios from the tool and combine them for further brainstorming. The result is different topic related views of future, how it might look like and appear to be.

The second tool is tech & trends matrix. Trend analysis has been mentioned previously in many articles during the literature review which point out that trend analysis is obviously seen as important tool. In this tool the columns and rows form a matrix, so that in columns are listed trends and in rows for each trend “How might we...” (HMW) statements. HMW is meant to be a solution-oriented, optimistic, and collaborative statement on how the team or organization could respond to the trend. For example, in the case of supermarket company

the HMWs could be for the urbanization trend: “Online supermarket”, “Mini supermarket”, and “Supermarkets near public transportation hubs”. This tool helps people to intuitively think about opportunities, possible customer needs, and things that the company might be able to do. (Board of innovation, 2023)

The third tool relating to opportunity exploration is ecosystem mapping, which helps to explore opportunities within the ecosystem of existing or possible solutions. In the tool the stakeholders are identified, and the relationships between them are established. The tool helps to find what kind of opportunities arise for each stakeholder. The opportunities of some stakeholders can sometimes be converted to business value. The objective of the tool is to help understand the ecosystem where a solution is already present and to find other opportunities for it from the ecosystem perspective. For example, the online supermarket could be used from the earlier example. The relationships in the ecosystem could be established, for example, between consumers, logistic companies, conventional supermarkets, and online supermarkets. Then different opportunities can be identified, such as the opportunity that the customer can choose between conventional and online supermarket depending on the current need. Another opportunity that could be found is, for example, that the same logistics companies that deliver the goods to the supermarkets deliver online purchases for the consumers. Also, other tools of the Board of Innovation toolbox might be suitable for opportunity exploration such as strategy tools, but the three listed tools are the most applicable for the purpose from the 73 tools based on the company recommendation. (Board of innovation, 2023)

Innovator’s toolbox is not the only toolbox on the market. Second example of innovation toolbox is Luke Hohmann’s (2006) book *Innovation Games: Creating Breakthrough Products Through Collaborative Play*. In the book innovation is approached with games that create innovation through collaboration. Third example is *Mitre Innovation Toolkit* (2023). Mitre is a USA based not-for-profit company that “was established to advance national security in new ways and serve the public interest as an independent adviser”. Mitre Innovation Toolkit has 26 tools that are categorized to five different outcome categories: define, evaluate, generate, scope, and understand. The fourth example is *Killer Innovations Innovation Toolkit* (McKinney, 2023). Killer Innovations show is a podcast of Phil McKinney who is former CTO of Hewlett-Packard. Phil McKinney “has built teams that have innovated award-winning technologies and products currently used by half-billion

people worldwide”. Fifth and last example is *Playbook for strategic foresight and innovation* (Carleton, Cockayne & Tahvanainen, 2013). The playbook is sponsored by Tekes, which is the Finnish Funding Agency for Technology and Innovation, and by LUT-University. The book provides “a hands-on guide for modeling, designing, and leading your company’s next radical innovation”. In **table 8** the toolboxes are listed with the link to the resource.

Table 8. Five innovation toolboxes including the link to the resource

Resource	Available at
<b>Board of Innovation: The innovator’s toolbox</b>	<a href="https://www.boardofinnovation.com/tools/">https://www.boardofinnovation.com/tools/</a>
<b>Innovation Games: Creating Breakthrough Products through Collaborative Play by Luke Hohmann</b>	Book
<b>Mitre Innovation Toolkit</b>	<a href="https://itk.mitre.org/toolkit/">https://itk.mitre.org/toolkit/</a>
<b>Killer Innovations</b>	<a href="https://killerinnovations.com/">https://killerinnovations.com/</a>
<b>Playbook for strategic foresight and innovation</b>	<a href="https://www.lut.fi/sites/default/files/media/documents/playbook-for-strategic-foresight-and-innovation.pdf">https://www.lut.fi/sites/default/files/media/documents/playbook-for-strategic-foresight-and-innovation.pdf</a>

### **ISO 56000 actions in exploiting insights**

Exploiting insights is ISOs (2020) equivalent term for opportunity exploration which systematically focuses on need identification. The methodology and terminology differ slightly between organization and writers, but the basic ideas are the same in the literature and in the ISO standards. Based on ISO 56000 (2020) opportunity exploration improves understanding in the organization about the internal and external context where it operates. Better understanding helps to make better decisions. Opportunity exploration is also one way to decrease uncertainty which is high in the front-end innovation.

ISO 56000 (2020) suggests that opportunity exploration should be practiced by identifying internal and external sources of knowledge which are equivalent to innovation sources. The importance of information flow in opportunity exploration is also seen as important factor as it accelerates the spread of the identified opportunities and knowledge. To practice opportunity exploration, the standard suggests that opportunity exploration processes should be developed, implemented, maintained, and improved. Developing competencies for opportunity search and analysis is also seen as valuable action when developing opportunity exploration.



### Opportunity exploration based on the chosen innovation search space zone

Tidd & Bessant (2021, p.252) presented *where* dimension in the innovation opportunity search framework. In the *where* dimension the innovation search space is divided to four areas like shown in **figure 14**. In the search space there are two dimensions, environmental complexity, and innovation incrementality or radicality. The two dimensions divide the search space to four zones which are exploit (zone 1), bounded exploration (zone 2), reframing (zone 3), and co-evolve (zone 4). (Tidd & Bessant, 2021, p.260-263)

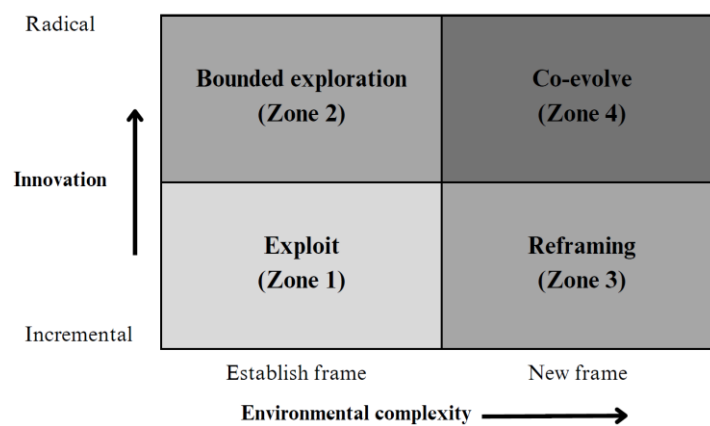


Figure 14. A map of innovation search space (Tidd & Bessant, 2021, p.260)

The search methods are different on each area as the characteristics of the innovation differs. Axis of innovation incrementality and radicality and axis of environmental complexity is seen in this model to be the most useful dimensions to define the search space for innovation and opportunity search. Anyhow each zone has its own challenges. For example, in zone 1 (exploit) the challenge is that the boundaries should incrementally be extended, and the changes should be more refinements and improvements than something more radical. Tidd & Bessant (2021) have suggested tools and methods for each zone of the opportunity and innovation search space. For example, in zone 3 (reframing) alternative futures, user-led innovation, extreme users, and prototyping could be utilized to find what kind of incremental opportunities a new innovation frame could offer. Last part of the search space-based opportunity search framework is the enabling structures for each zone. The enabling structures define what is needed for the search. For example, in zone 1 (exploit) high involvement across organizations as well as formal and mainstream structures are suggested. In contrast to zone 1, for zone 4 'licenced dreamers', outside agents and facilitators, as well as other far from mainstream structures are suggested. The challenges, tools, methods, and

enabling structures are presented in more detail in **table 9**. (Tidd & Bessant, 2021, p.260-263)

Table 9. Opportunity and innovation search space challenges, tools, methods, and enabling structures (Tidd & Bessant, 2021, p.263)

<b>Zone</b>	<b>Search Challenges</b>	<b>Tools and Methods</b>	<b>Enabling Structures</b>
1. 'Business as usual' – innovation but under 'steady-state' conditions, little disturbance around core business model	<ul style="list-style-type: none"> <li>- Exploit – incrementally extends boundaries of technology and market</li> <li>- Refines and improves</li> <li>- Close links/strong ties with key players</li> </ul>	<ul style="list-style-type: none"> <li>- 'Good practice' new product/ service development</li> <li>- Close to customer</li> <li>- Technology platforms and systematic exploitation tools</li> </ul>	<ul style="list-style-type: none"> <li>- Formal and mainstream structures</li> <li>- High involvement across organization</li> <li>- Established roles and functions (including production, purchasing, etc.)</li> </ul>
2. 'Business model as usual' – bounded exploration within this frame	<ul style="list-style-type: none"> <li>- Exploration – pushing frontiers of technology and market via advanced techniques</li> <li>- Close links with key strategic knowledge sources</li> </ul>	<ul style="list-style-type: none"> <li>- Advanced tools in R&amp;D, market research</li> <li>- Increasing 'open-innovation' approaches to amplify strategic knowledge search resources</li> </ul>	<ul style="list-style-type: none"> <li>- Formal investment in specialized search functions – R&amp;D, market research and so on</li> </ul>
3. Alternative frame – taking in new/different elements in environment Variety matching, alternative architectures	<ul style="list-style-type: none"> <li>- Reframe – exploration of alternative options, introduction of new elements</li> <li>- Experimentation and open-ended search</li> <li>- Breadth and periphery important</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative futures</li> <li>- Weak signal detection</li> <li>- User-led innovation</li> <li>- Extreme and fringe users</li> <li>- Prototyping – probe and learn</li> <li>- Creative techniques</li> <li>- Bootlegging and so on</li> </ul>	<ul style="list-style-type: none"> <li>- Peripheral/ad hoc</li> <li>- Challenging – 'licensed fools'</li> <li>- Corporate venture units</li> <li>- Internal entrepreneurs</li> <li>- Scouts</li> <li>- Futures groups</li> <li>- Brokers, boundary spanning and consulting agencies</li> </ul>
4. Radical – new to the world – possibilities New architecture around as yet unknown and established elements	<ul style="list-style-type: none"> <li>- Emergence – need to coevolve with stakeholders</li> <li>- Be in there</li> <li>- Be in there early</li> <li>- Be in there actively</li> </ul>	<ul style="list-style-type: none"> <li>- Complexity theory – feedback and amplification, probe and learn, prototyping and use of boundary objects</li> </ul>	<ul style="list-style-type: none"> <li>- Far from mainstream</li> <li>- 'Licensed dreamers'</li> <li>- Outside agents and facilitators</li> </ul>

### 3.4 Summary of literature review

The objective of the literature review is to find suitable tools and frameworks for opportunity exploration and to research what kind of actions are needed in front-end innovation management to ensure the success of the case company in the future as well.

The second research question, about suggested actions in front-end innovation, was answered first as front-end innovation is broader topic containing opportunity exploration. Front-end innovation has high influence on the innovation process as it is in the beginning of the process and therefore defines the directions of the innovation. Based on the literature review it is obvious that innovation has many advantages and that it generates new and sustains existing competitive advantage. The link to competitive advantage is seen to be one

of the key advantages of innovation. It was also discovered that competitive advantages have a major role on the success of the company as it is an ability of the organization to success in the competition against current and potential future competitors.

To make front-end innovation successful the company should have an innovation strategy, and it should use suitable tools and frameworks. The objective of front-end innovation management is to make often experimental, chaotic, and unpredictable front-end innovation more systematic, predictable, and less risky by creating suitable conditions for innovation by utilizing, for example, processes and activities. For the company, successful front-end innovation management can increase innovation capabilities and generate value.

For the first sub research question, which is about frameworks and tools, many suitable frameworks and tools were found. Opportunity exploration is presented in the literature with few different names such as opportunity identification or analysis and exploiting insights, but they all come before idea generation and their objective is the same: find opportunities that might become valuable for the organization and that are in line with the company strategy. In summary the general framework for opportunity exploration is to set goals, then use methods and tools to find opportunities, and finally evaluate and analyse if the found opportunities should go forward to the next phase such as idea generation. The tools vary a lot depending on the opportunities that are searched for. Some of the tools are formal like trend analysis and some informal like ad hoc sessions. The tools vary depending on the opportunity timespan, incrementality versus radicality of the innovation, push and pull innovation, and internal and external innovation. Close to 100 tools and methods were found for opportunity exploration during this literature review.

25 individual sources were used in the literature review. The sources were chosen based on the fit to the topic and high quality. In the initial literature review search authors were ranked by number of publications that were found with search word “front-end innovation management”. In the literature review only three of the authors were part of the main sources. Different authors than the ones listed in the initial literature review author search were used as there were only one search word in the initial search which limited the authors. The sources presented in the literature review are categorized and presented in **table 10**. The sources are divided to eight central themes of the literature review that are about innovation, front-end innovation, opportunity exploration, and competitive advantages. The findings listed in the table are the key findings from the literature review about each theme. Book

*Managing Innovation: Integrating Technological, Market and Organizational Change* (Tidd & Bessant, 2021), article *Providing Clarity and A Common Language to the "Fuzzy Front End"* (Koen et al., 2001), and book chapter *The 'Fuzzy Front End' of Innovation* (Herstatt & Verworn, 2003) were the main sources of literature review. The main sources used are well recognized on the field of front-end innovation and they are either cited often or they cite other peer reviewed quality sources about the subject.

Table 10. Literature review themes, authors, and main findings

Theme	Authors	Findings
<b>Innovation on general level</b>	(Tidd & Bessant, 2021), (Silva & Di Serio, 2016), (Mohan, Voss & Jiménez, 2017)	<ul style="list-style-type: none"> <li>• Something new that creates value.</li> <li>• Innovation culture is important for innovation performance</li> <li>• Innovation comes in trends. Current trend is probably sustainability.</li> </ul>
<b>Innovation sources</b>	(Tidd & Bessant, 2021), (Demircioglu, Audretsch & Slaper, 2019), (Wyrcki, Röglinger & Rosemann, 2021), (UK Department for Business, Energy & Industrial Sector, 2022), (Di Stefano, Gambardella & Verona, 2012)	<ul style="list-style-type: none"> <li>• Internal and external</li> <li>• Technology or knowledge push and demand pull</li> <li>• Incremental and radical</li> <li>• Depends on time horizon</li> <li>• Most important innovation sources are internal sources, customers, and suppliers</li> </ul>
<b>Characteristics of front-end innovation</b>	(Koen et al., 2001), (Dziallas & Blind, 2019), (Tidd & Bessant, 2021), (Herstatt & Verworn, 2003)	<ul style="list-style-type: none"> <li>• Experimental and often chaotic</li> <li>• Objective is to generate, screen, and evaluate ideas and concepts</li> <li>• High influence on innovation</li> </ul>
<b>Value of front-end innovation</b>	(Koen et al., 2001), (Tidd & Bessant, 2021), (Herstatt & Verworn, 2003), (Idris & Durmuşoğlu, 2021), (Markham, 2013), (Verheul & Linda, 2008)	<ul style="list-style-type: none"> <li>• Focus on opportunity exploration is important</li> <li>• Generates and sustains competitive advantages</li> <li>• Strategic advantages</li> <li>• Positive impact on product performance</li> <li>• Focus on opportunities instead of problems leads to higher innovation performance</li> </ul>
<b>Front-end innovation process</b>	(Koen et al., 2001), (Tidd & Bessant, 2021), (Markham, 2013)	<ul style="list-style-type: none"> <li>• Search, select, implement, and capture</li> <li>• Quality of ideas should be prioritized over number of ideas</li> </ul>
<b>Front-end innovation management</b>	(Tidd & Bessant, 2021), (Herstatt & Verworn, 2003), (Idris & Durmuşoğlu, 2021), (Terwiesch & Ulrich, 2008)	<ul style="list-style-type: none"> <li>• Importance of innovation strategy</li> <li>• Set and support procedures and practices for innovation</li> <li>• Systematic and proven way to generate innovation efficiently</li> </ul>
<b>Opportunity exploration framework, tools, and methods</b>	(Koen et al., 2001), (Tidd & Bessant, 2021), (Chan & Wu, 2002), (Wyrcki, Röglinger & Rosemann, 2021), (Verheul & Linda, 2008), (Savioz & Tschirky, 2003), (Board of innovation, 2023), (Hohmann, 2006), (McKinney, 2023), (Carleton, Cockayne & Tahvanainen, 2013), (Mitre, 2023)	<ul style="list-style-type: none"> <li>• Depends on the opportunities that are searched</li> <li>• Numerous very different toolkits, tools and methods available</li> <li>• Framework: goal, tools and methods, and analysis</li> </ul>
<b>Competitive advantage</b>	(Tidd & Bessant, 2021), (Rothaermel, 2016), (Barney, 1991), (Porter 1979), (Porter, 1990), (Porter 2008)	<ul style="list-style-type: none"> <li>• Enables success in the competition</li> <li>• 5 main competitive forces</li> <li>• Innovation is a major source</li> </ul>

## 4 Theoretical framework

In this chapter the connection of front-end innovation management, competitive advantage, and opportunity exploration will be presented in a theoretical framework based on the findings in the literature review. After the empirical part of this study the theoretical framework can be developed further to answer better to the main research question.

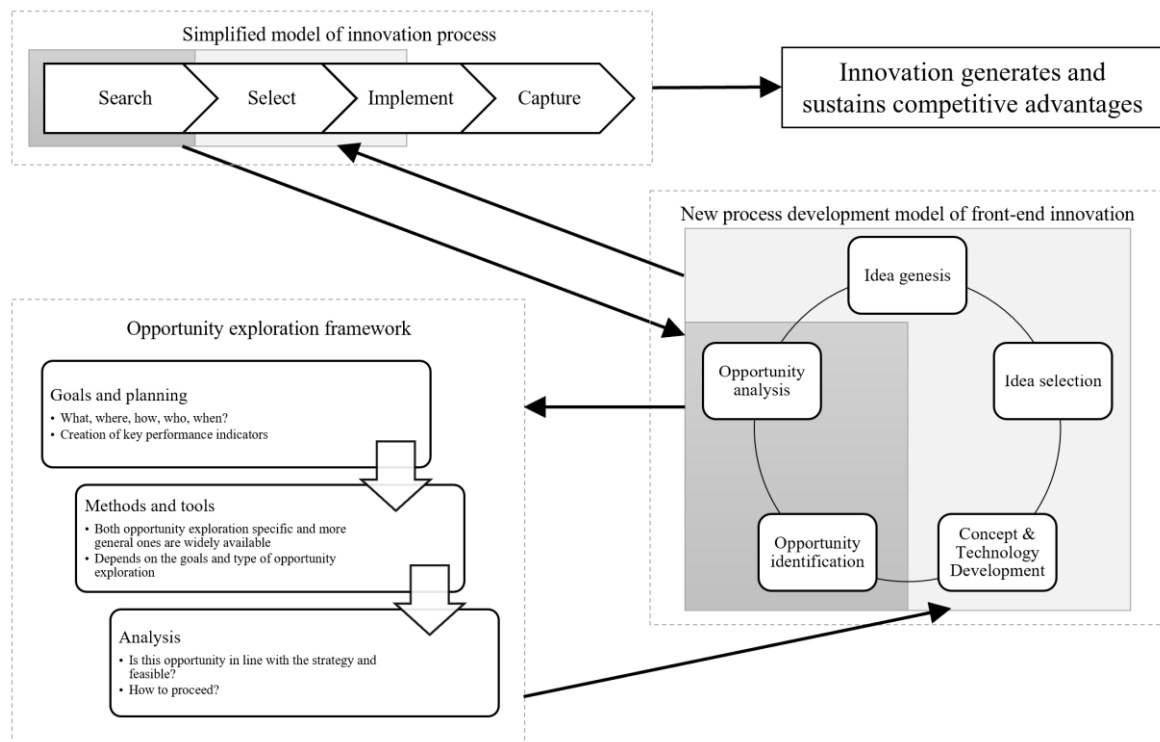


Figure 15. Theoretical framework of opportunity exploration including innovation and front-end innovation process

The theoretical framework, based on the literature review, in this context is designed to serve and foster innovations generally in a global manufacturing company. In some more specific areas of innovation such as in product development the model needs to be adjusted. The theoretical framework, based on the literature review, is in **figure 15**.

The starting point of the framework is the *simplified model of innovation process* (Tidd & Bessant, 2021, p.22). In the simplified model of innovation process the framework focuses on the front-end which is demonstrated with the *new concept development (NCD) model of*

*front-end innovation* (Koen et al., 2001). In NCD opportunity identification and opportunity analysis form opportunity exploration.

For *opportunity exploration framework*, *innovation opportunity search framework* of Tidd & Bessant (2021, p.252) from **figure 10**, *opportunity identification and selection of new product process* by Crawford & Di Benedetto (2014) from **figure 11**, and *opportunity identification and analysis in the fuzzy front-end of innovation* by Koen et al. (2001) from **figure 12** are combined. Creation of key performance indicators is added to goals and planning phase because measuring supports the later analysis phase and in literature review the measurement of front-end innovation is mentioned to be important. The connection of competitive advantages, innovation, front-end innovation, and opportunity exploration are visualized also in the framework. The framework forms an entity which demonstrates the place of opportunity exploration in the innovation context. The purpose of the framework is to visualize the connections between the elements.

A centric question is how opportunity exploration is applied in practice based on the theoretical framework. First it needs to be evaluated if opportunity exploration is needed on that specific case. For example, if there is already an opportunity or a problem that needs ideas the idea genesis phase can be entered directly. If the opportunity is not clear, or there is a development or strategic initiative or planning, opportunity exploration should be applied.

The *opportunity exploration framework* is straightforward as it consists of three simple steps. First the goals need to be set to define what is explored where, how, when, and by whom. The second step is to apply suitable tools and methods which can be listed and categorized for different purposes in advance. The last step is to collect the opportunities and analyze whether they are usable or not. The whole process should not take a long time, as it is only one part of front-end innovation, but different experts in addition to the moderator should participate in the activity. The practical model is presented after the interview section when the needs and current operating models have been mapped better so that the final model would suit the case company.

## 5 Methodology

In the methodology chapter the second part of the research is presented. The first part consisted of literature review which answered mainly to sub research questions and formed basis for the answer for the main research question. In the methodology chapter the main research methodology is interview. The chapter presents the research design and data collection. Data analysis is presented in the following results chapter.

### 5.1 Research design

The main purpose of the research is to answer the main research question: how the opportunity exploration should be practiced? Firstly, it is discovered how opportunity exploration is done currently and what academic literature says about it. Then data is collected, and the main research question is answered. Therefore, the research is exploratory research. As exploratory research is flexible and relatively unstructured it allows the research to adapt with the gained information during the research. Exploratory research relies on the quality of the data which in this case is interview data. The interviewees should be sampled carefully as the quality is prioritized. (Saunders, Lewis & Thornhill, 2016, p.174-176)

Total of 12 in-depth interviews were conducted. The used sampling method is purposive sampling combined with snowball sampling. The interviewees are selected based on their expertise and experience on front-end innovation. In the first interviews it is inquired if the interviewee would know people that would have the right background and experience for the interview. The interviewees were picked from different divisions and functions to ensure that the sample would reflect the whole company and that it would be reliable.

The study builds conclusions and theory from data. First there is literature review data and then it is fulfilled and supported with interview data. The approach to theory development is inductive approach which is based on specific observations, and it includes broad generalization which should be taken into consideration in the conclusions. Inductive approach to theory building suits well for theory building and conceptual framework building. (Saunders, Lewis & Thornhill, 2016, p.144-149)

To get to the goals of the research a specific research strategy is used which guides how the research is done. In this research the used research strategy is grounded theory which works with the inductive approach. Grounded theory is often used in business or management research as it is suitable for understanding people, organizations, and behaviour. In grounded theory the research data is analysed during the data collection. After every interview the data is analysed, and the theory and conclusions are built and improved. (Saunders, Lewis & Thornhill, 2016, p.177-195) The interview recordings are transcribed and coded. The codes are then grouped, and the relations of the codes are analysed. It is explored if there is a consensus on some topics and what kind of the answers are on a general level. Based on the codes answers for the research questions are formed, and theoretical framework is developed further from the literature review to suit the characteristics and needs of the company.

## 5.2 Interview data collection

The sampling method of interviewees was mainly purposive sampling which aimed to get relatively homogenous samples of people that are working closely with innovation. People working closely with innovation in the case company work in business development, product management, service management, product development, general management, and sales functions. Heterogenous sampling was also applied as people from four different divisions were interviewed to get thorough image of the company. Some of the interviewees work cross divisionally. The different divisions have different focus areas such as different products or then the nature of business is different like service versus manufacturing.

In the purposive sampling the sample was aimed to be pro innovation. People favoring innovation are useful in this interview as they have experience and views of innovation activities in the company. The people in the sample consisted of people that participate innovation activities as part of their work, which highlights the importance of innovation for them. Pro innovation sample has bias towards innovation as they tend to highlight the importance of innovation, but in this case, it is acceptable as the context of the study is front-end innovation management which demands that people managing it understand the topic and have expertise on it. The importance of innovation was not the core question of this study, so it was discussed only shortly in chapter 3.2.2. In this study the focus was on how



opportunity exploration and front-end innovation should be practiced based on the literature review and the expert interviews.

In total 12 people were interviewed. Eleven of the interviewees were working in the case company. The average experience of interviewees at the company was 26 years, which indicates that the interviewees were more senior employees. Most of the interviewees were some kind of managers. It was also considered whether younger or blue-collar employees should be included but due to the strategic characteristics of opportunity exploration it was evaluated that more experienced interviewees would be more useful source of information. In addition to 11 case company interviews one interview was conducted for LUT-University innovation expert that has experience both from research and the industry side. The purpose of external source is to give alternative perspective of the topic and to help to evaluate if the company sources are affected of some cognitive bias such as anchoring. The LUT-University interviewee was interviewed with slightly modified questions.

The interviewees were invited to Microsoft Teams interview few weeks in advance. The invitation included an introduction for the interview so that the interviewee could understand the context and would get motivated for the interview. The interview itself was estimated to be 60 minutes in total. Firstly, in the interviews there was brief personal introduction, introduction to the interview, official part of the interview, and finally an open conversation. In the introduction permission to record the official part of the interview was asked to get a transcription. The interviews were told to be confidential, the interview recording to be kept for a limited time, and the data to be anonymized for the research. The official part of the interview lasted on average 30 minutes and 22 seconds. In total of 6 hours and 4 minutes of transcription was made of the recordings which were analyzed in the data analysis part.

The interview questions were created in cooperation with the company supervisor of the study. The purpose of the interviews is to understand, based on the company employees, how opportunity exploration should be practiced in the company. First background information of interviewees was collected. After background information general questions of innovation were asked. As the interview progressed, the focus moved to front-end innovation and opportunity exploration. First it was discovered how opportunity exploration is done currently and after that it was asked how it should be practiced in the future and whether some support would be needed. The interview was a semi-structured interview and if the answer was already given in advance to a latter question, it was not asked again. For

some questions some interviewees did not answer, which was probably because the topic was already discussed, or the question was not properly understood. In total there were 22 questions which are presented in **appendix 4**. The questions were divided into seven categories:

1. Knowledge of innovation processes in the business area
2. Innovation culture
3. Innovation management
4. Sources of innovation and ideas
5. Opportunity exploration as part of front-end innovation
6. Opportunity identification and analysis now
7. Support for opportunity exploration

After the interviews the recordings were transcribed and from transcription text captions and codes were listed. Eleven of the interviews were conducted in Finnish and one in English. All the codes were translated into English, and they summarized the core messages of each interviewee for each question.

During the interview process, the data of each interview was collected and the data was analyzed. The codes of each interview question of each interview were gathered under the specific questions. All the data was divided into a graph. The idea of the graph is visualized below in **figure 16**.

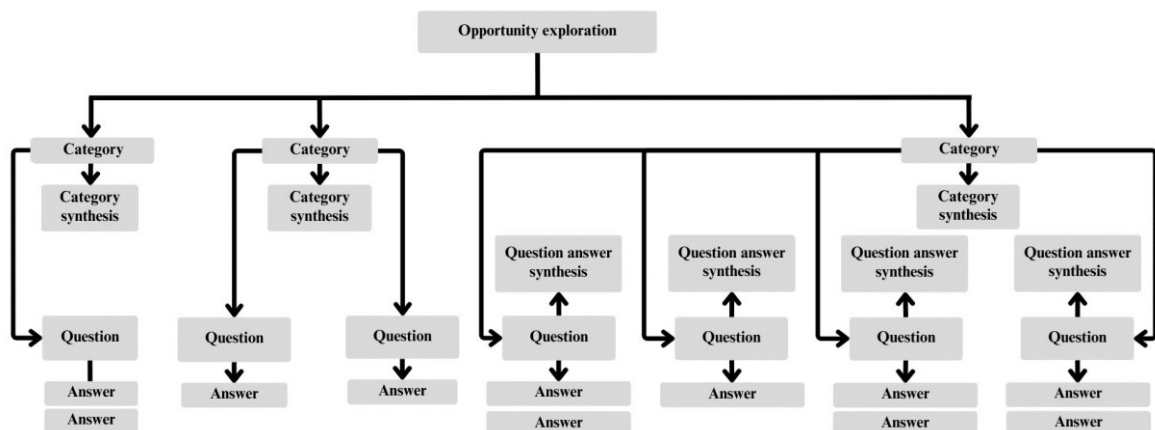


Figure 16. Interview data analysis graph template

The first level of the graph is categories, of which there were 7 in total. For each category a synthesis of the question answers was formed. If there were more than two questions in one

category, all the answers were separately synthesized into question answer synthesis. The method formed answers for each question and category. In the synthesis it was mentioned if there was variation in the answers.

## 6 Results

The interview data was analysed with the process described in the last chapter. For each category, a synthesis was made which the results are based on. If some interviewees presented significant or divergent views, it was considered in the synthesis or later in the result descriptions in this chapter.

### 6.1 Knowledge of innovation processes in the business area

In the first category, knowledge of innovation processes in the business area, there was one question: How familiar are you with the innovation processes in the business area? The question was intended to warm up the interviewee and to collect information of how familiar the interviewee is with the topic. The interviewees said they know the innovation processes on a basic level, but most interviewees were unsure about the current process. The context of the question was on the general innovation process. For example, product development process can be also an innovation process, but it is not the main area in this research as this is more about the general cross divisional and functional innovation process. The only yet implemented part of the company's innovation process is the idea management and it was recognized as an important part of the process, and it received generally good feedback.

### 6.2 Innovation culture

In the literature review innovation culture is identified to be important part of organizational innovation competency. Knowledge about innovation culture was asked with the question: How would you describe the innovation culture in your division? The innovation culture seems to vary between divisions but on a general level it is described to be on an average or a good level. Different innovation activities are conducted and are identified to be part of the company identity or 'company DNA'.

More focus could, and depending on the interviewee, should be on innovation. One reason why there has not been that much focus on innovation can be seen in one of the interview answers:

*“For maybe last five years there has been pressure to focus on profitability. That has been on the forefront of communication. Profitability needs to be increased and the costs needs to be cut. Communications effect on a general level. There have been situations where it has been though that something is not worth to do as most of the resources are allocated for cost cutting.”*

The transparency of innovation activities is criticized as it is difficult to know or get information on innovation activities in the company. Innovation activities, based on the interview answers, are highly decentralized as is the whole organization structure. Based on the answers, the main challenge is that innovation relies on individuals and the whole organization is not learning. Processes are seen to be a key to connect people in the grown organization. The grown organization size and increased remote work are also seen to threaten innovativeness.

### 6.3 Innovation management questions

Innovation management was studied earlier in the literature review, and it is a key part of innovation in an organization. Innovation management provides a way for how innovation activities are guided and what kind of innovation environment is created. Innovation management category consisted of two interview questions:

1. Do you find innovation management useful?
2. What do you expect of innovation management?

The first question leads to the second question and most of the interviewees already answered the second question while answering to the first question. In the interviews there was a consensus that innovation management is needed in a large organization. Some of the interviewees asked for a definition of innovation management. It was also said that the meaning and definition of innovation management might not be known through the organization that well. Most of the interviewees told that innovation management differs from more conventional management as innovations cannot be forced. Innovation

management was described to be about creating a suitable environment, culture, and way of working for innovations. The following two citations of the interview answers describes well how innovation management is understood among people who know what it is about:

*“Innovation cannot be forced. It needs suitable environment, platform for growth, and conditions. For sure the environment can be affected with innovation management.”*

*“Innovation management is about creating culture. The environment depends on the innovation management. ... Then there is the leadership. Inventors itself does not create value in the context of innovation. The commercialization is important in innovation.”*

#### 6.4 Sources of innovation and ideas

The sources of innovation and ideas are part of opportunity exploration. Also, the opportunities need to be found somewhere, and innovation sources are a good starting point. Sources of innovation and ideas were asked with one or two questions depending on the rhythm and direction of the interview. For some interviewees both questions were asked if the first answer did not cover both questions. The questions are below:

1. Where do new ideas typically come from?
2. What are the typical sources of innovation opportunities in your division?

Many different sources appeared in the answers. Two categories, like in the literature review, were identified in the answers: internal and external sources. In the internal sources technology, own personnel, system thinking, and innovation challenges were mentioned. The list of external sources is longer: technology, suppliers, megatrends, customers, regulation, patents, competitors, startup challenges, and markets. The most used sources were mentioned to be internal sources and technology even though there is in the company an emphasis on customer orientation. Innovations are created based on a few interview answers, combining two or more well-known things. Reuse or reapply of old technology is an example of that.

## 6.5 Opportunity exploration as part of front-end innovation question

In the company innovation process opportunity exploration is defined to be the first step of the process even though it is not a linear process as such. In the literature review it was found out that opportunity identification and analysis or opportunity exploration is part of front-end innovation. To understand the interviewees before going to more detailed opportunity exploration questions, it was asked: Do you recognize opportunity exploration as part of the front-end innovation? The answers were positive. In all the answers opportunity exploration was recognized as part of front-end innovation, and it was said that “opportunity exploration is needed in order to focus on the right things”. In the introduction of the interview the context was presented for the interviewees which in turn might have reinforced the understanding of opportunity exploration which might have affected on the answers.

## 6.6 Opportunity identification and analysis now

The state of opportunity identification and analysis in the company is one of the key categories in the interview. Opportunity exploration now category had six questions:

1. How do you find and analyse new opportunities?
2. What kind of frameworks or tools do you use in opportunity exploration?
3. How systematic is opportunity exploration in the teams or projects you are working with?
4. What criteria are used when opportunities are selected and compared?
5. Who make decisions in the innovation process?
6. In which point opportunity becomes official?

There is some overlap in the questions as the way how opportunity exploration is done is closely related to methods and tools that are used. Some of the questions were already answered earlier in the interview but if clarification for the topic was needed it was asked. For example, criteria used in opportunity exploration might have been already listed in the first questions of this category.

Based on the interviews, the interaction with other people and stakeholders was said to be the key to searching for and analysing new opportunities. Processes and methods were mentioned to be supportive for opportunity exploration. Lots of various methods, tools, and frameworks were listed in the interviews:

*Business model canvas, service design tools, ideation tool, stakeholder forum, invention process, cause effect relationship, pitch event, workshops, opportunity challenge submission form, cross functional activities, painstorming and partnership with customers.*

The list of mentioned methods, tools and framework is very diverse, as are the innovation topics. This finding points out that the methods, tools, and frameworks needs to be diverse and that it is challenging to make a very specific general method, tool, or framework guideline for opportunity exploration. However, it might be useful to collect the used methods, tools, and frameworks to one list and add the findings from the literature to the same list. The list might be useful for people who are searching for information, how to do opportunity exploration. The tools and methods could be categorized.

The next subcategory is systematicity. The interviewees answered that opportunity exploration is mostly not systematic and that it is informal in the teams or projects where they are working. There were some differences in the answers as some said that it is more systematic. In the beginning of innovation process the work was reported to be less systematic: “in the beginning of innovation funnel it is not systematic and there a formal process would not even work”, but when innovation process goes further it was said that the level of systematicity increases. Systematicity is not seen to be important in opportunity exploration as it can limit the number of ideas. However, as the opportunities should be in the right context, business thinking and some systematicity is needed.

After the three first questions it was asked what criteria in opportunity exploration are used. The criteria are typically used for comparing, analysing, and selecting opportunities. Somehow the opportunities need to be valued so that the best ones could be picked, and the resources could be allocated effectively. In the answers financial values were mentioned to be the key criteria but the fit to strategy was also seen as important factor. Also, these criteria were mentioned: strategy, profitability, competitiveness, business case, internal and external financial values, opinions, risks, input-output ratio, network effect, desirability, viability, and feasibility. The key findings were that the profits and strategy are main criteria but that



there are other variables depending on the case in hand. Absolute financial values were seen sometimes to be a bit untrustworthy as there is a lot of uncertainty in opportunities as it is the first phase of front-end innovation. In the interviews it was said that, if it is not possible to get reliable estimates of absolute financial values relative financial values can be used when comparing opportunities.

Second last question in the category was who makes the decisions in the innovation process. It is interesting to know who makes the decisions as, based on the literature review, the decisions are known to affect highly on the outcome of innovation. In the interviews it was said that it depends on the risk and on the size of the decision:

*“The decisions are made in our organization in the order how it is built. The decisions are made from lower level to higher level. ... If we invest on something larger then division management decision or even business area management decision is needed.”*

In practice, product management and division management make most of the decisions, sometimes business area management. Agility can be fostered in the early phase of innovation process by keeping the team small and by keeping the decision making simple by experimenting in small steps.

Last question was about the officiality of the opportunity: in which point opportunity becomes official? Official means that it is documented, and it is decided that something will be done to advance the opportunity. For most of the interviewees it was a bit unclear when it becomes official, but it was mentioned that probably in weekly or monthly meetings opportunities are concretized. There are many ways to concretize opportunities but for example for technological opportunities invention disclosure was said to be an example when things get official. The information when opportunities get official clarifies the level of formality in opportunity exploration. Based on this question, the beginning of opportunity exploration is informal and in the end of the process it gets more formal.

As a conclusion, in the case company the opportunity exploration seems to be conducted in a rather informal way and based on interactions. Methods, tools, and frameworks are used variably, and it is seen that too much systematicity might hurt the process in the beginning. However, it does not mean that there would not be systematicity and processes would not be used. There were differences in the answers, and the nature of opportunity exploration differs

between people as for some it is a regular activity that is done along the normal work but in a bit different form.

## 6.7 Support for opportunity exploration

Last and the most important part of the interview was to find out how opportunity exploration could be supported and how it should be practiced. The category answers the main research question from the point of view of the interviewees. The last category where it was discovered how it is practiced currently already shed some light on how it should be practiced but now it is asked differently, and it is asked also whether it could be supported. The support category consisted of four questions:

1. Would support be needed in opportunity exploration?
2. How could opportunity exploration be supported?
3. Would tools, frameworks, or processes support in opportunity exploration?
4. If yes, what kind of tools, frameworks, workshops, or processes would be helpful?

For the first question the answer was mostly yes. None disproved or told that support would be useless. Again, it was told that opportunity exploration is done already as part of some regular work but there are things that could be improved. It was also emphasized that culture comes before methods and tools.

When it was told that support would be useful in opportunity exploration it was easy to ask the next question where it was asked how opportunity exploration could be supported. Again, it was said that opportunity exploration is already done as part of some work and that there is already some support. For innovation specific opportunity exploration, a long list of actions was mentioned:

*Marketing and advertising of innovation activities, innovation challenges, innovation initiatives and projects, startup challenges, innovation events for employees, encouraging, innovation process, thorough and quick reasoning for ideas if they are not approved, formal business area level process for opportunity register, open organization culture that is diverse and inclusive, lower the threshold on participation, guiding on ideation, Smart Lab for every division, and networking.*

The suggested actions are diverse but there is a common factor: increased innovation activity. Most of the activities mentioned in the interviews are about increasing of innovation activity. Advertising and marketing are one way to get better visibility for innovation and to make people to think about innovation. Then the participation rate might increase and more innovation challenges, events, and all kind of activity would appear. It is helpful that people have ideas how the innovation activity could be increased. The mentioned activities need to be evaluated carefully to generate valuable recommendations on supporting opportunity exploration, as all actions might not be feasible.

To get more thorough answers about the support that could be given or ways how opportunity exploration should be practiced, it was asked whether tools, frameworks, or processes could support opportunity exploration. The question is overlapping partially with the last one, but it gives useful insight on the details how things should be done. Tools, frameworks, and processes were seen as useful as they tend to increase innovation activity which is seen as the most important factor. One of the most influential models mentioned in the interviews is initiatives or projects that are cross-divisional and are provided with financing and a license to operate. Cross-divisional activities unreleases the untapped potential of a division-led organization structure. The tools, methods and frameworks that could be useful were mentioned in plenty:

*Support to better understand customers, Salesforce field data from maintenance and salespeople, AI patent analysis, competitor and market analysis, startup programs, guidelines how innovations are practiced separately from daily work, simple tools that might have some automation like HSE platform, and customer painpoint tool.*

About the tools it was emphasised that the need and tools should meet, and focus should be on the work itself not only on the tools. About the processes that are defined for innovation it was said that they should not be defined too tightly. Tools were not mentioned to be the most important way how opportunity exploration could be improved. Numerous tools mentioned in the interviews could still be used in the future to improve opportunity exploration if there is a need for the specific tool.

## 6.8 Interviews summary

In interviews it turned out that opportunity identification and analysis is based on interactions. Tools and methods are used, and they are well-known such as business model canvas, ideation tool, and cause effect relationship. Workshops, cross functional activities, and partnerships with customers are also seen to be beneficial methods. Systematicity is not that necessary or valued but the opportunities should still be guided, and they should follow the company focus and strategy. In criteria financial values and fit to strategy were the most important ones. In decision making the product-based nature of the business was standing out as product management was the most influential decision maker next to division management. The opportunities become official in meetings or in some formal process like invention disclosure. As opportunities are not yet in the beginning official it means that there is informal work before the opportunity is concretized.

Opportunity exploration is already practiced in some extent as part of regular work but there is need for opportunity exploration that is done outside the regular work processes. In suggested support or improvement ideas the key is that innovation activity increases. Various ways how innovation activity could be increased were mentioned such as events, processes, challenges, methods, and tools. To develop opportunity exploration there is no single way to do it. It needs to be practiced with various ways as there is also an important informal part of the work that cannot always be strictly guided with processes or tools. There needs to be space for creativity. Innovation positive culture is also seen to be enabler for successful opportunity exploration.

## 7 Opportunity exploration framework and recommendations

In this chapter, results from the literature review and interviews are combined to form an answer to the main research question: how opportunity exploration should be practiced? The objective is also to form recommendations based on this research about what kind of activities should be carried out to practice opportunity exploration successfully. In the literature review and interviews, it turned out that opportunity exploration is a strategic phase of front-end innovation rather than an operational part like idea management. The characteristics of opportunity exploration are that it has a high influence on the innovation outcome, low cost of changes, and low amount of information. The characteristics reflect the early phase of the process.

In the literature review, the opportunity exploration was suggested to be practiced in three steps: goals and planning; methods and tools; and analysis. In the interview, current and suggested ways of practicing opportunity exploration were slightly different. Increased innovation activity was mentioned to be more important than the methods and tools as they are only supportive elements in the activities. In the literature, the importance of culture and innovation activity was highlighted, but there were few practical actions on how they could be achieved.

In **figure 17**, there is a refined version of the opportunity exploration framework that was presented earlier in **figure 15**. The refined framework considers the information that was collected in the interviews and then analyzed. In the literature, the framework was more on a general level, and it did not consider the needs of the case company, which represents a global manufacturing company. In the interviews, it was clear that opportunity exploration exists as part of front-end innovation. It was also clear that there should be innovation management, which creates a suitable environment for innovation.

In the refined version of the opportunity exploration framework, goal and planning have been kept as the first phase in the process, as the interview results support that some systematicity and planning are needed in opportunity exploration. Based on the literature review and interviews, opportunity exploration is a partly informal activity that should be managed and planned.

The next step is innovation activities supporting opportunity exploration. The *tools and methods* from the theoretical framework in **figure 15** are changed to *activities* because, in the interviews, it was emphasized that increased innovation activity is the key factor to success in opportunity exploration and front-end innovation in general. In interviews, increased innovation activity was mentioned to be the main way opportunity exploration could be supported, which might indicate that there is not enough innovation activity currently. The conclusion assumes that the interviewees were experienced and skilled employees in the field of innovation, as the average years of experience among interviewees were 26 years, and the interviewees were selected based on their experience with innovation work.

Innovation activities include, for example, an opportunity exploration process, a description of how it can be systematically practiced, methods, tools, and guidelines. Challenges, projects, and events are activities that are needed to boost innovation activity and to spread knowledge about opportunity exploration and front-end innovation. The activities provide information for people and improve the culture so that the threshold to participate in innovation activities gets lower.

The last step is retrospective, which is changed from the analysis part of the theoretical framework in **figure 15** as the whole framework is now more based on the *activities* than on the *tools and methods*. Retrospective suits the activities-based framework better than the original *analysis* phase of the theoretical framework as activities are not analyzed in the same way as opportunities that are found by using methods and tools. In retrospective, the innovation activities are evaluated, and it is checked if the goals in the first phase are met. The key performance indicators created in the goals and planning for opportunity exploration and front-end innovation are also checked in the retrospective.

The process in the *refined opportunity exploration framework* is a way for opportunity exploration to be managed. The activities can be run on a fixed time, like a month, every half year, or year, depending on the working methods. For example, if there is yearly planning for innovation, opportunity exploration should be planned at the same time as this process.

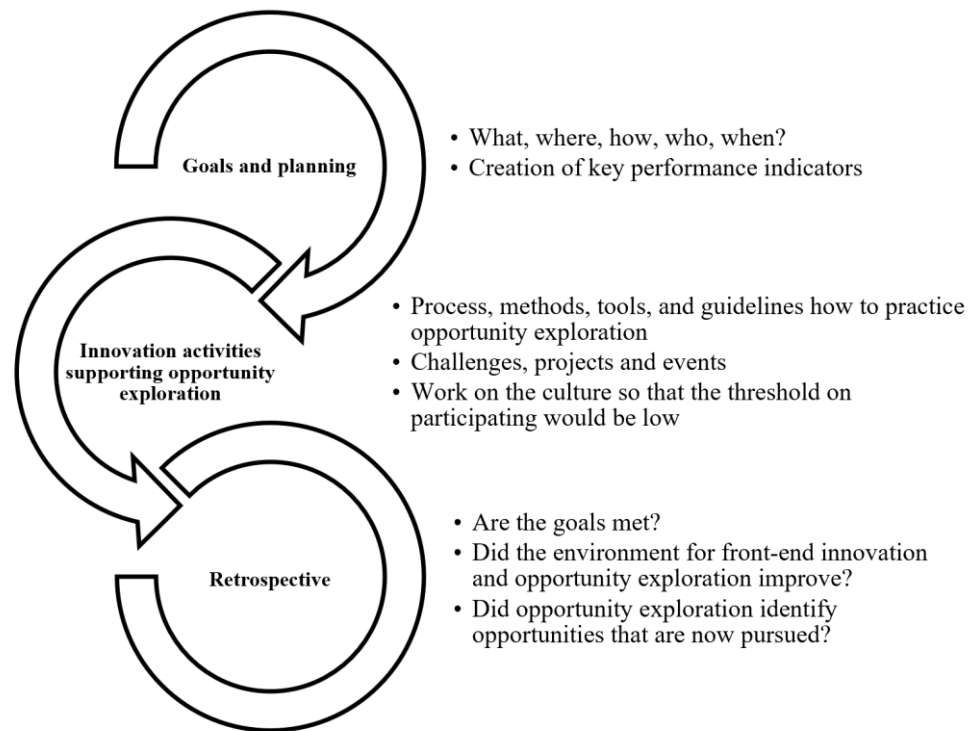


Figure 17. Refined opportunity exploration framework after interviews

**Recommendation 1: Apply the opportunity exploration framework to the innovation process**

In the innovation process, different steps are defined, like idea genesis or idea management. For the first step, which is opportunity exploration, an opportunity exploration framework should be applied to establish the part of the process. The opportunity exploration framework defines how opportunity exploration should be practiced. When the opportunity exploration framework is applied, it helps people to understand what opportunity exploration is from the point of view of innovation management. To successfully identify challenges and opportunities, suitable opportunity exploration activities should be practiced,

**Recommendation 2: An innovation center with all innovation-related information in one place**

Currently, in the case company, innovation-related information is not in one place, and for people searching for innovation-related information, it might be a bit confusing. If all the information were in one place and each area of innovation was presented in a simple and clear way, innovation as a topic would be approachable for people who are not yet aware of

innovation activities. The clearly described process would establish innovation better, which might increase innovation activity, which is favorable for opportunity exploration and for front-end innovation in general.

### **Recommendation 3: Opportunity exploration guidelines and toolbox**

The opportunity exploration framework is the process of how opportunity exploration is managed. Opportunity exploration in practice has an informal part that demands that there are innovation activities and that people think and are encouraged to go forward with their ideas. The more formal part can be practiced with methods and tools. In the literature review and in interviews, a long list of methods and tools for different types of innovation and opportunities are listed. Methods and tools are a systematic way to identify and analyze opportunities. In the innovation center, under opportunity exploration, guidelines and toolbox could be collected for people who are searching for information about how opportunity exploration is practiced formally and systematically, as there is also a need for formal and systematic work. Informal activities are not necessarily enough for successful opportunity exploration. The guideline would follow the opportunity exploration framework that was presented in **figure 15**. The tools in the toolbox should be limited so that it would be easier for the toolbox user to choose the suitable tools for their need. In the interviews, it was emphasized that the need and the tool should be met. From the literature review and interviews, suitable tools can be found, but it needs to be evaluated which ones are picked for the toolbox.

### **Recommendation 4: Annual Innovation Day**

To increase the awareness of innovation in the company, an annual innovation day could be launched. Innovation day would increase innovation activity and spread awareness and knowledge of innovation. At the innovation day, innovation-related topics could be presented, such as the innovation process, current innovation activities, and successes and failures in front-end innovation. During the innovation day, workshops could be arranged to boost innovation activity. Now that hybrid work has become more common, innovation day would be one more reason to come physically to the workplace and have important interactions with other people. The day could be arranged in a way that is not too resource-



demanding for the innovation team. For example, workshops could be arranged in divisions or teams with the help of given guidelines or themes. To make people more committed for the day, an event sponsor could be used from the business area level management. To make each innovation day unique and interesting, themes could be used. The themes could be based on trends or strategic directions like sustainability or energy efficiency.

### **Recommendation 5: Updated innovation strategy**

An updated innovation strategy would establish innovation activity better. The objectives, responsibilities, and plan for how to practice innovation would be clearer. Some kind of innovation audit could be used as a tool to form the strategy, even though this study already studied some areas of innovation in the company through interviews. To develop innovation activities, resources are needed. Even the running of basic processes needs enough competent personnel. When developing the innovation activities, even more resources are needed. An updated innovation strategy would help to review the true need for resources for innovation in the innovation team. The improvements or implementation of recommendations demand resources. In the innovation strategy, it could be defined how much resources the organization is willing to use for innovation. In the innovation strategy, it is defined how important innovation is for the company.

The five recommendations above are based on the literature review and conducted interviews. The recommendations are answers to the research questions on how opportunity exploration should be practiced and what actions should be taken to ensure the success of the company in the future. The exact tools are presented in the literature review and interviews. All the recommendations do not need to be necessarily implemented, but they work as a guideline for what should be done to be able to practice opportunity exploration and innovation successfully in the future. The value of opportunity exploration can be argued, but based on the literature review and on interviews, opportunity exploration is important, as it has a high impact on the innovation outcome and helps to set the innovation process on the right path. Front-end innovation activities, especially opportunity exploration, are difficult to measure with financial values, as the actual success that is based on innovation is difficult to measure (Dziallas & Blind, 2019), but based on the literature review in front-end innovation, financial value can be generated.

## 8 Discussion

The results of the study indicate that opportunity exploration is a phase of front-end innovation. Not all the literature identifies opportunity exploration as a separate part of front-end innovation, but often, opportunity exploration is somehow included in the front end of innovation. The simplest model of innovation process includes idea genesis, development, and scaling or commercialization. The presented innovation processes in the literature vary slightly, but the basic idea is basically the same. In a simple innovation process, opportunity exploration is related to the idea genesis phase, but if it is looked at in more detail, it can be handled separately from idea genesis as it typically comes before it.

The literature focuses more on the methods and tools in opportunity exploration. Methods and tools are the formal part of opportunity exploration. In the interviews, more informal parts of opportunity exploration were brought up. Opportunity exploration also includes an informal part, which consists of, for example, ideation along with work and interactions between people and stakeholders. In literature, *engine*, which is the culture and leadership of innovation, is mentioned to be an important factor in front-end innovation, but it is not discussed in the context of opportunity exploration, only in the context of front-end innovation. In interviews, culture and leadership of innovation were mentioned to be important factors of front-end innovation as well.

The literature did not unequivocally recommend how opportunity exploration should be practiced in a wider context. In the literature, only a process for the formal part, which consists of goals and planning; methods and tools; and analysis, was introduced. In the interviews, additional needs in the opportunity exploration were presented, such as increased innovation activity. The activities to increase innovation activity are presented in chapters 3, 6, and 7, and they are based both on the literature and the interviews, as the interviews brought up additional needs for opportunity exploration compared to methods presented in the literature.

The focus of the literature is on the tools and methods which are presented widely. The tools were also present in the interviews, and a lot of tools and methods were mentioned. However, the importance of tools and methods was not seen as high in the interviews. Mostly, the tools and methods that were mentioned in the interviews are also mentioned in the literature

review. This finding points out that there is a consensus on the type of tools that are used in opportunity exploration. To collect a useful toolbox for opportunity exploration, the tools should be chosen carefully, and the tools mentioned in both the interviews and the literature could be prioritized as the company employees are already familiar with them.

In this research, there is a hypothesis that front-end innovation is important and valuable and that it sustains and generates competitive advantages. Evidence for the importance of innovation for competitive advantages was found in the literature review. In the interviews, it was not directly asked whether innovation is related to competitive advantages or not, as it was not the core topic of the research. In interviews, innovation and innovation management are seen to be important and needed in a large organization. In the interviews, it was not explained why innovation is important and needed. Innovation management was explained to be important as organizing is needed in a large company. Competitive advantages are a broad subject, and the connection to innovation activities should be researched in a separate study.

The minor differences between the findings of the literature review and interviews might be because opportunity exploration is not that widely researched in the literature. Opportunity exploration is often included in other parts of front-end innovation, such as idea genesis. In the interview, opportunity exploration was considered a separate phase of front-end innovation. Some differences might also be because this study focuses on a global manufacturing company that has its characteristics, such as a decentralized organization structure. In contrast, the literature often deals with innovation in a general context.

## 9 Conclusions

In this study, opportunity exploration in front-end innovation was researched with a literature review and company interviews. The objective of the literature review was to find answers to the research questions and to explore the theories of the research topic so that quality interviews could be conducted. Findings from the literature review were used as a basis for further theory-building in the interviews. Answers to the research questions were formed based on the findings of both literature review and interviews. The main research question was:

***Main.** How should opportunity exploration be practiced as part of front-end innovation management in a global manufacturing company to sustain and develop competitive advantages?*

Based on the theory in the literature review, opportunity exploration was suggested in three steps: goals and planning; methods and tools; and analysis. In addition to the mentioned process in the literature, culture and leadership are seen as important factors in successful innovation activities. The key finding of interviews is that increased innovation activity is important in innovation and innovation management. The interviews also enlighten how the theory could be applied in practice for the needs of the case company. In the interviews, the informal activity of opportunity exploration was emphasized. Informal activity means that opportunities are explored as part of regular everyday work. In the interview, it was mentioned that a lot of informal work is done that can contribute to opportunity exploration.

In interviews, tools and methods did not get as high importance in opportunity exploration as in the literature. One reason might be that the tools and methods are not identified in the work; for example, a brainstorming method might be used without realizing that a method is used.

As innovation activities were seen in the interviews as a more important factor than in the literature, the theory framework was adjusted so that methods and tools are only one part of the second phase. In the second phase of the original theoretical framework, which was derived from the literature review, methods and tools were the main elements. Now, in the second phase, the focus is on increasing innovation activity that supports opportunity

exploration. The new and refined opportunity exploration framework is presented in **figure 17**.

The link between innovation and competitive advantages was found. Innovation creates new ideas which are needed in competition to generate new value and to support business renewal. There are many reasons why innovation is important. One of the most significant reasons why innovations are important is that they sustain and generate competitive advantages. The link to competitive advantage was included in the main research question, as there was a hypothesis that competitive advantage is one of the main benefits of innovation. The hypothesis was confirmed in the literature review.

Frameworks and tools are part of the answer to the main research question. To focus more on the frameworks and tools that could be used in opportunity exploration, a separate sub-research question was made:

***Sub-1.** What kinds of frameworks and tools are suitable for opportunity exploration?*

After the literature review, an opportunity exploration framework was created based on the frameworks and theory of:

- Opportunity identification and analysis in the fuzzy front-end of innovation (Koen et al., 2001) from figure 12
- Innovation opportunity search framework (Tidd & Bessant, 2021, p.252) from figure 10
- Opportunity identification and selection of new product process (Crawford & Di Benedetto, 2014) from figure 11

In the literature, there was not yet a very comprehensive opportunity exploration framework available. Therefore, the most comprehensive framework *opportunity identification and analysis in the fuzzy front-end of innovation* (Koen et al., 2001) framework was enriched with the *innovation opportunity search framework* (Tidd & Bessant, 2021, p.252). The framework of Tidd & Bessant (2021, p.252) supplements the first phase of Koen et al. (2001) framework, which is goals and planning, with more detailed instructions on how to set goals for opportunity exploration. From *opportunity identification and selection of new product process* (Crawford & Di Benedetto, 2014) it was added to the created framework that in the last analysis phase, it should be considered how it should proceed when the opportunities

are explored and analyzed. The beginning of new product process is also an innovation process, which makes it applicable to front-end innovation theory.

The first sub-research question includes a hypothesis that tools are one important way to practice opportunity exploration. The research confirmed the hypothesis even though, in the literature, tools were emphasized more than in the interviews. A long list of suitable tools is listed in the literature review and interviews. Most of the tools are well-known, such as business model canvas, trend analysis, service design tools, ideation tools, and cause-effect relationships analysis. The tools have that in common that they are more used for strategic work, and they should be applied with knowledge and combined with sources such as competitor and market research. The second sub-research question is about the actions that should be taken to practice opportunity exploration as described in this research.:

***Sub-2.** What actions in front-end innovation management are needed to ensure the success of global manufacturing company in the future as well?*

The question is based on the fact that the case company, which represents a global manufacturing company, has been very successful in history and is also now. Innovations have been seen as a major success factor, so successful innovation will also be a focus in the future.

To practice opportunity exploration and front-end innovation successfully, the following five recommendations of actions were defined based on the literature review and company interviews: apply an opportunity exploration framework to the innovation process; establish an innovation center with all innovation-related information in one place; create opportunity exploration guidelines and toolbox; arrange annual innovation day; and update or create an innovation strategy. All the recommendations do not need to be necessarily implemented to ensure success in opportunity exploration. The resources need to be shared between all the areas of innovation in a way that there are enough resources for all the innovation process phases so that the process would work successfully. Some of the recommendations also directly support other areas of innovation than just opportunity exploration.

The results of this study are relevant and important for both theory and practice. The results of this research in the context of global manufacturing companies and opportunity exploration do generate new information and value for front-end innovation theory. In the theory of front-end innovation, opportunity exploration is recognized, but there only exists

a little research. This study confirms that in opportunity exploration, the culture and leadership called the *engine* in literature, are important, like in the other areas of innovation. In the current literature, the focus is more on the tools and methods than on the culture and leadership.

As a practical implication of this study, the company and global manufacturing companies now have guidance on how to explore opportunities in practice. This study proposes how opportunity exploration could be practiced generally and what actions are needed in the case company to manage innovation successfully. Opportunity exploration has a high influence on the innovation outcome, and therefore, attention should be paid to how it is practiced.

In the results, it is worth noticing that the average experience of interviewees at the company was 26 years, which means that they are experienced. If the average experience in years had been lower, different kinds of answers might have been received as then the interviewees might have had more external knowledge as they would have had less time from their studies or they would have had worked in different companies.

The results of this study might be generalizable on some level for similar types of global manufacturing companies. If the results are applied for some other type of company, caution is needed, as the context of this study is a global manufacturing company, and the interviews were conducted only for one company. The case company operates in a specific geographical and cultural context, which might limit the generalisability. In generalizability, each company should be considered as an individual case, and the possibility to use the results of some specific study should be evaluated each time separately. The literature review part of this study is more easily applied to other companies than the results, findings, and recommendations of the interviews.

In future research, it would be useful to research how front-end innovation should be practiced in different kinds of organizations. The study found that front-end innovation management is especially needed in large organizations as a larger group of employees needs to be organized. This study already pointed out that in a global decentralized organization, high innovation activity is desired as it can sustain and generate competitive advantages. Interactions of people and stakeholders are mentioned to be one of the most important factors of front-end innovation in this study. Based on this study, the industry, the size of the organization, the organization structure, and the culture, for example, affect how front-end

innovation can and should be managed. Even though more research is needed about front-end innovation and opportunity exploration for different kinds of companies, this study has created useful recommendations for the case company how to practice opportunity exploration successfully.



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Appendix 1. 1/2 Strategic advantages through innovation (Tidd & Bessant, 2021, p.14-15)

<b>Mechanism</b>	<b>Strategic advantage</b>	<b>Examples</b>
<b>Novelty in product or service offering</b>	Offering something no one else can	Introducing the first . . . Walkman, mobile phone, fountain pen, camera, dishwasher, telephone bank, on-line retailer, etc. . . . to the world
<b>Novelty in process</b>	Offering it in ways others cannot match – faster, lower cost, more customized, etc.	Pilkington’s flat glass process, Bessemer’s steel process, Internet banking, on-line bookselling, etc.
<b>Complexity</b>	Offering something which others find it difficult to master	Rolls-Royce and aircraft engines – only a handful of competitors can master the complex machining and metallurgy involved
<b>Legal protection of intellectual property</b>	Offering something which others cannot do unless they pay a licence or other fee	Blockbuster drugs like Zantac, Prozac, Viagra, etc.
<b>Add/extend range of competitive factors</b>	Move basis of competition – e.g. from price of product to price and quality, or price, quality, choice, etc.	Japanese car manufacturing, which systematically moved the competitive agenda from price to quality, to flexibility and choice, to shorter times between launch of new models, and so on – each time not trading these off against each other but offering them all
<b>Timing</b>	<p>First-mover advantage – being first can be worth significant market share in new product fields Amazon.com, Google – others can follow, but the advantage ‘sticks’ to the early movers.</p> <p>Fast follower advantage – sometimes being first means you encounter many unexpected teething problems, and it makes better sense to watch someone else make the early mistakes and move fast into a follow-up product</p>	<p>Personal digital assistants (PDAs), which captured a huge and growing share of the market and then found their functionality absorbed into mobile phones and tablet devices. In fact, the concept and design was articulated in Apple’s ill-fated Newton product some five years earlier – but problems with software and especially handwriting recognition meant it flopped</p>

Appendix 1. 2/2 Strategic advantages through innovation (Tidd & Bessant, 2021, p.14-15)

<b>Mechanism</b>	<b>Strategic advantage</b>	<b>Examples</b>
<b>Robust /platform design</b>	Offering something which provides the platform on which other variations and generations can be built	Walkman architecture – through minidisk, CD, DVD, MP3 . . . Boeing 737 – over 50 years old, the design is still being adapted and configured to suit different users – one of the most successful aircraft in the world in terms of sales Intel and AMD with different variants of their microprocessor families
<b>Rewriting the rules</b>	Offering something which represents a completely new product or process concept – a different way of doing things—and makes the old ones redundant	Typewriters vs. computer word processing, ice vs. refrigerators, electric vs. gas or oil lamps
<b>Reconfiguring the parts of the process</b>	Rethinking the way in which bits of the system work together – e.g. building more effective networks, outsourcing and co-ordination of a virtual company, etc.	Zara, Benetton in clothing, Dell in computers, Toyota in its supply chain management
<b>Transferring across different application contexts</b>	Recombining established elements for different markets	Polycarbonate wheels transferred from application market like rolling luggage into children’s toys – lightweight micro-scooters
<b>Others?</b>	Innovation is all about finding new ways to do things and to obtain strategic advantage – so there will be room for new ways of gaining and retaining advantage	Napster. This firm began by writing software which would enable music fans to swap their favourite pieces via peer-to-peer (P2P) networking across the Internet. Although Napster suffered from legal issues followers developed a huge industry based on downloading and file sharing. The experiences of one of these firms – Kazaa – provided the platform for successful high volume internet telephony and the company established with this knowledge – Skype – was sold to eBay for \$2.6bn and eventually to Microsoft for \$8.5bn.

Appendix 2. Opportunity-led ideation framework (Wyrtki, Röglinger & Rosemann, 2021)

Activity	1. Initiation	2. Immersion	3. Investigation	4. Integration
<b>Techniques</b>	-Generate big ideas that capitalize on the opportunity sources	-Select one big idea -Choose a structure for the big idea -Create an idea concept based on that structure	-Identify opportunities originating from each source -A structured search using a need-driven and feature-driven approach	-Use sources to generate small ideas -Populate small ideas around the idea concept -Elaborate the big idea to produce a detailed, comprehensive theme
<b>Tools</b>	-Opportunity sources: Corporate resources, customer, competitor, science and technology -Formal and informal ideation tools for general idea generation (e.g., envisioning of megatrends, scenario thinking and ad hoc discussions) -Narratives that provide a first outline of the big idea	-Idea selection voting -A framework that serves as the foundation for the idea concept (e.g., three horizons, 2x2 matrix and logic tree)	-Opportunity sources: Corporate resources, customer, competitor, science and technology -Identify specific sources of opportunities -Identify specific methods for opportunity discovery and recognition (recombination of assets, customer segmentation, market analysis, sensing of state-of-the-art technologies) -Structure sources using a need-driven and feature driven perspective -Need-driven approach according to the jobs to be done and the benefactors -Feature-driven approach according to the features and the jobs that could be done	-Idea concept -Populated opportunity sources -Established ideation tools for specifying ideas (e.g., scenario, storyboards, roleplaying)
<b>Roles</b>	-Source experts -Moderator -External experts (e.g., consultants, researchers)	-Source experts -Moderator -Experts with knowledge about the used framework	-Source experts	-Source experts -Moderator
<b>Output</b>	-Big ideas -Short narratives per big idea	-An idea concept as the structure of the chosen big idea	-Populated opportunity sources that serve as the foundation for the further development of an idea concept	-A big idea enriched with small ideas structured based on the idea concept

### Appendix 3. Board of Innovation open-source innovation toolbox (Board of innovation, 2023)

1. How Might We Statement [AI]
2. Research brief [AI]
3. Future Scenario Maker [AI]
4. Innovation Portfolio Management – Flowchart
5. Innovation Funnel
6. Innovation Project template
7. Innovation Portfolio Mapping
8. From Company vision to Actionable Projects
9. Innovation audit questionnaire
10. Dimensional design cards
11. Dimensional designer
12. Corporate startup partnership mapper
13. Social impact wheel
14. Revenue model flowchart B2C
15. Solution flowchart B2B
16. Solution validation script
17. Pitch evaluation script
18. Pitch evaluation sheet
19. First-step ideation bundle
20. Cognitive biases poster
21. Business model kit
22. Ballpark figures
23. Experiment picker
24. Growth engine
25. Future scan
26. Innovation matrix
27. Social impact intentions mapper
28. Go-to-market roadmap
29. Brainstorm cards for emerging economies
30. Brainstorm cards
31. How-now-wow matrix
32. Fragment cards
33. Go-to-market strategy cards
34. Stakeholder mapping
35. Patient behaviour biases poster
36. Innovation poster
37. Pitching checklist
38. Pitching canvas
39. Team canvas
40. Concept disruptiveness test
41. Idea shopping cart
42. Concept card
43. Empathy interview guide
44. Problem validation script
45. How might we statement builder
46. Innovation blueprint
47. Social impact toolkit
48. Persona
49. 3 horizons model
50. Innovation mission map
51. Scoping canvas
52. Patient behaviour journey map
53. Tech & trends matrix
54. Innovation battlefield”
55. Innovation landscape
56. Analogy thinking
57. Assumption mapper
58. Build it, break it, fix it
59. Experiment card
60. Customer journey map
61. Vision card
62. Problem sizing canvas
63. Unit economics calculator
64. Social impact explanatory cards
65. Innovation A to Z
66. Social impact partnerships flowchart
67. Market sizing
68. Business model canvas
69. Market planning
70. Venture capital readiness checklist
71. Customer barriers and boosters
72. Ecosystem mapping
73. Behavioural challenge statement builder

## Appendix 4. Interview questions

### **Background information**

1. What is your position within the company?
2. What are the main activities that you work with?
3. How long have you been working in this company?

### **Front-end innovation management**

4. How familiar are you with business area innovation processes?
5. How would you describe the innovation culture in your division?
6. Do you find innovation management useful?
7. What do you expect of the innovation management?
8. Where do new ideas typically come from?
9. Do you recognize opportunity exploration as part of the front-end innovation?

### **Opportunity exploration**

10. What are the typical sources of innovation opportunities in your division?
11. How do you find and analyse new opportunities?
12. What kind of frameworks or tools do you use in opportunity exploration?
13. How systematic is opportunity exploration in the teams or projects you are working with?
14. What criteria are used when opportunities are selected and compared?
15. Who make decisions in the innovation process?
16. In which point opportunity becomes official (eg. from coffee table conversation to official evaluation of opportunity)?
17. Would support be needed in opportunity exploration?
18. How could opportunity exploration be supported?
19. Would tools, frameworks, workshops or processes support in opportunity exploration?
20. If yes, what kind of tools, frameworks, workshops or processes would be helpful?

### **Open conversation and questions:**

21. Any other thoughts, insights regarding opportunity exploration you would like to bring up?
22. Who else do you think I should interview?