TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

SIMO JYLHÄ-OLLILA

PATHS OF EMERGENCE OF NEW TECHNOLOGY COMPANIES

Master of Science thesis

Examiners: Prof. Saku Mäkinen and Assoc. Prof. (tenure track) Marko Seppänen
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ABSTRACT

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Since the economic crisis in 2008, the Finnish economy has not managed to pick up on its previous tracks and the challenges have been under discussion in the recent times. The challenges can be seen especially in the Finnish manufacturing industry that has not managed to properly recover since its slump. Despite the relative role of manufacturing decreasing overall, it is still important for the economy in creating jobs and growth. Especially important in this growth are new technological innovations that affect performance both on firm and national level, by contributing to growth, jobs, efficiency and renewal. Learning how these new technological innovations can appear and be fostered can then contribute on both on the national and firm level. Focusing on the equipment and machinery sector, the goal of the research is therefore to learn how new technology companies emerge. It will study the resources required and the ways to attain them in the process from discovery of an idea to commercialization.

Interviews with case companies were chosen as the empirical part of the study. The case companies were chosen according to three criteria: operating in the equipment and machinery industry, located in Finland and year of incorporation after 2010. Finally, 21 companies were included in the sample. Semi-structured interviews were conducted to discuss the research themes with the companies. All the interviews were recorded and transcribed. The data was analyzed and examined based on the most relevant topics.

The results indicate that most opportunities are based on discovery instead of a purposeful search. There are several sources where the initial opportunity may spawn: personal needs or needs within a business, market opportunity, personal interests and scientific research. The teams can consist of varying experience, bring important resources to the team and usually build from existing social networks. The companies have a narrow view of the ecosystem, focusing on their own needs and operations. The role of resources was particularly highlighted in the evidence. The companies often face challenges during their path, especially related to finance and marketing. Most companies require external funding for development and for their product to reach the markets, highlighting the importance to enable different ways to attain this. The companies usually have strong competences in technology but lack on the marketing side. Once their orientation turned from development to more to the commercialization side, they usually faced most challenges in establishing the business.

TIIVISTELMÄ

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Vuoden 2008 talouskriisin jälkeen Suomen talous ei ole kyennyt palaamaan vanhoille raiteilleen, ja talouden haasteet ovat olleet viimeaikoina paljon esillä. Haasteet ovat erityisesti näkyvissä valmistavassa teollisuudessa, joka ei ole onnistunut palautumaan pudotuksen jälkeen. Valmistavan teollisuuden suhteellisen merkityksen vähenemisestä huolimatta sillä on edelleen tärkeä rooli taloudessa työpaikkojen ja kasvun luonnissa. Erityisen tärkeää tässä on uusien teknologisten innovaatioiden rooli, vaikuttaen kasvuun, työpaikkoihin, tehokkuuteen ja uudistukseen. Oppimalla miten uudet innovatiiviset yritykset syntyvät ja miten syntyä voi tehostaa voi täten avustaa sekä kansallisella että yrityksen tasolla. Keskittyen koneita ja laitteita valmistavaan teollisuuteen, tämän tutkimuksen tavoitteena on oppia miten uudet teknologiayritykset syntyvät. Tutkimus pyrkii selvittämään myös mitä resursseja yritykset tarvitsevat ja miten voivat hankkia niitä matkalla idean löytymisestä tuotteen kaupallistamiseen.

Työn empiirinen osio toteutettiin haastatteluilla kohdeyrityksissä, jotka valittiin tutkimuksen kriteerien mukaan: ovat koneita ja laitteita valmistavalla alalla, sijaitsevat Suomessa ja ovat perustettu vuoden 2010 jälkeen. Otokseen sisältyi lopulta 21 yritystä. Haastattelut suoritettiin teemahaastatteluina tutkimuksen teemoihin perustuen. Kaikki haastattelut nauhoitettiin ja litteroitiin, minkä jälkeen tulokset analysointiin ja käsiteltiin tärkein aiheiden perusteella.

Empiiristen tulosten pohjalta mahdollisuuden, tiimin ja resurssien merkitystä käsiteltiin. Tulosten perusteella useimmat mahdollisuudet perustuvat niiden huomaamiseen systemaattisen etsimisen sijasta. Mahdollisuus voi nousta muutamista eri lähteistä, joita ovat henkilökohtaiset tarpeet tai liiketoiminnan tarpeet, markkinarako ja tieteellinen tutkimus. Tiimit muodostuvat pääasiassa yrittäjien henkilökohtaisten verkostojen pohjalta. Tiimillä voi olla aiempaa kokemusta teknologiasta, markkinoista ja yrittäjyydestä, mikä on usein ollut merkittävä tekijä yrityksen syntymisen kannalta. Yrityksillä on kapea näkemys ekosysteemistään, ja keskittyvät lähinnä omiin tarpeisiinsa. Erityisesti resurssien rooli nousi esille tuloksissa. Yritykset kohtaavat usein haasteita erityisesti rahoitukseen ja markkinointiin liittyen. Useimmat tarvitsevat ulkopuolista rahoitusta kehittämiseen ja saadakseen tuotteensa markkinoille, mikä nostaa esille eri keinot hankkia rahoitusta. Yrityksillä on usein vahvaa osaamista teknologian suhteen, mutta markkinointiin liittyen on puutteita. Yritykset kohtasivat eniten haasteita toiminnan rakentamisessa siityessään teknologiaorientaatiosta kohti kaupallistamista.

PREFACE

This thesis is part of Radical and Incremental Innovations in Industrial Renewal project (RAID). It is a joint research project conducted by Tampere University of Technology and VTT Technical Research Centre of Finland. The aim of the project is to study how significant innovations can trigger industry-wide transitions and examine the role of the innovation support environment in the Finnish and Swedish manufacturing industries. The goal is also to examine the challenges and different ways to support the development of innovations in these industries. By comparing the results the differences in the two countries can be analyzed and based on the study, suggestions for policy improvements will be developed. RAID consists of four connected subprojects, and this thesis is conducted as a part of the subproject focusing on case studies in the Finnish equipment and machinery industry. Through in-depth case studies the aim is to understand how new technological innovations emerge in the industry, industry conditions and renewal and the role of the business ecosystems in all this.

I would say the whole project has been an interesting process overall. The thesis process may have had some slight ups and downs here and there but overall it has been maybe even surprisingly smooth. One of the most memorable things probably is the people I met from many interesting new companies, some of which are just starting their journey in the business. Many different kinds of companies and different kinds of people are behind them.

I would like to thank my supervisors, professors Marko Seppänen and Saku Mäkinen for guidance, as well as the researchers at VTT who were part of the RAID project. Thanks also to the case companies who were interested in sharing their stories and contributing to the research.

Now, it is time for the next challenges.

Tampere, 25.5.2016

Simo Jylhä-Ollila

CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

FFE = Fuzzy Front End

GDP = Gross Domestic Product

ICT = Information and Communications Technology

NPD = New Product Development

R&D = Research and Development

SMEs = Small and Medium-sized Enterprises

1. INTRODUCTION

1.1 Background of the Study

As the word innovation and the importance of innovations seem to show up a lot these days, it may be justified to ask, what makes innovations so important? Innovation can be a crucial element for growth and renewal. According to OECD (2015, p. 2) innovation provides the foundation for new businesses, jobs and productivity growth, making it an important driver of economic development. It can contribute to growth through various forms and channels, such as (OECD 2015, p. 3-4):

- Contribution from technological progress
- Contribution from investments in R&D, design and intellectual property, data, firm specific skills, organizational capital and such
- Contribution linked to multi-factor productivity growth, i.e. increased efficiency in the use of labor and capital enabled by process and organizational innovations
- Contribution from the creative destruction when new firms enter the market, growing quickly and then increasing

Together these often contribute around 50% of total GDP growth, even more than that in Finland during 1995-2013, as it varies per country (OECD 2015, p. 3-4). Innovation are also seen essential for both firms and countries to recover from the economic crisis and succeed in today's competitive global economy (OECD 2010, p. 2), something that Finland has not managed very well recently. Until the financial crisis Finland had outperformed most comparable countries by GDP growth, but has been recovering very weakly from the downturn, which is only expected to continue (OECD 2014, p. 6). The government has a major part in this by creating an environment favorable that is for innovations, investing in the foundations and helping overcome barriers (OECD 2015, p. 2). This requires a strategy focusing on long-term growth and may include tools such as seed capital funds, policies fostering entrepreneurship and start-ups, training and investment in capabilities for innovation. (OECD 2009, p. 3)

Perhaps it is then the lack of innovations hindering the development of the Finnish economy at the moment. In his recent report, Kaivo-Oja (2015) examines the development of the Finnish innovation system based on chosen statistic indicators, aiming to create a comprehensive picture of the last few years' development. He states that all central studies about technology call for more investments on R&D, and that despite this the proportion of government funding to R&D is only diminishing in Finland. In addition to the need for more R&D funding, other challenges that the Finnish innovation system poses

are the inability to produce radical innovations and lack of exports, especially in the high-tech sector. (Kaivo-Oja 2015). Although innovation is not only about R&D activities, this sounds worrying for a country with a history of success particularly in the manufacturing and ICT industries. The current policies should not complicate the already challenging state of the country, but instead aid new firms and promote growth through sustainable policies.

It is not only about the national level, and innovations matter on a firm level too, as it is seen that innovative firms can achieve major advantages compared to their less innovative competitors. Today, most companies cannot sustainably compete just based on efficiency and effectiveness, but continuous innovation is what drives the competition (Moore 2006, p. 32). The importance of innovation to a company's performance has been widely studied (e.g. Subramanian and Nilakanta 1996), and results show that innovativeness indeed seems to lead into better results. Inkinen and Kaivo-Oja (2009, p. 34) state that despite much research about the topic, there is no consensus on what actually enables organizations to innovate. They say that innovation is nowadays not seen as a linear process of discovery, but instead as learning. This learning is not a straight and defined path and can happen with a wide variety of actors within a firm's external environment from customers and suppliers to universities and research institutes. Therefore it is important to study what firms need to enhance their innovative behavior and create more innovations. Supporting these activities that foster innovations should lead into greater competitive advantage and sustainability by the firm, and in the end resulting in benefits in the national level too.

The challenges in the Finnish economy can be seen particularly in the manufacturing industry, which has not been able to recover after the financial crisis in 2008. Figure 1 below illustrates the developed of industrial production in manufacturing in Finland and four other countries for comparison. It shows that the manufacturing industry has been struggling and has not able to find a path to sustainable growth.

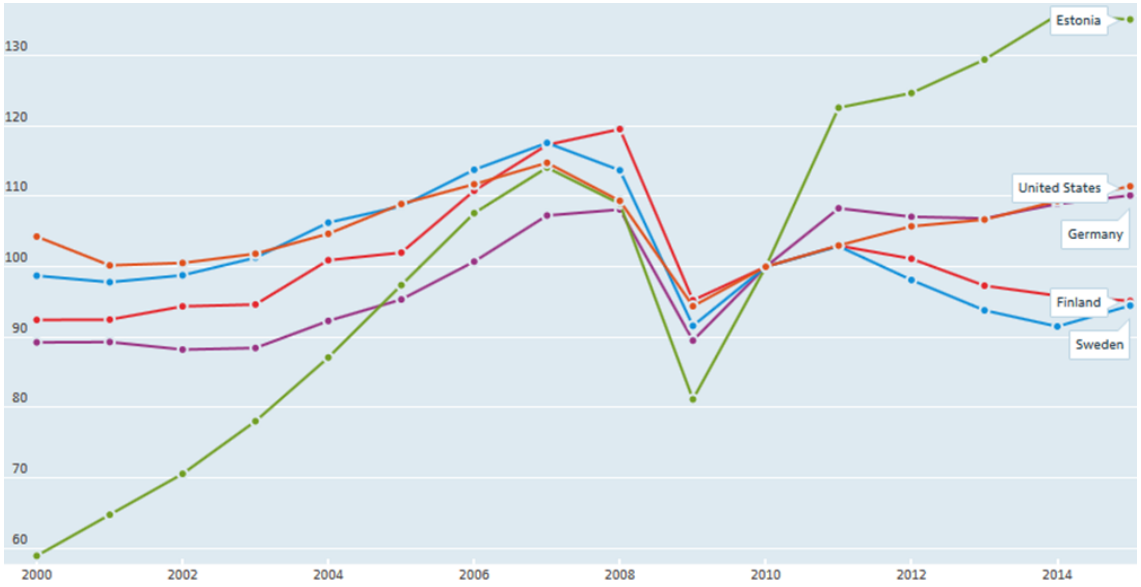

Figure 1: *Changes in the volume of production output in manufacturing in Finland and four other countries for comparison (Extracted from OECD 2016a).*

Despite the fact that relative importance of manufacturing is dropping, it is still especially important because of its ability to generate well-paying jobs (Smil 2016). In addition to decline in manufacturing, young firms' contribution to growth may pose another challenge. In Finland the start-up rate is low, SME contribution to job creation is low and most small business are more than ten years old. (OECD 2016b, p. 21). This is important as economic renewal happens both though the restructuring of old firms and the emergence of new companies, of which the latter provide the main contribution to employment growth in OECD countries (OECD 2016b, p.20).

1.2 Research Question

The goal of this research is to generate knowledge about how new technologically innovative firms emerge. The aim is to learn the history behind these firms as well as current situation and future goals. The research will study what has led to the formation of the firm, and the paths they have taken in the process of commercializing their innovations. These firms may often lack critical resources, so the goal is also to explore what resources do they require in order to succeed in the competitive environment and successfully commercialize their innovations. These resources can come from both within and outside the firm and this research will explore the role of the firms and their ecosystem in fostering innovations.

The main research question is the following:

How do new technology companies emerge?

The question can be divided to two sub-questions, which are as follows:

> *What kinds of resources do the firms require from the discovery of opportunity to commercialization?*
>
> *How do they attain these resources?*

These questions are answered by conducting in-depth case studies with firms in the Finnish equipment and machinery industry. In order to consider the most recent conditions and their impacts, only firms formed as a joint-stock company from the year 2010 onwards are included in the study. The included firms must their own product or service and do research and development to attain a presentative sample of technologically innovative firms.

1.3 Structure

This thesis is divided into four main chapters; literature review, research methodology, results and analysis and conclusions. Chapter 2 focuses on the literature review and is divided into four parts. The first three parts will focus on the three themes derived from the research question: innovation, new venture and ecosystem. This forms the background of the study and is concluded on the fourth part of the chapter.

The third chapter includes the methodology of the study. It begins by describing the chosen research strategy and the arguments behind it. After that the formation of the sample is discussed with criteria and some details presented about the case companies. The chapter then presents the methods used in data collection and data analysis, also presenting the arguments that favored the choices.

Empirical findings and analysis will be presented in chapter four. The chapter is first divided into four subchapters based on the themes in interview outline: opportunity, team and networks, resources and radicalness. Results of the interviews will first be presented in each of these chapters, followed by analysis and linking it to academic discussion. In the last subchapter it is attempted to link these themes together and to the literature review summarized in chapter 2.

Conclusions of the study are presented in the last chapter. First the answers to research questions are discussed. After that contribution to academic discussion of the research and managerial implication are presented. The thesis concludes by presenting the limitations to the study and proposing further research opportunities identified based on this research.

2. THEORETICAL BACKGROUND

The literature review will focus on three these that are derived from the research questions: innovation, ecosystem and new venture. These themes will be approached based on the focus of the research.

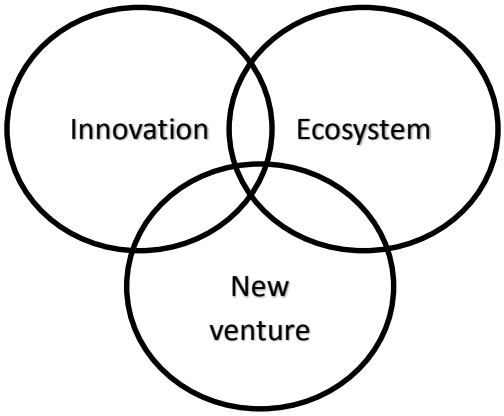

Figure 2: *Focus in the literature review.*

The literature review will discuss the topic on a general level, but with a slight emphasis on new and small firms. The role of different actors, resources required during the process and the ways to attain them are also brought up.

2.1 What are Innovations?

This chapter has two main goals. The first one is defining what innovation is with respect to this research. The second part focuses on the process aspect of innovation. The aim is to focus on the different phases and activities and on their importance in creating innovations. Although generally they tend to apply better for large firms, they can be a useful tool to grasp the breadth of innovation activities.

2.1.1 Incremental and Radical Innovations

First of all, it is important to distinguish between invention and innovation, as not all new ideas or even inventions lead to innovations. Freeman and Soete 1997 (Cited from Hill and Rothaermel 2003, p. 258) define invention as the discovery of new knowledge such as new methods or materials, and that innovation means the commercialization of this invention. This kind of approach points out that innovation is merely coming up with some new idea. It is not until the commercialization with the economic benefits that earns the invention the label of innovation. Van de Vrande et al (2006, p. 350) also state that technology itself has no value, but requires a business model to unlock it. The business

model then indicates how those technologies can be connected to products or services that a customer is willing to pay for (van de Vrande et al 2006, p. 350). Edquist (1999, p. 2) shares a similar view by saying that innovations are creations that have either material or intangible economic significance.

Previous definitions are in accordance with (Belliveau et al. 2002, p. 446) s definition of innovation, as they state that innovation means the creation of a new product or process, by starting from the invention and working to bring the new idea or concept to the final form. The discovery of knowledge for an innovation can happen fast, but for it to succeed as an innovation it can take years, as it has to solve a problem worth solving, prove to be workable and be better than competing inventions (Stefik and Stefik 2006, p. 69). There are often failures along the way and many of them will never be fully realized, as Jolly (1997) even states that most technological inventions do not further than the conception phase. Edquist (1999, p. 2) points out that although innovations can be brand new, they are usually new combinations of existing knowledge. A general consensus seems to be that an innovation consists of an invention and the events required to successfully commercialize it. The process aspect of innovation will be discussed in more detail in chapter 2.1.2.

A commonly made categorization is dividing innovations to incremental and radical ones. Nevertheless there exists many different definitions of these in the literature and there is not a single commonly accepted definition. It is generally stated that most innovations are of incremental nature (e.g. Schoenmakers and Duysters 2010, p. 1051), but there is still some variation in the definition. A simple definition is provided by Schoenmakers and Duysters (2010, p. 1051), who describe incremental innovation as having minor improvements or adjustments to existing technology or products, having limited impact on the technological system. Similar view is shared by Hill and Rothaermel (2003, p. 58), although they emphasize that an incremental technology innovation builds directly on the incumbent firm's technology, improving the methods or materials used to achieve the firm's objectives. Kettunen et al. (2008, p. 35) use sustaining innovation synonymously with incremental innovation. They depart from solely focusing on the technological view and highlight the marketing aspect of innovation by stating that sustaining innovations usually sustains the current market approach and target market (Kettunen et 2008, p. 35).

According to Bessant et al (2014, p. 1284) incremental innovations typically have low levels of risk and are based on established knowledge bases. They also state that it often includes small-scale experimenting and problem solving which can be undertaken by a wide range of employees in an organization. Despite some variations, the definitions of incremental innovation are typically quite similar, according to Bessant et al. (2014, p. 1284).

Table 1: *Definitions of incremental innovation*

Author(s)	Definition
Schilling (2002)	Relatively small changes to current practices
Bessant et al. (2014)	Based on established knowledge bases, low level of risk
Gatignon et al. (2002)	Improvement in price per performance rate is consistent to current technical trajectory
Koberg et al. (2003)	Low impact, usually structural, procedural, personnel-related or HR-related changes
Schoenmakers and Duysters (2010)	Minor improvements or adjustments to existing technology, limited impact on the existing technological system
Freeman and Soete (1997)	Builds on the incumbent firms technology, improving the methods or materials
Henderson and Clark (1990)	Extends an established design, improvement occurs in individual components, but the core concepts and links remain same
Christensen (1992)	Either: 1. Improvements in component performance based on the established technological concept 2. Changes in the technical relationships among components, refining the system design

As can be seen on Table 1, incremental innovation is characterized by minor changes and especially the technology-related view is highlighted. The definition of radical innovation arises more discussion and different opinions in the literature. In contrast to incremental innovations, according to Freeman and Soete (1997, cited from Hill and Rothaermel 2003, p. 258) radical technological innovation uses methods and materials that are new to incumbents, that may be based on an entirely different knowledge or be a recombination of parts of the established knowledge in a new way. Especially newness and departure from old methods and solutions is seen typical for radical innovations.

Table 2: *Definitions of radical innovation*

Author(s)	Definition
Schilling (2002)	Very new and different from existing solutions
Apilo and Taskinen (2006)	New kind of solutions and new business concept
Gatignon et al. (2002)	Improvement in in price per performance advances significantly more and current rate of progress
Koberg et al. (2003)	Have a major scope, strategic changes in products or services, markets served, and technological breakthroughs used to create a product or service based on significant innovation
Leifer et al. (2000)	Has potential to produce one or more of the following • Completely new set of performance features • Improvements of at least five times in known features • Significant reduction in cost (at least 30%)
Leifer et al. (2001)	A product, process or service with superior features or familiar features that bring significant improvements in performance or costs that transform or create markets
Freeman and Soete (1997)	Methods and materials new to incumbents that are based on entirely new knowledge or a recombining parts of the existing knowledge in a new way
Chandy and Tellis (1998)	Either: 1. Substantially different technology from existing products 2. Satisfies customer needs better than existing products
Henderson and Clark (1990)	Establishes a new core concept and new linkages between core concepts and components
Christensen (1992)	Both a new fundamental approach at the component level and new architecture

Compared to incremental innovations, the definition of radical innovations brings more varying views. They all consider it to bring major improvements or changes, but the scope of it can vary. Whereas technological base is still relevant, focus is also on market and other performance related aspects. The rationale for differentiating between incremental and radical innovations is the impacts they can have. Radical innovations can bring significant changes to the company, markets and technology that currently exist. It is often pointed out, that radical innovations can make earlier successful products or business models useless (Kettunen et al 2008, p. 35), which Saarnio and Hamilo (2013, p. 22) call competence destroying aspect of a radical innovation, stating radical innovations can sometimes make current innovations in the market irrelevant. Radical innovations therefore have the potential to create new technological systems or even new industries (Schoenmakers and Duysters 2010, p. 1051). Schilling (2012, p. 47) claims that for some

firms a radical innovation can also be competence enhancing if it builds on their existing knowledge and skills.

Because of the nature of the innovation, radical innovations usually have higher impact on the innovating firm that incremental ones. According to Apilo and Taskinen (2006, p. 15) radical innovations change the company's business concepts, processes and structures. The view of interaction between a radical innovation and a company is also shared by (Rice et al 2001, pp. 413-414) who claim that radicalness of a technology and a firm's capacity to commercialize it is connected by technological, corporate strategy related, and market related issues.

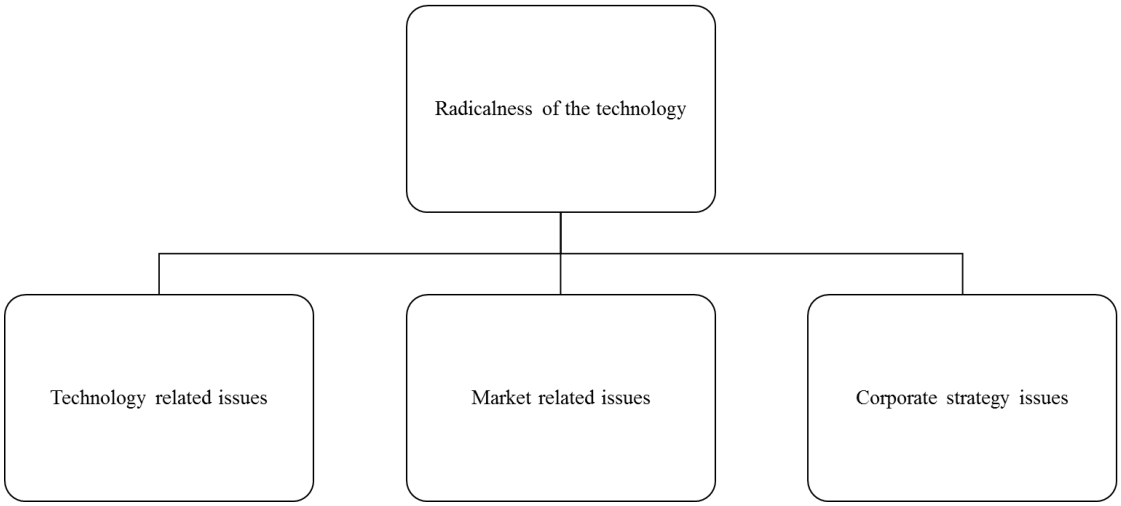

Figure 3: *The Links between a radical technology and an organization (Adapted from Rice et al. 2001, p. 414)*

Technology related issues handle with questions such as whether the technical insight can offer new opportunities for business or improve current performance substantially. On the other hand it can also lead to major cost reduction of current products. Market issues assess the technology's impact on the applications in the market and within the firm. The technology must have robust application possibilities, and whether it has the potential to leap over with the current alternatives has to be evaluated as well. Also the impact on the current products of the organization must be considered and there has to be a possibility to develop a prototype for demonstration. Corporate strategy issues refer to the technology's suitability to the firm's core business. It also has to be evaluated if the technology can extend the business to new directions or contribute to future vision. (Rice et al. 2001, pp. 414-415).

Table 3: *Characteristics of radical innovations.*

Author(s)	Characteristics
Apilo and Taskinen (2006)	• Often based on technological leap and change the firm's concepts and processes
Schilling (2012)	• Depends on the view of the observer and may change over time
Leppälä (2014)	• Can originate from technology or be a radical disruption to the way of thinking • Often part of larger system • Slow to create in a wide scale • Can make current business models useless
Rice et al. (2001)	• Technology, market and corporate related issues
Bessant et al. (2014)	• More uncertainty and higher risks • Less links to established knowledge base
Kettunen et al. (2008)	• Large developments in understanding and new ways of seeing problems • Not automatically achieved by conventional means • Taking risks many people are not comfortable with
Saarnio and Hamilo (2013)	• Can make current innovations irrelevant
Gatignon et al. (2002)	• Have bigger organizational effects compared to incremental innovations • Can be competence destroying or competence enhancing
Leifer et al. (2002)	• Require exploration competencies
Schoenmakers and Duysters (2010)	• Potential to create new technological systems or even industries
Hill and Rothaermel (2003)	• Much uncertainty with commercial potential, radical technology does not guarantee market success

Despite innovation being usually categorized to either incremental or radical, this type of approach is not perhaps always the most practical one. Some authors talk about the degrees of incremental and radical innovations (e.g. Dewar and Dutton 1986), which is important to consider in this research too. Categorizing innovations to solely to two categories may not give the most accurate definition.

2.1.2 Innovation as a Process

The process aspect of innovation was already present in the definitions earlier. Innovation is not a single event, but a continuous process that transforms an invention into a commercialized product – an innovation. Tidd and Bessant (2014, p. 310) describe innovation as "a process of turning ideas into reality and capturing value of them". Edquist (1999, p.7) has a similar approach, emphasizing that the process does is not only about the emergence, diffusion and combination of knowledge elements, but also turning them into new

products and productions processes. According to Jolly (1997) it is important to know where in the technology commercialization process challenges can occur and why, in order to understand what can go wrong. The view of innovation as a process is shared by many authors, but as with the definition of innovation, there are many different models presented for the innovation process. In all the models, innovation is broken down into several different phases, which are used to describe the actions towards developing the innovation. It is the classifications, details and interactions that vary depending on the model.

It has to be remembered that being a complex phenomenon, it is difficult or even impossible the capture the whole essence of innovation with a simple model. Edquist (1999, p. 7) says that the process does not follow a linear path, but instead consists of, complicated feedback mechanisms and interactive relationships with spanning across technology, learning, production, organizations, institutions and policies. Inkinen and Kaivo-Oja (2009, p. 33) claim that innovation process theories can be classified as linear or systems-oriented. The former is a simplistic view, which usually emphasizes the R&D part of the process. The latter includes the complexity of the innovation process, taking into accounting the interdependencies, leading into a more demand-side emphasis. (Inkinen and Kaivo-Oja 2009, p. 33). However the process perspective of developing innovations provides a good simplified framework for evaluation and analysis. Breaking down the birth of innovation into different phases or activities can help distinguish the importance, impact and requirements of different stages during the process.

Linear innovation process

A basic view to demonstrate the innovation process is the linear model. Kettunen et al. (2008, p. 90) present a model divided into four phases: foresight, concept development, new product development and commercialization and market entry. The first two they call the fuzzy front end (FFE) of the innovation process, and combine the first three phases under research and development (R&D).

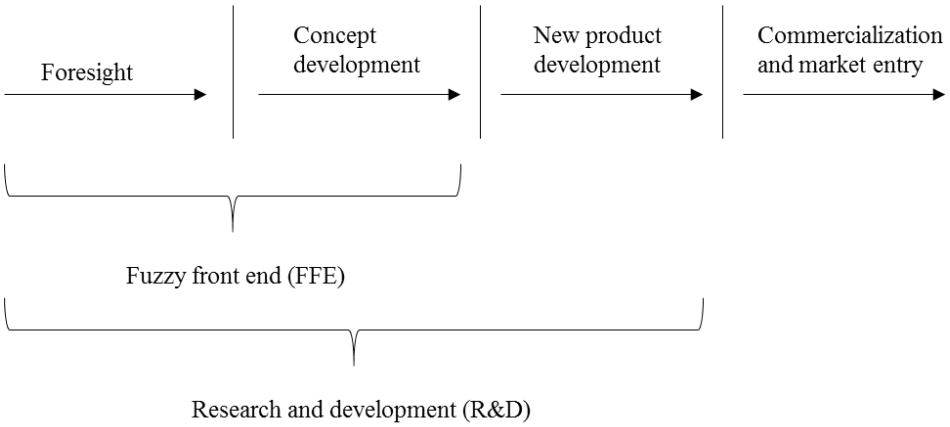

Figure 4: *Linear model of innovation process (Adapted from Kettunen et al. 2008, p. 90)*

In the core of fuzzy front end are idea generation and enrichment and concept development, but it can also include activities that are aimed at understanding the development of the business environment better. The fuzzy front end is usually relatively informal and iterative, being characterized by spontaneity, experiments and chaos. Its purpose is to identify opportunities and assess and strengthen the business case. (Kettunen et al 2008, pp. 90-91). Activities in this phase can include recognizing opportunities, generating ideas, improving ideas and evaluating ideas, and phase usually has large impact on the later phases (Apilo and Taskinen 2006, p.44). Both internal technology base and the external environment can be used to find interesting ideas (van de Vrande et al 2006, p.350). In some studies this is depicted the most challenging and uncertain part (Rice et al 2001, p. 409).

According to Kettunen et al. (2008, p. 90), the research and development phase however is usually more structured and purposeful project-based activity. The research part stands for technological research to support new product development or market research, but there also many different activities that may be covered in this phase. The type of development work required differs depending on the original idea, and can be productization of a particular core technology, development of production methods, and development of different types of components of modules or productization of service concepts (Tanayama 2002, p. 33) Commercialization phase is claimed be the Achilles heel for Finnish companies (Kettunen et al 2008, p. 91). In the end, the success of the innovation is determined by the markets. Hamilo and Saarnio (2014, p. 239) state that in a small market like Finland, it inevitably means internalization. Marketing investments related to commercialization can be larger than R&D costs, which can make it particularly challenging for a new companies (Hamilo and Saarnio (2014, p. 242).

Even though presented as one, Kettunen et al. (2008, p. 91) acknowledge that innovation process does not follow a rigid linear model, and present a ‘revised’ innovation process model. In the revised model it is acknowledge that there are interactions between various groups and that different phases overlap in time and scope. It presents commercialization

as a parallel to other development work, aiming to provide a more realistic picture of the process.

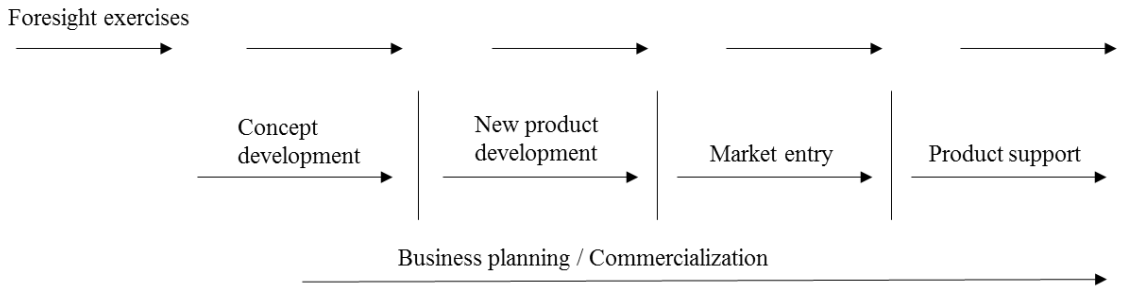

Figure 5: *A revised model to better capture the nature of the innovation process (Adapted from Kettunen et al. 2008, p. 91)*

Slater et al. (2014) focus on defining the activities required especially in radical innovation processes. Despite not presenting an actual visual model, the activities they present and focus on relate highly to the ones presented above. In the previous ones however there was no distinction made about the type or scope of the innovation. Slater et al. found three core activities for radical innovation; discovery, incubation and acceleration, and argued that commercialization needs to be added as fourth. (Slater et al. (2014, p.561-562). The main differences in the radical innovation process was the emphasis on the early phases of search and discovery and less structured nature of it, compared to the models presented by Kettunen et al. (2008).

Funnel model and open innovation

An often seen model of the innovation process is the so-called funnel model (e.g. Schilling 2012, p. 5; Leppälä 2014, p. 165-166). In funnel model the development starts with big amount of potential ideas, which during the process are analyzed and developed until there is a final product. It suggests that the activities done in an organization include generating ideas, recording, categorizing, analyzing and decision-making. (Leppälä 2014, p. 166). The aim to explain the iterative nature of the process is the main difference compared to the linear alternative. According to Leppälä (2014, p. 166) the funnel model brings up many important and often neglected aspects of the fuzzy front end of the process. He also calls this particularly interesting part of the process, where ideas are developed, combined and chosen (Leppälä 2014, pp. 165-166).

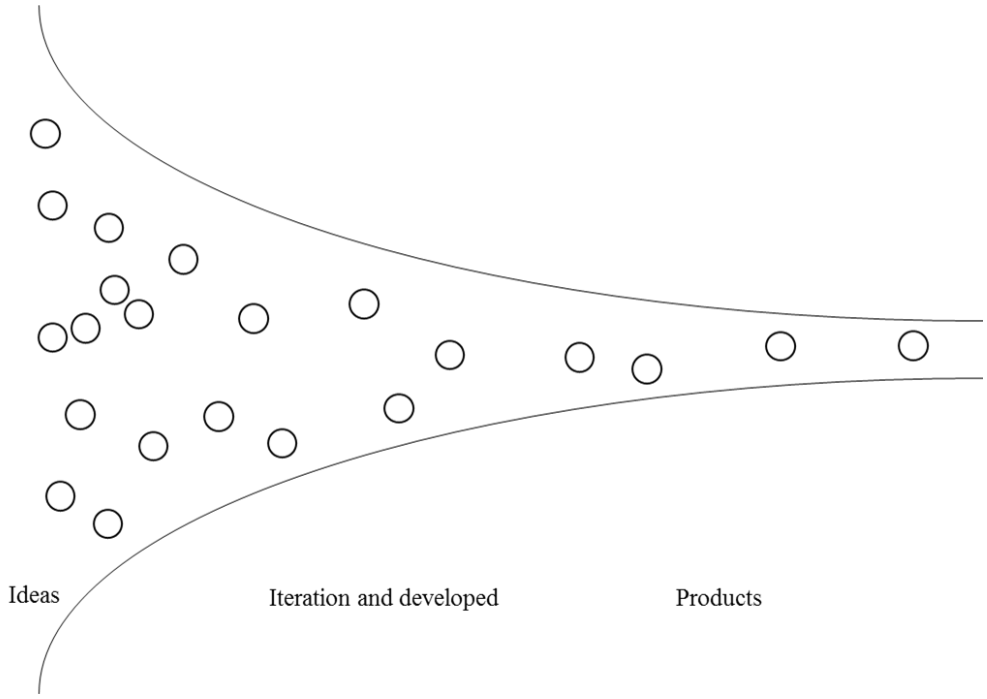

Figure 6: *Innovation funnel as a demonstration of the innovation process (Based on Schilling 2012, p. 5; Leppälä 2014, p. 165)*

The previous model sees the process mainly from internal perspective, although the early phases of discovery were mentioned to be influenced by environmental aspects. Opposite to the idea that companies develop everything internally, Chesbrough (2003) introduced the term open innovation. Open innovation combines both internal and external ideas into systems to create value. Not only can ideas can come both inside or outside the firm at different phases of the process, but also seep out during the process for example in the research phase or later in the development phase, to be and be developed by other actors. Examples of these are licensing or employees changing firms. Open innovation recognizes that internal ideas can be taken to market through external channels go generate additional value. (Chesbrough 2003, p. xxiv).

Saarnio and Hamilo (2014, p. 24) describe open innovation as a model of different practices that a company can use to utilize external information in addition to conventional public sources. Although it has been mentioned earlier that firms often scan external environment for ideas, the definition by Saarnio and Hamilo (2014, p. 24) refers to a more formal or structured approach that can happen at any time during the process. A company can utilize different channels together with internal R&D process and commercialization. (Saarnio and Hamilo 2014, p 24). Kettunen et al (2008, p. 36) also state that open innovation a systematic utilization of external knowledge. It refers to the interactions between the original innovator, which can be a person or a group, and the external contributors that can include all relevant groups that can contribute to or benefit from the development work. (Kettunen et al. 2008, p. 36).

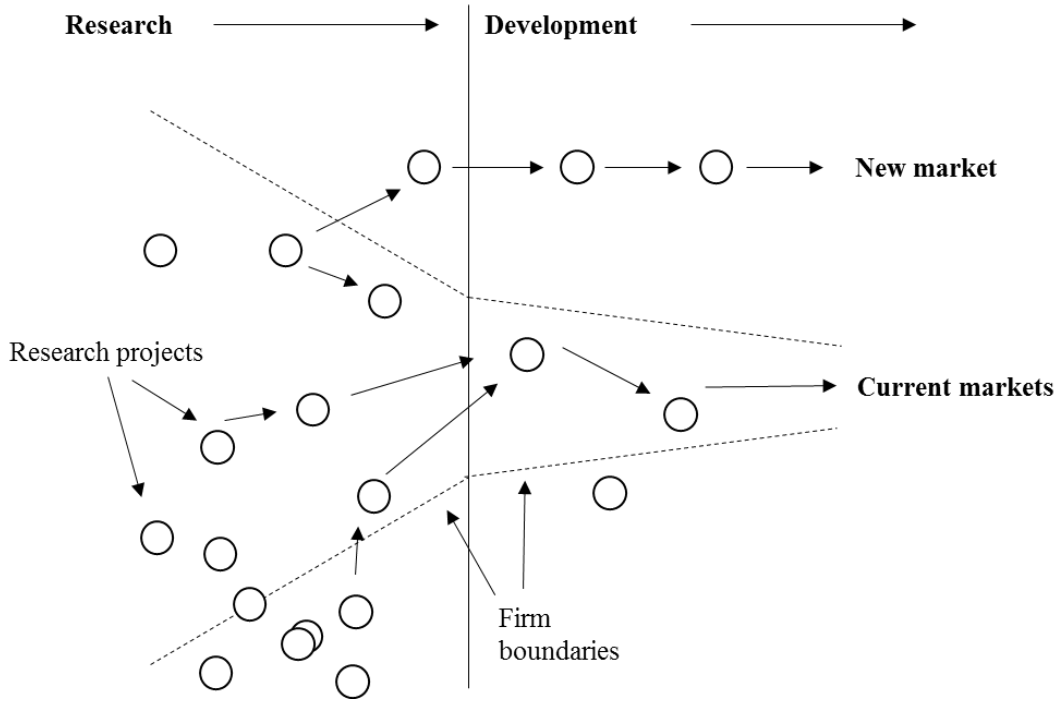

Figure 7: *Open innovation process. (Adapted from Chesbrough 2003, p. xxv)*

The model above takes into consideration that not everything happens within the boundaries of the firm. The resources spanning in and out of the firm can be ideas, technology, know-how or other competences and can happen in manufacturing, idea generation, experimentation, engineering or marketing and sales (Lazzarotti and Manzini 2009, p. 620). Leppälä (2014, p. 182) that openness is not really about achieving savings, but sees it as a necessary way to access resources as technologies get more complicated.

Technology commercialization process

One challenge is that most of the models presented in the literature do not go into very much in details on the different functions, activities and how the process moves from one activity to another within the innovation process, but only present a broad categorization usually including R&D, development and commercialization. Especially commercialization or marketing is usually just presented as a broad category, despite having a major role in turning inventions into innovations. A model presented by Jolly (1997) aims to describe on the commercialization of new technologies. It also captures both the overlapping and iterative nature of the process. It provides a more descriptive categorization of the process compared to more general categories, which can help pinpoint specific challenges more accurately. In the model technology commercialization process is divided into five subprocesses and the bridges connecting them.

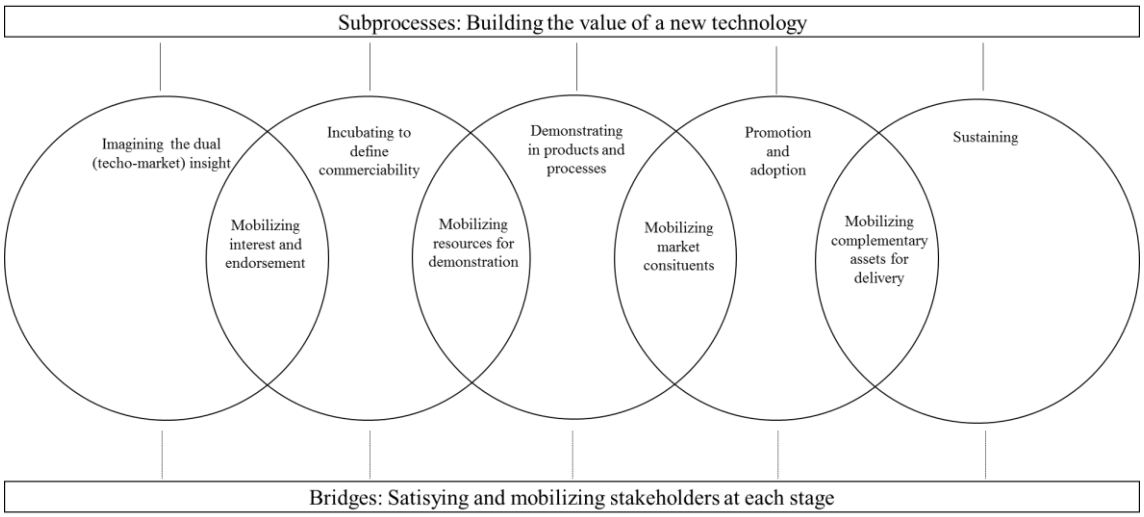

Figure 8: *The technology commercialization process (Adapted from Jolly 1997).*

Imagining starts in the idea phase itself. For technological innovations imagining refers to when an opportunity for a technical breakthrough gets combined with a potential market opportunity. It includes the process of a new idea getting recognized and pursued. Incubating is described as the moment when substantially more resources are committed to the technology. An idea requires committed resources and capital to be developed further, and the idea needs to be proven both technologically and market-wise. In practice this means taking a technology to a point where it gets recognized to have commercial potential. Demonstrating is usually associated with product development, and it means the demonstration of the idea in marketable products or processes. It requires creating something on the one hand attracts customers, and on the other is actually possible to achieve with the technology in hand. (Jolly 1997).

Promoting is the act of gaining market acceptance for the new technology. It has two dimensions, first one being about persuading people to adopt. Inventions rarely get automatic reception, and persuading is required to get full acceptance. The second one is about creating an infrastructure to support the delivery of the technology. This can include creating new distribution infrastructure, or getting parts of the current infrastructure to adopt the technology. This can require an already sufficient demand, which in turn would require an infrastructure, leading into problems for the investor. Sustaining is ensuring the success and realizing value in the long term. It means making sure the products and processes incorporating it have a long presence on the market while generating value. (Jolly 1997).

Jolly (1997) uses the term bridging to describe connecting the overlapping phases. It means creating enough value to make a technology go further, and at the same time mobilizing stakeholders and the next stage and convincing them. To the first two bridges he refers as the technology transfer problem. The first one between imagining assembling resources of R&D involves mobilizing those who is needed for support to take the idea

further. The second bridge is between a generic technology and a marketable product, which includes seeking cooperation from more actors, with and within the organization, and increasing commitment from the backers. The latter two bridges are market-related. The first is about building acceptance of the product by the early customers as well as a host of market constituents. The last bridge concerns inclusion of suppliers of complementary products and the infrastructure required to fully realize the benefits of the technology, dealing with the broader diffusion of the technology. (Jolly 1997). All in all in Jolly's process the activities themselves do not differ from the other ones that were presented. However it goes into much more detail in distinguishing the different activities usually present and required to commercialize a technology.

2.2 New Venture Creation

This chapter focuses on the creation of a new venture, focusing on new and small firms. It aims to identify the main themes related to new venture creation from entrepreneurial perspective and the roles these themes play when forming a new entrepreneurial firm.

2.2.1 Entrepreneurial venture

Using a definition by Carland et al. (1984, p. 79), entrepreneurial venture is one that seeks profitability and growth and the business is characterized by innovative strategic practices. To define criteria for these innovative characteristics they use Schumpeter's (1934) five categories of behavior which are introduction of new goods, introduction of new methods and production, opening new markets, opening new sources of supply and industrial reorganization. Carland et al. (1984, p. 78) state innovation is the key point that differentiates entrepreneurial ventures from other ventures.

The process of creating innovations was discussed earlier, but not all inventions or innovations follow a clearly defined process. Those may illustrate how innovation or product development is approached in large organization, but especially in smaller or entrepreneurial companies it may not be so straightforward. Timmons and Spinelli (2008, p. 110) focus on the entrepreneurial perspective and state that there is a core entrepreneurial process that drives and explains the success of high-potential ventures. They say that regardless of different technologies, geographies or businesses, there are these driving dominant forces that shape the dynamic process. These forces are controllable and focusing on these can help to analyze risks and determine the chances of success. The process is opportunity driven, led by the entrepreneur and his team, resources-constrained, integrated and holistic, sustainable and requires a balance amongst these. (Timmons and Spinelli 2008, p. 110). These forces are presented in the Figure 9 blow.

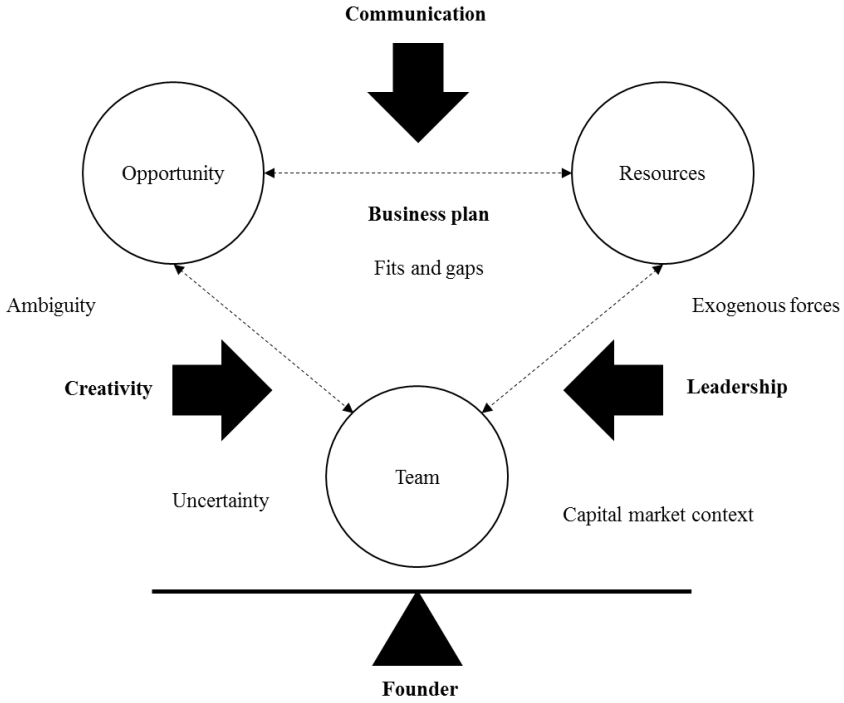

Figure 9: *The Timmons model of entrepreneurial process (Adapted from Timmons and Spinelli 2008, p. 110)*

The start of a new venture will be discussed via this framework – determining opportunity, team and resources as the key aspects of a new company. Wickham (2004) approaches entrepreneurship with a similar process to Timmons model of entrepreneurial process. He also emphasizes the constant reconfiguring the elements and the interactions they have and points out the learning that happens during the process and is determined by the success and failure of the actions. (Wickham 2004, pp. 136-138).

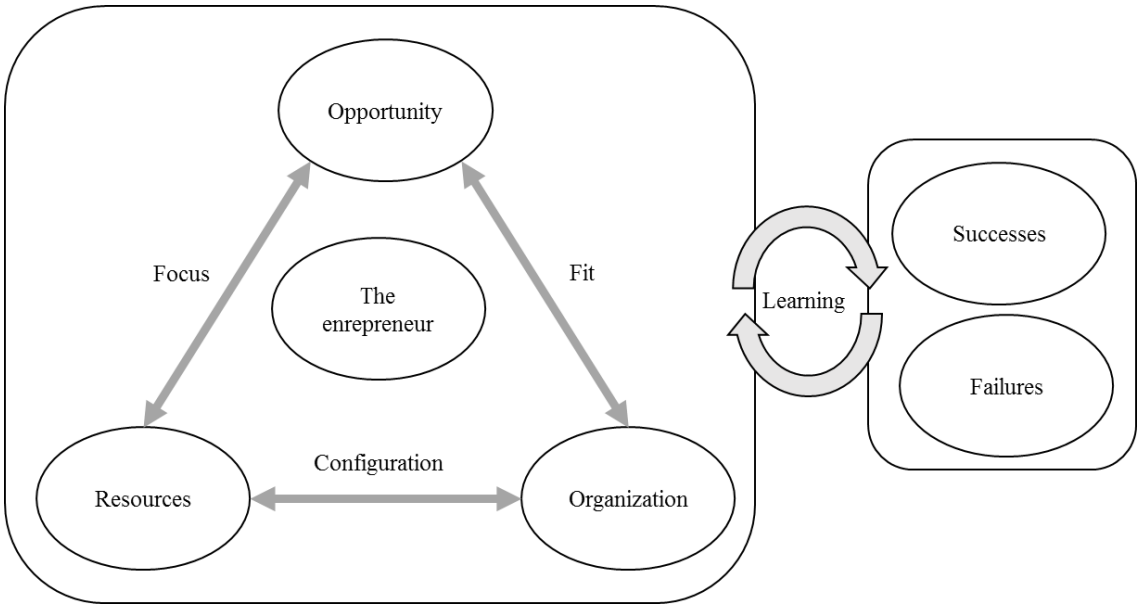

Figure 10: *Learning in the entrepreneurial process (Adapted from Wickham 2004, pp. 138-139)*

The process requires constant fit and balance between the opportunity, the resources and the team. It means continual assessment, revising strategies and tactics. This leads into shaping the opportunities, the resources and the team to find fit. One aspect highlighted is also the importance of timing, which requires decisiveness in recognizing seizing on opportunity. (Timmons and Spinelli 2008, pp. 114-116). The constant reforming of the entrepreneurial elements is line with a study by Deakins and Freel (1998, p. 153) who state that entrepreneurship and growth is a non-linear and discontinuous path.

2.2.2 Opportunity

It is emphasized that the process starts with an opportunity, not capital, strategy, business plan or networks. Dealing with all the forces in a dynamic environment requires constant balancing by the entrepreneur and his team. As the opportunity is the starting point, the size, depth and shape of it defines both the team and the resources that are required. (Timmons and Spinelli 2008, pp. 110-111). Sarasvathy et al. (2003, p. 145) divide entrepreneurial opportunity to three categories; recognition, discovery and creation. The classification depends on whether the supply or demand exist or has to be created by the entrepreneur.

Table 4: *Categories of entrepreneurial opportunity (Gathered from Sarasvathy et al. 2003, p. 145)*

Type of opportunity	Explanation
Opportunity Recognition	Both sources of supply and demand exist. The opportunity for bringing them together is recognized.
Opportunity Discovery	Only one side, e.g. demand, exists. The other one has to be 'discovered' and then implemented.
Opportunity Creation	Neither supply nor demand exist, both have to be created before matching them up, requiring inventions in also marketing, financing and so on.

According to study of Shane (2000), opportunities are not discovered because entrepreneurs have special attributes that enable them to recognize opportunities better. They found that prior experience makes people able to discover certain opportunities better than others. Knowledge about markets, ways to serve it and the problems of customers are important in opportunity recognition. Shane (2000, p. 459). The ability to recognize opportunities is further improved by entrepreneur's technical knowledge and learning abilities (Corbett 2007, p. 111-112). Thompson (1999, p. 286) claims that visionaries can see and create opportunities that others miss by combining available information and seeing patterns, concluding entrepreneurship is not about a flash of inspiration, but a systemic exploitation of resources in the environment.

A study by Ardichvili and Cardozo (2000) indicates that opportunities are discovered through recognition instead of purposeful search. They studied several factors leading into opportunity recognition in the entrepreneurial process and concluded that it is a combination of things and lead into recognizing opportunities. They claim that the major factors are entrepreneurial alertness, entrepreneur's networks and prior knowledge of markets and customer problems. Prior knowledge can come from revenant education, work experience, non-work related experience and events or a combination of these. (Ardichvili and Cardozo (2000, p. 103, 116).

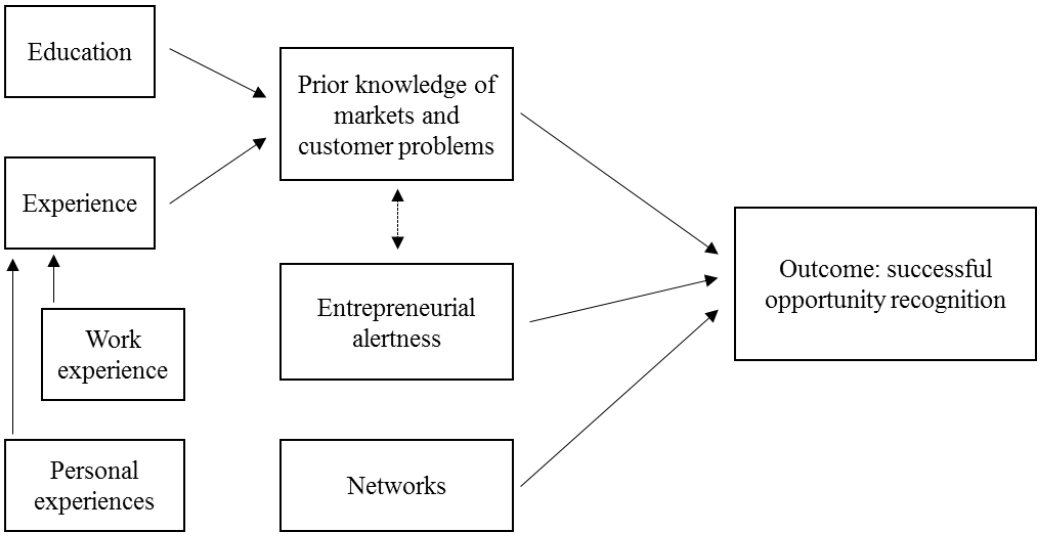

Figure 11: *Factors affecting opportunity identification (Adapted from Ardichvili and Cardozo 2000, p. 115)*

In addition to the three major factors, Ardichvili et al. (2003, p. 106) continue to add personality traits, such has risk-taking, optimism, self-efficacy and creativity, and type of opportunity as a major factor that influences the process that leads into recognizing opportunities and ultimately into business formation. Ardichvili et al. (2003, p. 118) acknowledge that processes may differ between individuals and teams, as whereas some may be good at inventions, others may excel at creating business models.

In the Timmons model, opportunity is driven by market aspects. Timmons and Spinelli (2008, p. 111-112) provide demand, structure and size, margin and readiness as good points of analysis for the opportunity at hand. The opportunity is greater the more imperfect the market is. (Timmons and Spinelli 2008, p. 112).

Table 5: *A starting point for opportunity analysis. (Modified from Timmons and Spinelli 2008, p. 112)*

Market aspect	Examples
Market demand	• Customer payback time • Market share and growth potential • Reachable customers
Market structure and size	• Emerging or fragmented • Size of potential • Entry barriers
Margin analysis	• Capital requirements compared to competitors • Break-even time • Gross margin • Increase of P/E ratio

2.2.3 Resources

According to Wernerfelt (1984, p. 171) resources and products are two side of the same coin. By specifying the size of a firms activities in a market it is possible to infer the minimum required resources for it. Vice versa, by analyzing the resource profile of a firm it is possible to find most optimal product-market activities. In the widest definition resources can be anything that can be considered as a strength or a weakness to a firm. They can be tangible or intangible being tied to a firm at a given time, and some examples of resources are knowledge of technology, brand names, machinery, capital, trade contacts and so on. (Wernerfelt 1984, p. 171). But only having resources may not be enough. Barney (1995) argues that sustainable competitive advantage depends on the uniqueness of the resources that the company has. He claims four questions need to be addressed about the company's resources and capabilities (Barney 1995):

- Value: Do the resources add value by enabling to exploit opportunities and neutralize threats?
- Rareness: Is there only a small amount of competitors controlling them?
- Imitability: Are there significant disadvantages for other companies trying to obtain or develop them?
- Organization: Is the company organized to exploit its resources?

Barney and Hesterly (2007, p. 93) bring the four questions together to create the VRIO framework. It addresses the questions of value, rarity, imitability and organization in relation to competitive implications, which can be seen on table 6.

Table 6: *The VRIO framework to evaluate competitive advantage. (Adapted from Barney and Wright 1998, p. 38; Barney and Hesterly 2007, p. 93)*

Valuable?	Rare?	Difficult to Imitate?	Exploited by the Organization?	Competitive Implications
No	-	-	No	Competitive Disadvantage
Yes	No	-		Competitive Parity
Yes	Yes	No		Temporary Competitive Advantage
Yes	Yes	Yes	Yes	Sustained Competitive Advantage

Wickham (2004, p. 200-201) divides an entrepreneur's resources to three broad categories; financial resources, operating resources and human resources. An entrepreneurial venture is created by combining these elements in an innovative way, which then delivers new value. His definition of resources slightly differs from the one of Timmons model, which emphasizes financial and operating resources and places people-related resources under 'Team'. In either case human resources are an important aspect of a new venture,

as financial and human capital that firms employ are found to be the most clearly related to new venture growth (Gilbert et al. 2006, p. 932).

Table 7: *Examples of resources in an entrepreneurial venture (Gathered from Wickham 2004, pp. 200-205)*

Type of resource	Explanation and examples
Financial resources	• Resources that are or can be converted into cash • Loans, investment capital, cash in hand
Operating resources	• Used to deliver outputs to the market • E.g. facilities, buildings, office equipment, machinery, raw materials
Human resources	• Transforming financial and operating resources into business • People, effort, knowledge, skills, insight • Technical expertise, productive labor, provision of business services, functional organizational skills, communication skills, strategic and leadership skills

Timmons and Spinelli (2008, p. 112) claim that the requirement to have all the resources is a common misconception among entrepreneurs, claiming that there is a shortage of good opportunities, not money. Focusing on the capital aspect, they think that if the opportunity is good, investors and money will follow. They also say that bootstrapping is a way for entrepreneurs to create significant advantage. It means minimizing and controlling the required resources instead of owning them, and can include anything from assets to people and capital. (Timmons and Spinelli 2008, p. 112).

When it comes to resources, Bird and Jelinek (1988, p. 26) state that entrepreneurs also develop networks to access resources such as expertise, information and encouragement, and the range and number of these can vary. Gilbert et al. (2006, p. 933) say that the financing that is required for growth usually has to be attained outside of the one's own personal network, implicating that without outside support the growth of the firm will be very slow. As mentioned, the entrepreneurial process requires constant balance. The resources needed may change during the process, as was studied by Aarikka-Stenroos and Sandberg (2012). They say that when moving from R&D to commercialization, firms need resources to accelerate diffusion, adaptation and market creation. This may also require changes in the firms' network as the activities require different kinds of resources. (Aarikka-Stenroos and Sandberg (2012, p. 205)

2.2.4 Entrepreneur and the Team

The importance of the entrepreneur and the team is often highlighted. New ventures can be formed by one or several entrepreneurs. Whether the venture is formed a sing person or a team of several persons will have big effects on it. Especially the experiences of the founders have substantial importance when new ventures are founded by teams instead

of an entrepreneur and both the team size and heterogeneity of the team affect the venture (Gilbert et al. 2006, p. 931).

Gartner (1985) discusses the key aspects that can affect entrepreneurial behavior. He defines individual factors as a one of the key variable in new venture creation. According to Gartner (1985, p. 702) characteristics that can affect entrepreneurial behavior are:

- Need for achievement
- Locus of control
- Risk taking propensity
- Job satisfaction
- Previous work experience
- Entrepreneurial parents
- Age
- Education

These characteristics can have many implications during the creation of new venture, and entrepreneurs have many tasks they need to excel at. The entrepreneur needs to be lead and teach, set the pace, create the culture, build communication and attract other members for the management team. The quality of the team is another aspect that requires things from commitment and motivation, creativity and adaptability. (Timmons and Spinelli 2008, p. 113). Similar points are brought up by Bird and Jelinek (1988), although they emphasize the recruitment of people with the needed skills and motivating them.

Table 8: *Important aspects of an entrepreneurial leader and a team. (Adapted from Timmons and Spinelli 2008, p. 113)*

Entrepreneurial leader	**Quality of the team**
Learning and teaching	Relevant experience and record
Dealing with adversities	Motivation, commitment, determination
Integrity	Tolerance of risk and uncertainty
Building entrepreneurial culture	Creativity and adaptability
	Leadership and courage
	Communication and team locus of control

The previous authors focus on the soft management skills required to lead a venture and a team. Wickham (2004, p. 245) also highlights that entrepreneurs do not only need the right knowledge and skills, such as knowledge of the industry sector, people skills, general management skills and leadership, but also need to develop them actively. But they rarely work alone and also need people who have skills complementary to their own. Examples of people required are specialists and technical experts, people who make the

product or deliver the service, general managers and people who build relationships outside the firm. (Wickham 2004, p. 245).

Especially industry experience and educational background seem to be brought up as important factors. Gilbert et al. (2006, p. 931) claim that educational background, prior related industry experience, and prior entrepreneurial start-up experience have direct effects on the sales and employment growth of new firms. Kor et al. (2007) also discuss resources and capabilities in relation to an entrepreneur's industry-specific experiences. Experience and knowledge gained in an industry by working with suppliers, buyers, distributors and other stakeholders can aid in the evaluation of new entrepreneurial opportunities. In addition to discovering opportunities, it can also benefit in securing resources and business orders though the old connections in the industry (Kor et al. 2007, p. 1198).

When it comes to forming teams for the new venture, Teal and Hofer (2003, p. 45) found that teams that had prior experience working together and previous entrepreneurial experience improve the performance of a new venture. According to Carter and Jones-Evans (2006, p. 259) most technology-based startups come from a field where the lead entrepreneur has worked previously. This also provides an opportunity to evaluate and bring together people with suitable skills (Cater and Jones-Evans 2006, p. 259). This means the entrepreneur's previous experience may not make up only the skills he brings, but also define the team. Carter and Jones-Evans (2006, p. 259) state that an entrepreneur's local, professional and social networks affects the composition of the team, but that team members founding a start-up usually bring contrasting skills and expertise. Therefore even though they may have worked in similar settings before, the focus of their expertise might be different.

Burns and Dewhurst (1996) categorize factors influencing entrepreneurial decision into three categories. They have both the previously discussed personal experiences and experience in a previous organization as a factor, but on top of that they consider the economic condition as a third one. They also attempt to define a more exactly what it is in these categories that affect the entrepreneurs.

Table 9: *Factors influencing on the entrepreneurial decision (Adapted from Burns and Dewhurst 1996, p. 22)*

Antecedent influences	Incubator organization	Environmental factors
• Genetic factors • Family influences • Educational choices • Previous career experience	• Geographic location • Nature of skills acquired • Contact with other potential founders • Motivation to stay or leave • Experience in small business setting	• Economic conditions • Access to venture capital • Example of entrepreneurial action • Opportunities for consulting • Availability of personnel and support • Accessibility of customers

2.3 Business Ecosystems

This chapter on business ecosystems focuses especially on identifying the different actors and their role in the system. Also the implications of competing in an ecosystem and enabling or restricting role of the actors will be examined.

2.3.1 Defining Business Ecosystem

The idea of business ecosystems originates from Moore (1996) when he compared the business world to a biological ecosystem. This analogy presented the business world as an ecosystem, where value is produced for consumers who are also a component of an ecosystem. The participants are suppliers, competitors, manufacturers and other actors, and the system aligns itself to certain directions set by the companies. (Moore 1996, p. 37). His idea of a dynamic and interconnected business environment has since been studied and developed further. The ultimate idea is that everyone in the ecosystem is connected and one's actions do not happen in isolation – what a company does will have an effect on the other actors in the system, and what other actors do will affect the company.

Moore (1996) divides business ecosystem to three layers. The core of it is created by direct suppliers, distribution channels and core contributors. The second layer is termed 'the extended enterprise'. It proceeds to include direct customers, customers or customers, suppliers of suppliers, standard bodies and suppliers of complementary products and services. The third layer will then include the whole ecosystem – including investors, owners, government agencies, competitors and so on. (Moore 1996)

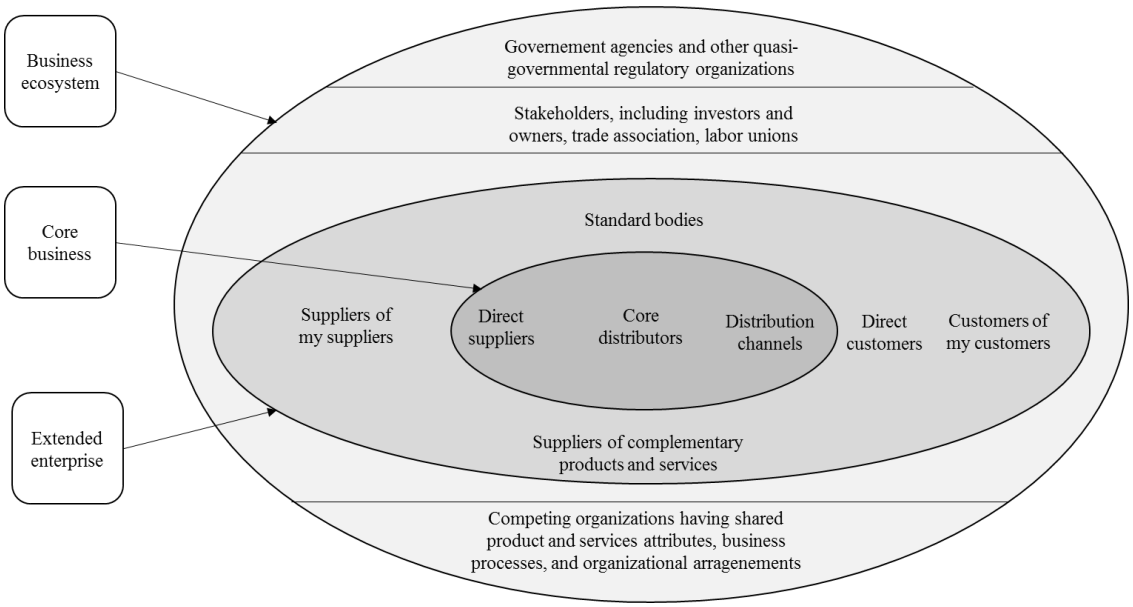

Figure 12: *Actors in a business ecosystem (Adapted from Moore 1996)*

It is not easily clear how the business ecosystem approach actually differs from the concept of networking. Pittaway et al. (2004, p. 149) provide a comprehensive schematic of

the actors in an innovation network. They make the division between the networking interface and networking infrastructure. Networking interface includes direct relationships with external parties, such as customers and suppliers. Networking infrastructure extends the field into incubators, science partners, clusters and such. This kind of networking approach is very similar to the idea of business ecosystems presented by Moore.

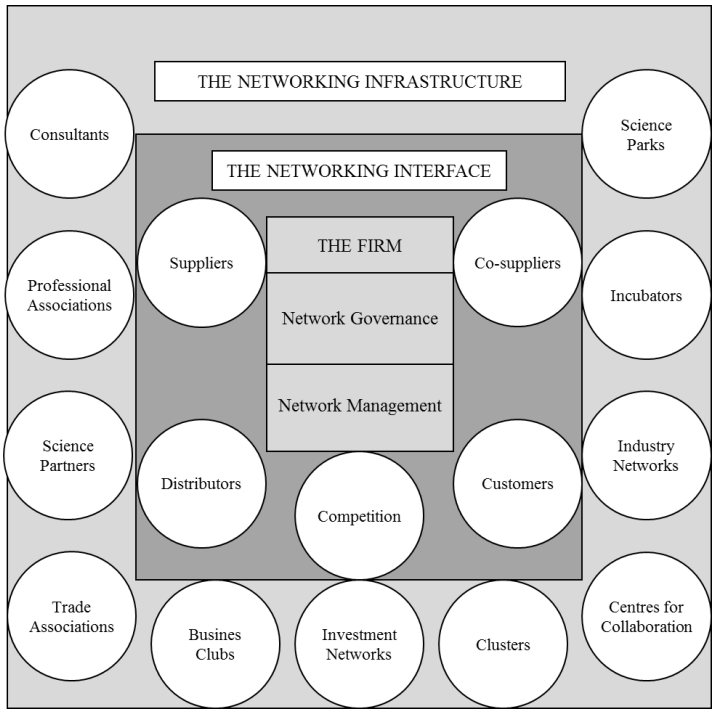

Figure 13: *Networking and innovation: networking interface and infrastructure (Adapted from Pittaway et al. 2004, p. 149)*

Zahra and Nambisan (2012, p. 219) use the terms business ecosystem and business networks somewhat interchangeably, and they say the term business ecosystem is used as the term when referring to physical and digital networks firms create when competing in a global arena. These relationships can provide firms resources, information and partners, and are a result of an evolutionary process by the industry players. These players are a group of companies that interact and share a set of dependencies while producing goods and services. (Zahra and Nambisan 2012, p. 219-220). Heikkilä and Kuivaniemi (2012, p. 19) claim that business ecosystems and business networks differ by the actors included in the concepts. They claim that networks are typically limited to co-operating activities such as designing or producing whereas ecosystems are widened to include complementors, competitors, investors and such (Heikkilä and Kuivaniemi 2012, p. 19). However when compared to the earlier networking infrastructure by Pittaway et al (2004, p. 149) the amount of actors is just as wide as in the ecosystem. The definition of an ecosystem that differs perhaps the most from networking comes from Peltoniemi (2005, p. 62) who finds several ways in which business ecosystems differ from value networks and clusters. The most significant features of a business ecosystem are rejecting the role of geography,

competition and cooperation simultaneously, disregarding the term industry, decentralized decision making and interconnectedness bring the enabler and sharing fate as the motivator of cooperation (Peltoniemi 2005, p. 62).

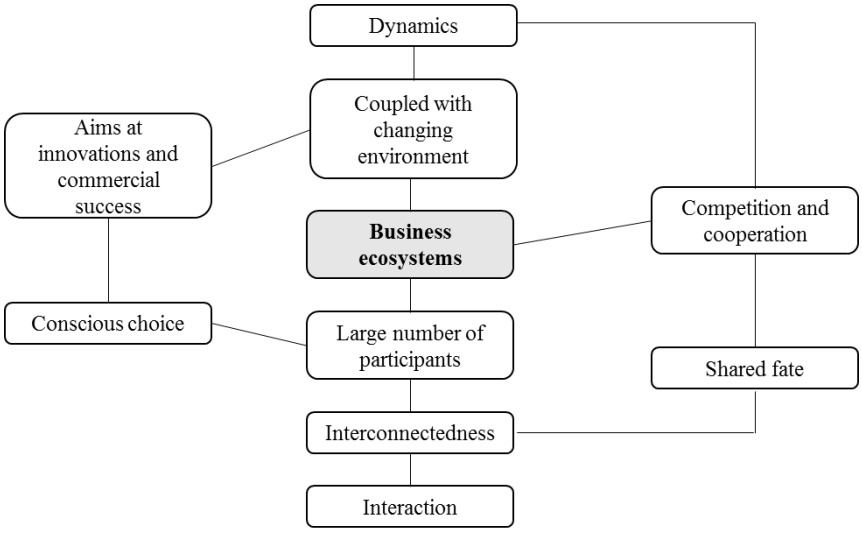

Figure 14: *Characteristics of business ecosystems (Adapted from Peltoniemi 2005, p. 64)*

Iansiti and Levien (2004) have a similar definition to ecosystem as Moore (1996) as they include in the ecosystem all entities that can affect or have interdependencies with the firm. They identify three ecosystem strategies that a firm can choose: keystone, dominant or niche. It is choice affected both by the firm's intentions and also the current ecosystem (Iansiti and Levien 2004). Similar three roles is identified by Zahra and Nambisan (2011), although they acknowledge that the roles are typical manifestations and hybrids of theses exist in the big variety of companies.

Table 10: *The most typical roles in an ecosystem.*

Authors	Roles	Definition / tasks
Iansiti and Levien (2004)	Keystone	• Building and developing ecosystem • Creating value to the ecosystem
	Dominator	• Exploiting: integrating horizontally or vertically and taking most of network • Displacing: taking value but giving little back
	Niche	• Specializing on particular capabilities or areas • Dependant on other actors
Zahra and Nambisan (2011)	Feeder	• Discover novel technologies • Develop the ecosystem's knowledge base in a radical way
	Breeder	• Turn inventions into innovations • Convert original ideas developed by others into products
	Niche	• Complementary products to the platform • Usually connected to leaders, helping them satisfy market needs

Zahra and Nambisan (2011, p. 9) also discuss the evolution of an ecosystem, which is driven by dynamism and continuous innovation. New entrepreneurs and companies appear and form relationships. The variety of sources for innovation determines the ecosystem's viability and staying power, and knowledge is adapted and shared. This leads into creative destruction, where some will fail to meet the new demands and some will replace the old knowledge with new one. This can also lead to creation of new niches or even industries. Zahra and Nambisan (2011, p. 9)

Table 11: *Characteristics of a business ecosystem.*

Characteristics	Author(s)	Explanation
Reach	Moore (1996)	From direct suppliers to government agencies
	Peltoniemi (2005)	Rejects the meaning of geography and industry
Risks	Adner (2006)	New risks related to uncertainties about complementary innovations and adoption across the value chain
Interconnectedness and Interdependence	Adner and Kapoor (2010)	Innovations are often dependent on the success of other innovations in the external environment
	Peltoniemi (2005)	Organizations actions have effect on other organizations and vice versa
Roles	Iansiti and Levien (2004)	Three roles: Keystone, dominator, niche
	Zahra and Nambisan (2011)	Three roles: Feeder, breeder, niche
Parallel goals and processes	Heikkilä and Kuivaniemi (2012)	Developing firm's business model while also adjusting the network strategy
	Nambisan and Barson (2012)	Entrepreneurs in hub-based systems have to deal with own goals and goals set by the leader
Co-evolution	Zahra and Nambisan (2011)	Driven by dynamism and continuous innovation: new companies appear and form relationships while some fail to meet the demands

2.3.2 Why the ecosystem approach?

Today networking and collaborating with a variety of actors is seen as a crucial aspect. External relationships can be exploited for many different purposes from manufacturing to marketing. They can occur at different stages in the process, from the early discovery for ideas to the late commercialization. They also vary by the strength of the ties – some of them can involve tight cooperation whereas some of them occur as a one-way support such as funding. These relationships can include a wide variety actors that form the environment around the organization.

Organizations have the possibility to either develop their new products alone, or join forces and collaborate with other companies. Collaboration is seen as an essential aspect

nowadays, even an imperative. A common rationale presented for collaboration and networking is that most firms cannot effectively utilize all their intellectual capital themselves (e.g. Kettunen et al 2008, p. 129). This is especially difficult for SMEs, who rarely have all required expertise of technology, funding and marketing to fully commercialize their innovation (Lee et al 2010, p. 298), and arguably even more so for small and micro firms. SMEs apply less resources to R&D and have less systematic market research and technology monitoring (Tödtling and Kaufmann 2012, p. 15), therefore collaboration with other companies however may grant access to complementary assets that are needed to make an innovation into a commercial success (Faems et al 2005, p. 240). This collaboration can happen with a wide range of organization through direct or indirect relationships and through different channels of communication (Tidd and Bessant 2009, p. 285). Kessler et al. (2007, p. 4) list several common gaps for SMEs, such as technical limitations, limited marketing capabilities, lack of formal processes and owning fewer assets. Due to the gaps in their knowledge, SMEs then seek partners to fill them (Kessler et al. 2007, p. 4).

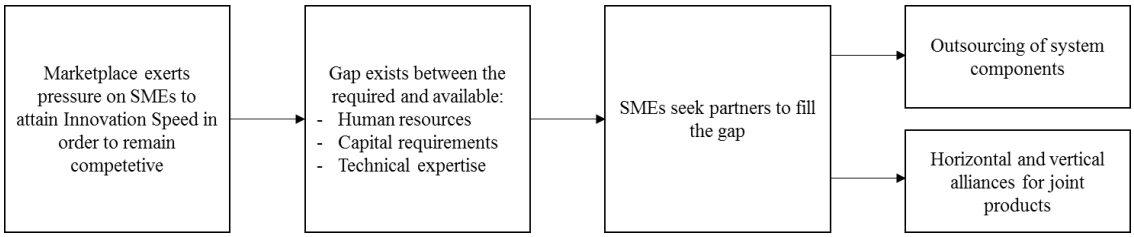

Figure 15: *Why and how SMEs seek external help from outsourcing and alliances (Adapted from Kessler et al. 2007, p. 4)*

Eggers et al. (2014, p. 1389) claim that especially SMEs access extensive or specialized knowledge though the use of networks. Their study suggested that networking with industry partners to support marketing, particularly product development, decisions is a viable path for SMEs to promote radical innovation (Eggers et al. 2014, p. 1389). Lee et al. (2010, p. 292) divide the most common network models involving SMEs to explorative and exploitative modes. Exploration part refers to R&D activities, such as funding, licensing, outsourcing, R&D partnerships and networks. Exploitation is about commercialization activities that can include outsourcing, partnerships and networking. Exploration activities sometimes seem to attain more attention, and some authors such as van Hemert et al (2013, p. 446) remind that sometimes interaction is SMEs can greatly benefit from external support at the commercialization stage too.

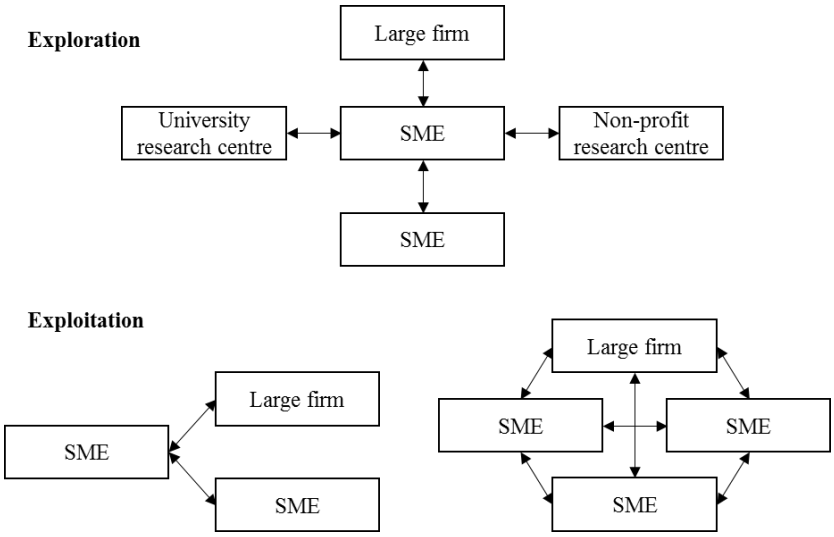

Figure 16: *Examples of explorative and exploitative modes of collaboration for SMEs. (Adapted from Lee et al. 2010, p. 293)*

The business ecosystem perspective moves beyond this. The rationale for seeing business as an ecosystem is that everything is connected and innovations do not thrive in isolation, and often need complementary innovations to succeed. This means that a firm's innovation performance is not only about the challenges they face, but also about the challenges the external environment faces (Adner and Kapoor 2010, p. 307). It may require overcoming more obstacles in specifying, sourcing and integration, and can impact technological as well as organizational routines of the firm (Adner and Kapoor (2010, p. 312). Focusing only on the firm's own perspective then is not enough. Collaboration does not mean only within the firm, because developing products and services in an ecosystem in a common manner requires aligned vision, mutually supportive R&D, synergistic operating processes. This requires set ways for putting the different actors' contributions together and close dialogue with customers (Moore 2006, p. 34). Zahra and Nambisan (2011, p. 5) claim that network-centric innovation are nowadays common element in the economy, especially in technology-based industries. This sort of integrated approach requires protecting and developing the ecosystem where the innovation occurs, which is done by collaborating with many kinds of stakeholders. Nowadays the emerging ecosystems are typically consisting of small companies and new ventures, most likely because the size of opportunities is small too. (Zahra and Nambisan (2011, p. 5).

The difference of the ecosystem perspective can be illustrated by using the approach of Adner and Kapoor (2010). They approach ecosystems by linking value creation to the structure of interdependencies between firms. They state that both the magnitude and location of the challenges faced in the ecosystem matter. On the location aspect they focus on upstream (suppliers) and downstream activities (customers and complementors), claiming that there the challenges faced in each pose significantly difference implications for the focal firm. Upstream challenges lead to the firm bring unable to bring its innova-

tion to the market, while downstream challenges prevent firms from utilizing the full potential of their innovations. (Adner and Kapoor 2010). Adner (2012, p. 84) provides an example of all the locations and links of complementors that are not on the direct path on the value chain, but however are critical for success, calling it a value blueprint.

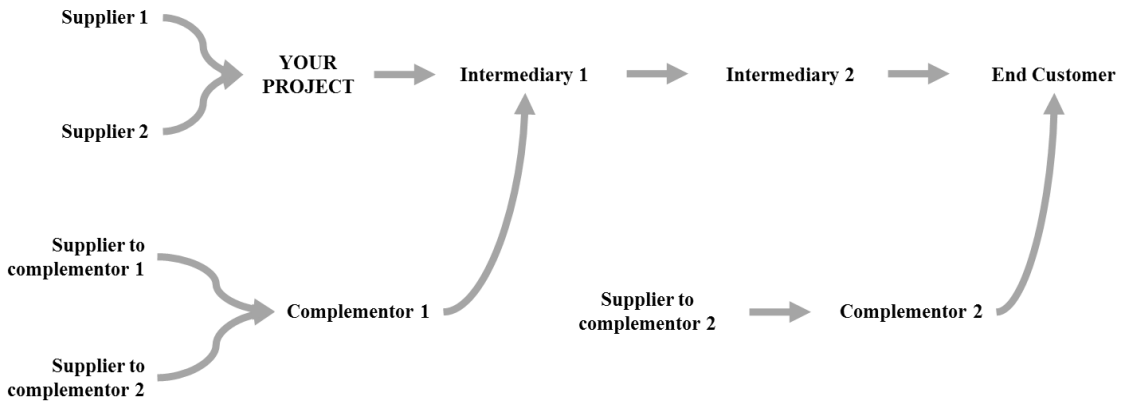

Figure 17: *A generic presentation of actors that create an ecosystem (Adapted from Adner 2012, p. 87).*

According to Zahra and Nambisan (2012, p. 222) long-term success is dependent on understanding, managing and exploiting linkages formed in an ecosystem. They say that entrepreneurs recognize their importance in transforming the ecosystem, and therefore establish these linkages to introduce new business models to change behavior in the system or change the mix of resources needed to operate. Instead of just keeping up with the existing relationships, they systemically reshape their ecosystem to get the most advantage. (Zahra and Nambisan 2012, p. 222). Peltoniemi (2005, p. 35) also states that interconnectedness is an important aspect in ecosystems, as organizations' actions have an effect on other organizations in the systems. An organization can have its own goals and directions, but not everything is possible because other organizations can prevent them. According to Zahra and Nambisan (2011, p. 6) members of an ecosystem usually develop new products cooperatively and competitively based on a shared set of technologies and skills that comprise a platform, which then becomes the base for the members to leverage each other's skills too.

Adner (2006) finds that competing in an ecosystem brings along new risks. An organization has to prepare for events that are out of one's control, for example expecting and planning for delays, compromises and disappointments (Adner 2006, p. 9). According to Adner (2006, p. 3), competing in ecosystems also bring new kinds of risks, which he divides into three categories:

- Initiative risk: the common uncertainties of managing a project
- Interdependence risk: uncertainties related to complementary innovators
- Integration risk: uncertainties about the adoption process across the value chain

In ecosystems especially the latter two provide interesting points of view and potential challenges for a company. They have mainly to do with the fact that innovation can be part of a larger solution. The success of an innovation can depend on the other components of that solution, which may still need to be developed. Even if they exist and are developed, they may also need to be adopted by customers or other firms, before the final customer can adopt one's innovation. (Adner 2006, pp. 4-5).

2.3.3 National Innovation System

In relation to collaboration, networks and ecosystems exists the national innovation system, which Roos et al (2005, p. 6) define national innovation systems as all economic, political and other social institutions that affect learning, searching and exploring activities, which includes for example universities, research bodies, financial system, policies, and private firms). Hassink (2002, p. 153) describe innovation support system to consist of all the agencies found in three support stages that are providing general information, technological advice and join R&D projects between other firms, higher education institutes and public research establishments. The agencies either give advice or refer them to other agencies in further support stage, and they can be regional, national or supra-national. Hassink (2002, p. 153).

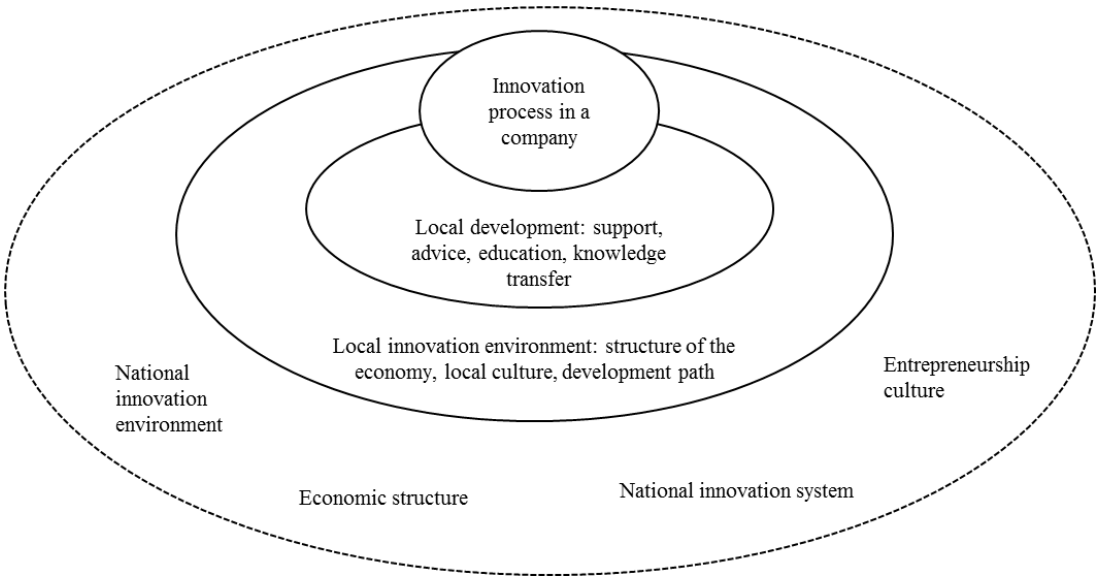

Figure 18: *An illustration of the innovation environment (Adapted from Mustikkamäki and Sotarauta 2008, p. 103).*

As can also be seen on the Figure 19 above, the public sector has a governing role in national innovation systems (Inkinen and Suorsa 2010, p. 169), which is based on the national innovation policy. The public sector has several functions to support regional and national activities that range from consultation to direct financial support (Inkinen and Suorsa 2010, p. 169). Edquist (1999, p. 2) defines public policy as a public action that influences technical change and other kinds of innovations, including elements of

R&D policy, technology policy, infrastructure policy and education policy. Therefore the role of public policies can influence many different aspects of innovative behavior, from a firms R&D to the overall structure to the system. The public organizations influences the innovations processes with policy instruments. These instruments can be combined into mixes that address the problems in the system. (Borrás and Edquist 2013, p. 1513)

It is stated that innovation support can often only be understood as financing, technological support or technical know-how (Kaufmann and Tödtling 2002, p. 154; Heydebreck et al 2000, p. 97). However firms often need consultancy in marketing, innovation management, strategy formulation (Kaufmann and Tödtling 2002, p. 154), commercialization and distribution (Heydebreck et al 2000, p. 97). Especially new technology-based firms require soft mentoring services, such as mentoring, networking, raising awareness, or mating, e.g. searching for partners or analyzing potential markets. (Heydebreck et al 2000, p. 97). According to Falk (2007, p. 666) modern approach to innovation policy is about acquiring learning capabilities, problem-solving skills and knowing where to find complementary knowledge. It seems there are several ways to approach the national innovation policy, and Carter and Jones-Evans (2006, pp. 59-60) use three categories to distinguish between the possible aims, methods and targets of government policies.

Table 12: *The aims, methods and targets of innovation policies. (Modified from Carter and Jones-Evans 2006, pp. 59-60)*

Aims	Methods	Targets
• Cost reduction, reducing the costs of inputs into the business • Risk reduction, reducing uncertainties • Increasing available information: readily available information on global and local trends and issues	• Finance • Providing information • Providing specialist advice • Training and personnel development	• Stage of business development: idea formation, start-up, development • Type of business, firm size, sector, location • Factor inputs and resources, e.g. capital • General business climate, culture of entrepreneurship

Although innovation support aims to improve the innovativeness of the firms, it is not influenced directly, but through inputs to the innovation process (Kaufmann and Tödtling 2002, p. 154). It is important to identify the actual problems in the innovation system, and design the innovation policy according to these (Borrás and Edquist 2013, p. 1518). Otherwise it can create obstacles that hinder innovations instead, as stated by (Patanakul and Pinto 2014, p. 97). As mentioned, innovation policy is formed by the various instruments affecting the actors. Takalo (2012, p. 160) states that the main policy tools are intellectual property, R&D, subsidies and R&D funding, tax incentives, prizes and costs, and public procurement for innovative services.

Table 13: *Public support methods that can be used to support businesses.*

Author(s)	Goal	Methods or instruments
Patanakul and Pinto (2014)	Encouraging technological changes and providing opportunities for technological transformation	• Assisting firms in developing technical capabilities • Developing infrastructures and business platforms • Promoting quality of work force • Creating favorable business environment
Smits and Kuhlmann (2004)	Goal will affect the choice of instruments	• Financial: stimulating R&D • Diffusion: transfer of knowledge and/or technological competences • Managerial gap: support for running a business • Systemic: facilitating change
Carter and Jones-Evans (2006)		• Finance • Providing information • Providing specialist advice • Training and personnel development

Borrás and Edquist (2013)	Regulations: binding regulations
	
	Economic instruments: stimulating positive incentives in cash
	
	Soft instruments: complement to the previous two
		• Regulations
		  ○ Intellectual property rights
		  ○ Competition policy
		  ○ Universities and public research organization statuses
		• Economic transfers
		  ○ Competitive research funding
		  ○ Support to venture seed and capital
		  ○ Tax exemptions
		  ○ Support to universities and research organizations
		• Soft instruments
		  ○ Codes of conduct
		  ○ Voluntary agreements
		  ○ Public-private partnerships
		  ○ Voluntary standardization

2.4 Summary and Previous Research

This chapter attempts to conceptualize the research setting as well as discusses previous studies that related to the topic. The main themes related to creating incremental and radical innovations are the discovery of an idea and the following development and the commercialization of it. It is an iterative and overlapping process and can be broken into smaller phases. The importance of the entrepreneur, the team and the ecosystem are highlighted throughout the whole process, although there can be particular phases where they are particularly essential. Figure 20 illustrates the key concepts of this research.

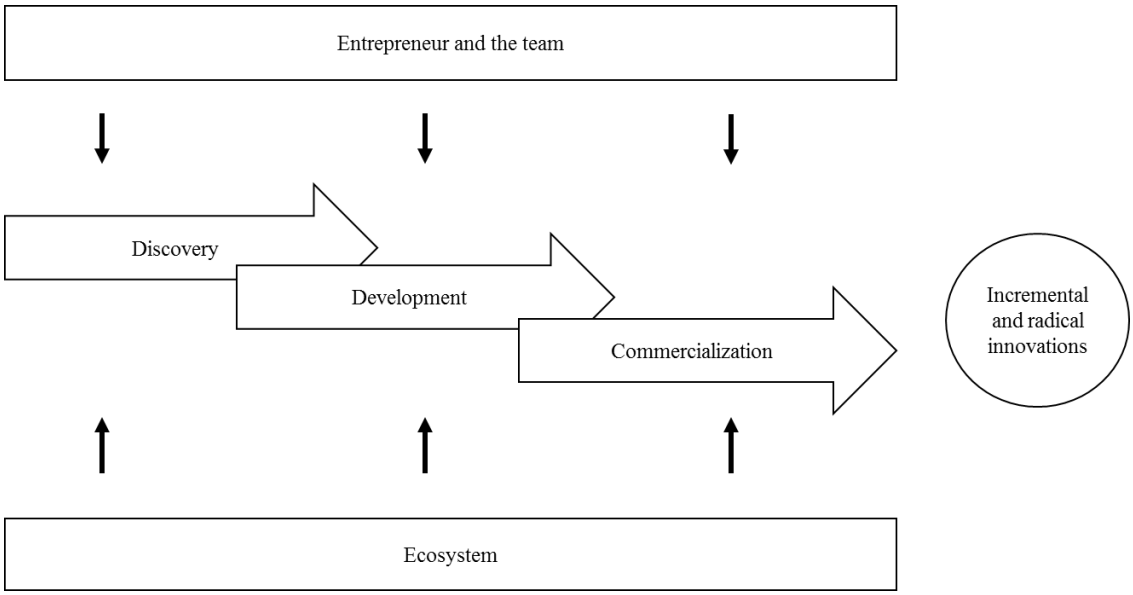

Figure 19: *The key concepts of the research.*

There are several approaches to the radicalness of an innovation, including themes such as newness, performance, markets, technology and features. The process view of innovation can be examined in several different ways, as identified in chapter 2.1.2. The table below combines the most important aspects of the discussed models.

Table 14: *Summary of the innovation processes.*

Model	Author(s)	Phases	Other key aspects
Linear innovation process	Kettunen et al. (2008)	1. Foresight 2. Concept development 3. New product development 4. Commercialization and market entry	• First three phases can be categorized under R&D
Revised model	Kettunen et al. (2008)	1. Foresight exercises 2. Concept development 3. New product development 4. Market entry 5. Product support	• Interactions between various groups • Commercialization parallel to other development work
Funnel model	Schilling (2012); Leppälä (2014)	1. Ideas 2. Screening 3. Development 4. Testing 5. Commercialization	• Iterative nature • Fuzzy front end particularly interesting

Model	Author(s)	Phases	Other key aspects
Open innovation	Chesbrough (2003); Lazzarotti and Manzini (2009)	1. Research • Ideas • Experiments 2. Development • Manufacturing • Marketing and sales	• Resources and ideas span in and out of the firm
Technology commercialization process	Jolly (1997)	1. Imagining a. Mobilizing interest 2. Incubating b. Mobilizing resources 3. Demonstrating c. Mobilizing market constituents 4. Promoting d. Mobilizing complementary assets 5. Sustaining	• Five subprocesses and the bridges connecting them • Overlapping and iterative process

Timmons model of entrepreneurial process can be used to analyze the entrepreneurial setting of the companies. Consisting of the entrepreneur, the team, the resources they bring and the opportunity, this framework will be used to analyze how these factors can influence the creation of a new innovative venture.

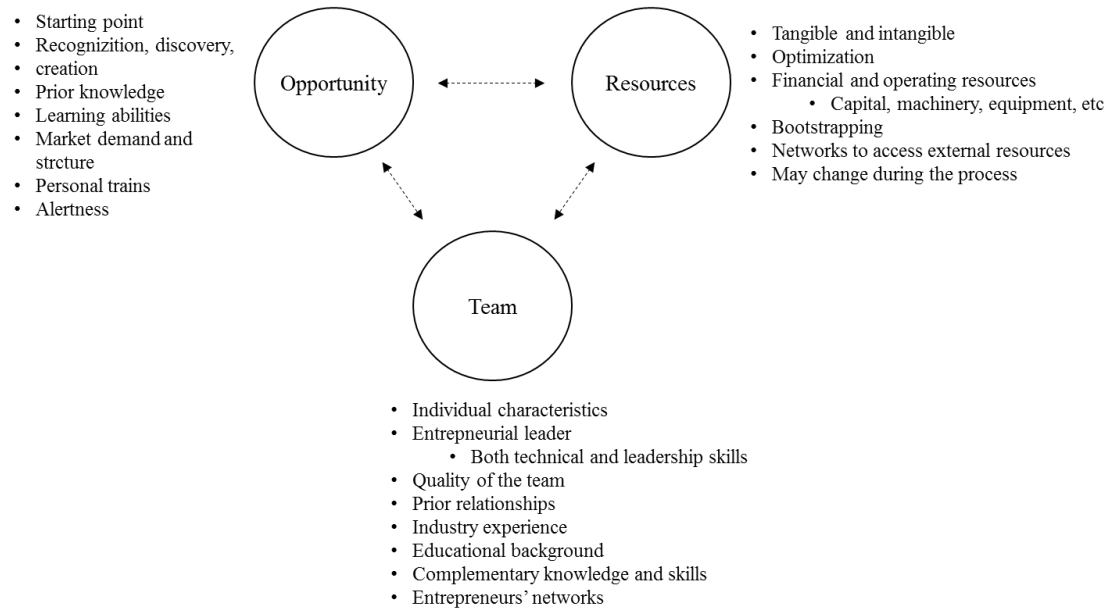

Figure 20: *The importance of the entrepreneur and the team in a new venture.*

With regards to business ecosystems, the most important dimensions related to the research are the relevant actors in the environment, external support and other factors than can have effects on the firm.

Table 15: *Elements of a business ecosystem.*

Actors	Support mechanisms	Other influencing factors
Core business • Direct suppliers • Distribution channels Extended enterprise • Direct customers • Customers of customers • Suppliers of suppliers • Suppliers of complementary products Business ecosystem • Government agencies • Stakeholders • Competing organizations	Government support • Finance • Information and specialist advice • Transferring knowledge • Assist in developing capabilities • Serving as an intermediary • Developing favorable environment and infrastructure Cooperation with other organizations • Resources, information, partners • Activities in R&D, producing, marketing etc. • Access to complementary assets • Mutual vision and putting contributions together	• Existing structures • Role in the ecosystem • Competitors • Co-operative activities • Interconnectedness • Risks based on interdependence • Success dependent on exploiting linkages • Ecosystem platform

Previous research on the topic

In his study consisting of 228 small and medium –sized manufacturing firms, Freel (2000a) focused on the relationship of external linkages and product innovation. He compared innovative and non-innovative firms and found that innovative firms seem to exploit more linkages with external organizations. On the other hand he found than less than half the innovative firms collaborate suppliers or subcontractors for innovation. Those who collaborate do it related to new product development or improvement, followed by research and development. Similar results were found for links with customers, although R&D collaboration is closer to NPD in importance. Links to competitors and universities were even less important, while other links to public sector placed somewhere in between but closer to universities, indicating the importance of vertical relationships compared to the other ones. Especially longevity of the relationships were seen important for successful cooperation. (Freel, 2000a).

Jenssen (2001) studied how social networks and entrepreneurial resources are related to entrepreneurship. With a sample of 100 individuals with the intention to be entrepreneurs, they found that social networks are important for the success of a start-up and are especially important when considering them as channels to gaining access to resources (Jenssen 2001, pp. 108).

Marvel and Lumpkin (2007) discuss technology entrepreneurs' human capital and its effects on innovation radicalness in their research. Their sample consisted of 145 founders of technology ventures, supporting the importance of differences in human capital and

opportunity recognition. They found that education and depth of knowledge in a single area are more important in creating radical innovations compared to broad experience in several areas. Of the different types of opportunity recognition (markets, customers, ways to serve, technology), only technology knowledge was found greater for entrepreneurs who created radical innovations. Considering all innovations, ways to service markets become the other major factor. (Marvel and Lumpkin 2007)

Freel (2000b) studied the nature and extent of barriers amongst small manufacturing firms. His sample consisted of 238 manufacturing SMEs in the UK. His sample had no evidence that innovators would be more likely to apply for external finance. The firms identified improving internal skills, such as technical and marketing competencies, more important than accessing external skills or increasing the number of internal experts. He also found out that interaction with external agencies is low, referring to lack of trust and inability to find suitable partners as the main reasons. (Freel 2002b).

In the study consisting of 259 new technology-based firms and 106 researchers, Heydebreck et al. (2000) attempted to find out needs of these new technology-based firms when it comes to innovation support services. They identified four needs bundles: marketing, technology, financing and soft service support, and of these finance was seen most important followed by marketing and soft services. Market assistance and market analysis were the biggest needs in marketing. Biggest technology-related need was consulting. The most important support need was financing of innovation projects, followed by contact with financiers. Training and education and seminars were the most important soft services. (Heydebreck et al. 2000)

Albaladejo and Romijn (2000) studied the key internal and external sources of innovation capability in small and medium –sized firms in the UK. Their sample had 50 firms from low- medium and high-tech industries, which belonged to electronics, clothing and software sector. They identified a range of relevant internal factors contributing to innovations. Owner's technical education and prior working experience in large firms and R&D institutions and technical skills of the workforce, especially highlighting science and engineering background, were relevant factors in enabling innovative behavior. These can come in the form of access to established markets or laboratory facilities, or development costs already occurred in the previous organization. Also efforts on technological development and on-the-job learning were important. Important external factors was financial support for R&D, especially that provided by support schemes. They found no evidence that networking or interaction with customers or suppliers would be imperative for innovation capabilities. (Albaladejo and Romijn 2000)

3. METHODOLOGY

The methodology of the study is explained this chapter. It starts by discussing the research strategy, followed by the selection and characteristics of the case companies. After that the data collection and analysis is explained.

3.1 Research Strategy

This is an explorative type of study with the aim of generating new knowledge about the subject. The subject is new and not fully understood and there is no knowledge about what will be the most relevant aspects related to the topic, which makes an explorative research approach particularly useful as the study focuses on what is happening and seeking new insights (Saunders et al. 2009, p. 139; Ghauri and Grønhaug 2005, p.58).

The research was conducted as a multiple case study, as it was seen best to fit in line with the research questions set for the study. Case studies are particularly useful if the concepts and variables are difficult to quantify or study outside their natural setting (Ghauri and Grønhaug 2005, p. 114), and in this research the aim was to gain in-depth qualitative knowledge about the case companies. Case studies are also suitable for the research strategy when "how" and "why" type of questions are asked (Ghauri and Grønhaug 2005, p. 115) and contemporary elements are examined (Yin 2014, p. 12), which is exactly the case in this study.

Multiple case study was chosen over a single one, as it offers a broader perspective and all the phenomena would probably not occur in a single case study. The evidence received from a multiple case study will also make the findings more compelling and increases the robustness of the study (Herriot and Firestone (1983, p. 14) as well as making the results more generalizable (Saunders et al 2009, pp. 146-17).

3.2 Case Companies

Interviews with case companies were chosen as the empirical part of the study. Purposive sampling method was used as it enabled to select cases that best fit the needs of the research questions and objectives, and enabled to choose cases that were seen as particularly informative (Saunders et al 2009, p. 237). The case companies were chosen according to criteria discussed together with the research partner. The companies would need to fit the following requirements: Finnish company operating in the equipment and manufacturing sector, formed in 2010 or later as a joint-stock company and having an innovative element in their product or service. First Orbis database was used to list all active companies and companies in unknown situation. Next the criteria was entered into the search system;

Manufacturers of machinery and equipment, located in Finland and year of incorporation after 2010.

	Step result	Search result
1. All active companies and companies with unknown situation	148,368,241	148,368,241
2. NACE Rev. 2 (Primary codes only): 28 - Manufacture of machinery and equipment nec	858,003	702,455
3. World region/Country/Region in country: Finland	1,316,683	2,343
4. Year of incorporation: on and after 2010 up to and including 2015	39,584,022	286

Figure 21: *The search criteria used in Orbis database.*

This list included 286 companies, which would then need to be further evaluated to fit into the research requirements. All subsidiaries of multinational organizations, companies that had been reincorporated and resale companies were removed from the shortlist. After this companies that have their own product or technology and conduct research and development were looked at. The goal was to find companies in these requirement that have an innovative element in their operations. Out of these the most promising ones were hand-picked, leading into a shortlist of 34 companies. They were and then further discussed and evaluated within the research group. After validation they were contacted to shortly discuss their applicability to the requirements and inquire for their interest to participate. In the end 21 of the 34 identified companies were included in the study. Some companies were found not to meet the criteria, and some declined the offer to participate in the research.

In the companies the goal was to interview a key individual or individuals related to the formation of the company and the products. All interviews were conducted face-to-face except one, which was conducted via Skype. The interviews were conduction during the time period 14.1.2016 – 31.3.2016. Table 16 below presents chosen information about the interviewed companies. Most financial and personnel information is based on the year 2014, while the age is based on the age on the 9th of March 2016. All the information was not available in the Orbis database, which is indicated in the sample size.

Table 16: *Chosen information about the interviewed companies.*

	Turnover (1000 USD)	**Employees** (number of)	**Age** (years)
Average	592	3,2	3,2
Median	121	3	2,2
Highest	4341	12	6,0
Lowest	0	1	0,7
Sample size	19	13	21

Using the definition by European Commission (2015, p. 11) all the companies are small or micro companies, which means a headcount of less than 50 and annual turnover and balance sheet total of less than 10 million euros. Majority of the companies were micro companies with less than two million annual turnover and balance sheet total and less than 10 employees, except two of them that exceed both the criteria.

3.3 Data Collection

Semi-structured interviews were chosen as the most appropriate method for the data collection, as they are well-suited for an exploratory study, as well as for situations when the gathered data is analyzed quantitatively (Saunders et al. 2009, pp. 321-322). Qualitative methods are particularly suitable when emphasis is on wanting to reveal and understand "why", in addition to "what" and "how", which helps understand the attitudes, opinions and the reasons the research participants have taken. (Saunders et al 2009, p. 321). The aim of the study is to collect in-depth knowledge about the specific issues around the research questions, and Yin (2014, p. 106) also states that in case studies interviews have strengths of being target and insightful, meaning it has a direct focus on the case study topic as well as provides personal views and explanations, such as perceptions and attitudes. They are also suitable for situations where the results can be multifaceted and diverse (Hirsjärvi et al 2007, p. 200), which was seen as a possibility.

In semi-structured in structured interviews the researcher will have a list of themes and questions that will be covered (Saunders et al, p. 320). These themes and the interview outline were provided by the research partner from VTT in accordance to the research goals and then discussed with other members of the research group, leading into minor adjustments. It is loosely based on the Timmons model of entrepreneurial process that was introduced in the literature review, and the chosen themes were:

- Opportunity
- Team, networks and competitors
- Resources
- Radicalness of innovation

These topics were broadly discussed, and some specific questions were prepared beforehand. Although the questions are prepared beforehand, the order of the questions and the even the questions themselves may vary depending on how the conversation progresses (Saunders et al, p. 320), which also frequently occurred in this study. Before the interviews company data was gathered from Orbis database, Tekes' funding database and news search. Information about things such as funding, owners and external partners were combined into a timeline, in order to build an encompassing picture of the organization as possible, prior to the interviews. This allowed the researchers to guide the interview towards the planned themes better and prepare specific questions beforehand, meaning the interview outline sometimes varied per interview.

Table 17: *Summary of the interviews.*

Case companies		Roles of the interviewees				Average length
Interviews	Interviewees	Founder or co-founder	CEO	Sales and/or marketing	Product development	
21	24	21	21	2	1	55 minutes

The interviews were conducted by different researchers in the group, either alone or in a pair. Due to having several people conducting the interviews, the goals, questions and themes were thoroughly discussed, in order to increase comparability. After the first few interviews summaries were made and shared within the group, in order to ensure that the research design matches the goals and all the relevant information will be acquired. All the interviews were recorded to be able to focus on the interview fully, and it also provides a more accurate interpretation than taking notes (Yin 2014, p. 110). The interview outline can be found in Appendix 1.

3.4 Data Analysis

The approach the data analysis in this study was inductive, which means the principle of collecting data and developing theory based on that data afterwards (Saunders et al 2009, p. 41. It is usually associated with qualitative research such as this, where conclusions are made based on the empirically collected data (Ghauri and Grønhaug 2005, p. 15).

Inductive approach is particularly suitable in this case when the topic is new, exciting debate, and has little existing literature Saunders et al (2009, p. 127). The theory is built during the data collection and analysis, instead of defining a theoretical framework and the themes to follow up and concentre on usually emerge during the process (Saunders et al. 2009, p. 490). In this research the frameworks with which the findings are analysed were chosen depending on the themes that occurred during the study.

According to (Ghauri and Grønhaug 2005, p. 15), the process of inductive research goes observation → findings → theory building, and that findings are compared to current knowledge and theories. In this study we use several frameworks to examine the findings and to tie them into the current literature. However Saunders et al (2009, p.127) point out that induction requires a close understanding of the research context, which was strengthened by extensively studying the existing literature on the topic.

4. RESULTS AND ANALYSIS

4.1 Opportunity

In the interview the factors behind the formation of the company were discussed. The interviewees were asked for example if the formation of the company was based on an identification of an opportunity. If they thought so, it was then discussed what was that opportunity, how did it develop, and eventually how did it lead into current situation. The technological aspects and risks related to the innovation and the company were discussed too.

Three of the interviewees told their innovation was born out of a personal need (#4, #7, #8). They had a need or a problem in their everyday life that they wanted to solve.

> *"Born from a real need - - [the inventor] was watching how mother is getting tired and father is working all the time and someone is always carrying something. Born from that need." - #4*

In two cases it was clearly stated that they tried to find alternative solutions before the decision to create it themselves.

> *"I searched for a few days, and couldn't find anything handy - - not a big deal, I'll start developing one myself" - #8*

> *"[After trying create an alternative solution to avoid the problem] Then I thought that I'll make my own - - I thought that if I could decide, what kind of would I make?" #7*

Four innovations were based on a need in the entrepreneurs' other company (#5, #13, #17,#18). They had a problem that required solving and had to develop the solution themselves.

> *"It started from a personal need. - - I had no money to buy these kind of stuff [equipment], like, I'm not going to get these for a few hundred potential customers. I thought, why do I even have to. Then it struck me. - - Immediately realized it has existing markets and users" - #13*

In all these cases the interviewees mentioned that they tried to find already existing solutions on the market. When they found out were not any available, they started trying to solve it themselves.

"Was born out of a need. [the inventor] produces energy grabbles and accessories for tractors. The operating pressure may be varying. The pressure is a problem, started to look for a solution. Could not find any with a good operating efficiency" - #5

"We tried to build this kind of product, we bought a device for it from a store. - - [After failing several times] And then when I examined later it kind of appeared that it does not exist. Then I realized that the hole [opportunity] exists and that it's damn big when you think how bad the existing products are" - #17

In addition to the four that were identified in the entrepreneurs' own business, two companies were born out of an idea or need in another company (#1, #20). One was noticed as a student doing a study for a company, one idea was suggested by an acquaintance.

" - - conducted the research and noticed there that this is an unresolved problem and one could build something for it." - #1

According to the entrepreneurs, the origin of five companies are related to identifying market potential (#3, #12, #14, #15, #21). Compared to the previous ones there was no particular personal need mentioned behind this, but the entrepreneur(s) saw that there is an opportunity in the market that can be captured.

"*The current available solutions do not satisfy me - - I saw a market niche. Others don't have similar products" - #3*

"- - there is a really big market demand but there is no offering, There is a good opportunity, we should get there. We saw that the only we to get there is to develop a new [product]" - #12

In one case this market opportunity was spotted in a previous company in the same field. It was mentioned that the development would not have been possible in the previous company because it is too set it in its on ways.

"The formation of the company based on opportunity recognition, that there was a need for that, and then we had knowledge and skills to produce them so we started producing - - We wanted to create better solutions and in our own way, because we were in such a big corporation that always if you tried to suggest or do things in your own way it was dismissed. - #15

Three companies emerged as a result of a scientific research project conducted at a university (#2, #10, #11).

> *"[One of the founders] presented an idea about this kind of water filtering technology - - [after simulations] concluded that the theory is promising and on that basis we started looking for funding." - #2*

Four companies were formed because of the entrepreneurs own interests (#6, #9, #16, #19). They had previous experience in the industry and had either worked for another company or had a previous company of their own beforehand. The entrepreneurs usually had interest for developing new things and in some cases this was not possible in the previous company.

> *"The company was born because we just wanted to do something. But the product was born because we noticed an opportunity. But we did not consider it commercial but thought that we'll do it anyway" #6*

> *"For a few years we had thought things could also be done differently - - we noticed that it cannot be renewed - - If you try to change something too much I would consider that impossible. And that creates to opportunity to create new. And often it cannot be done except via a new company" - #9*

> *"Well actually the interest for developing new, and in the old environment, old work place, that was not actually possible" #19*

The opportunity in this context discusses the ultimate reason or origins behind the company and the innovation. The identification of opportunity can consist of several elements that overlap. For example #18 said that even though the opportunity was discovered based on personal needs, he was approaches things with the market potential in mind. Also in #12 scientific research project with university was required to actually develop the technology to create products for the market demand. In #19 the company was formed on the basis of personal interests, but the entrepreneur stated he knew there would be a market for it. The origins of opportunity have been listed below:

- Personal need in everyday life
- Personal need related to hobbies
- Need in own business
- Need when creating another product
- Need when starting business
- Research for a company that had a problem
- No satisfying products in the market
- Recognizing an opportunity in the market
- Scientific research project
- Own scientific research
- Personal interest
- Not satisfied in current company

The empirical evidence can be categorized five categories based on how the initial opportunity emerged. These are personal need, particular business need, market potential, science-push and personal interests. The descriptions and typical characteristics based on the evidence are presented in Figure 23 below.

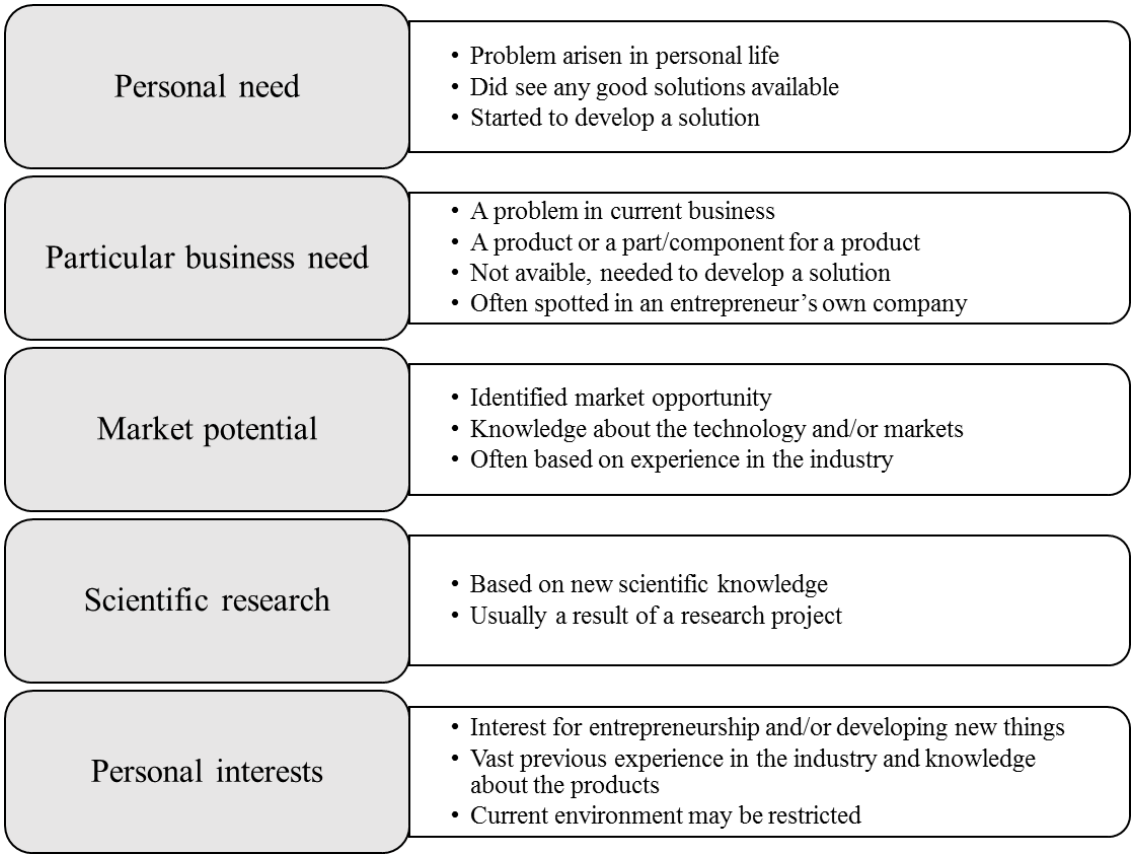

Figure 22: *The origin of the opportunity.*

In the Timmons model the entrepreneurial venture was presented as a combination of opportunity, team and resources. The three first categories above can be attributed to opportunity. They have all started from either noticing a personal or business need or potential in the market, which can be considered as an opportunity identification. So the statement in the Timmons model that the entrepreneurial venture starts with an opportunity is in line with majority of the empirical evidence in this study.

The other two categories however did not originate from identifying an opportunity in the same sense as the previous ones. Four companies were formed because of the entrepreneurs' own interests. They had previous experience the industry and interested for doing things in their own way. This can be seen as a resource-based start for the company, as the skills and knowledge the entrepreneurs possessed was the starting point. The remaining three companies were founded after new scientific discoveries. In the Timmons model is places under the team as it can be considered as the starting point.

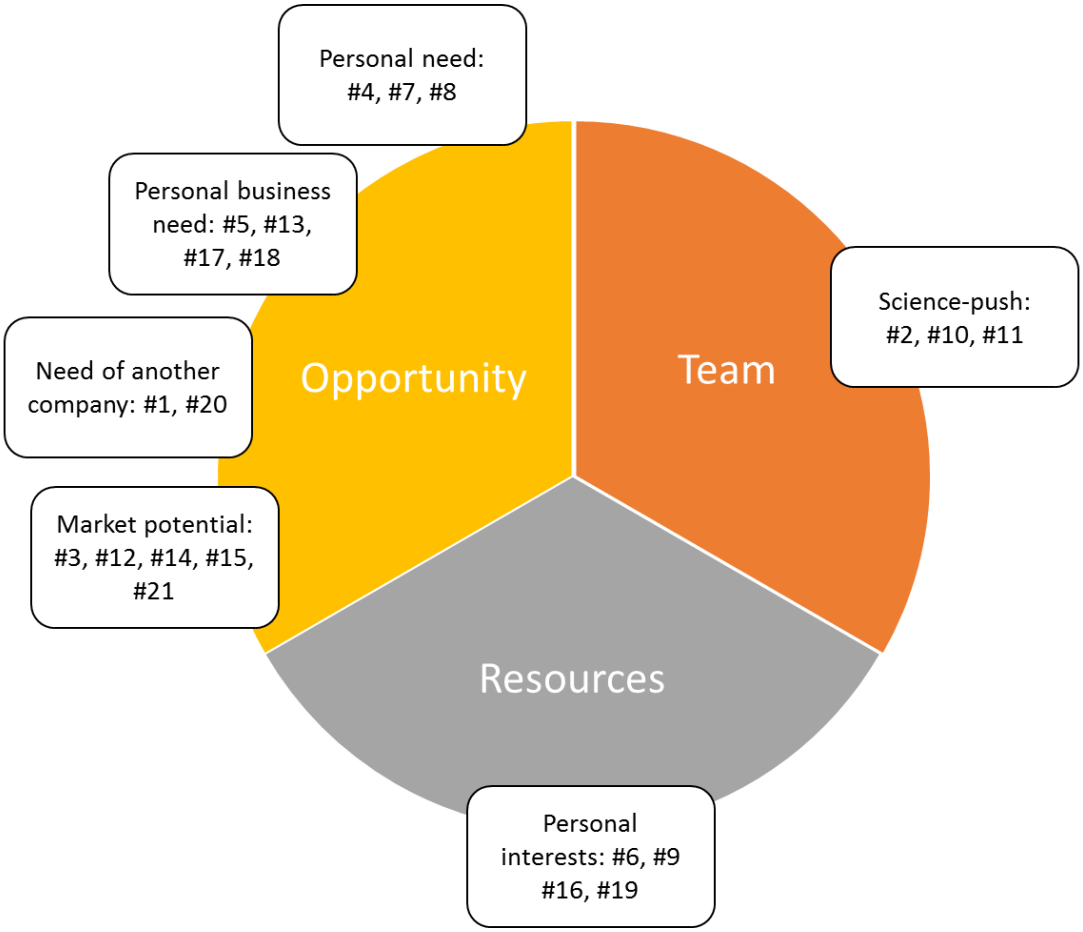

Figure 23: *Connecting the origin of companies with Timmons model.*

As mentioned, opportunity as discussed so far handles the origin of the opportunity. However it is usually a combination factors that are present around the opportunity that contribute to the innovation. Sources of innovation can include competition, demand, science and technology, regulations (Oksanen and Rilla 2009, p. 35), entrepreneur's education, experiences, networks and alertness (Ardichvili and Cardozo 2000, p. 115), inspiration, users, imitation, recombination, exploring alternatives (Tidd and Bessant 2009, p. 230), unexpected occurrences, and changes in markets, industry and preferences (Drucker 2014). The sources of opportunity identified in the literature are presented in Figure 25. The factors that were most present are highlighted with grey color, bolder meaning it had a major role. Those that were not important sources of opportunity have dotted line.

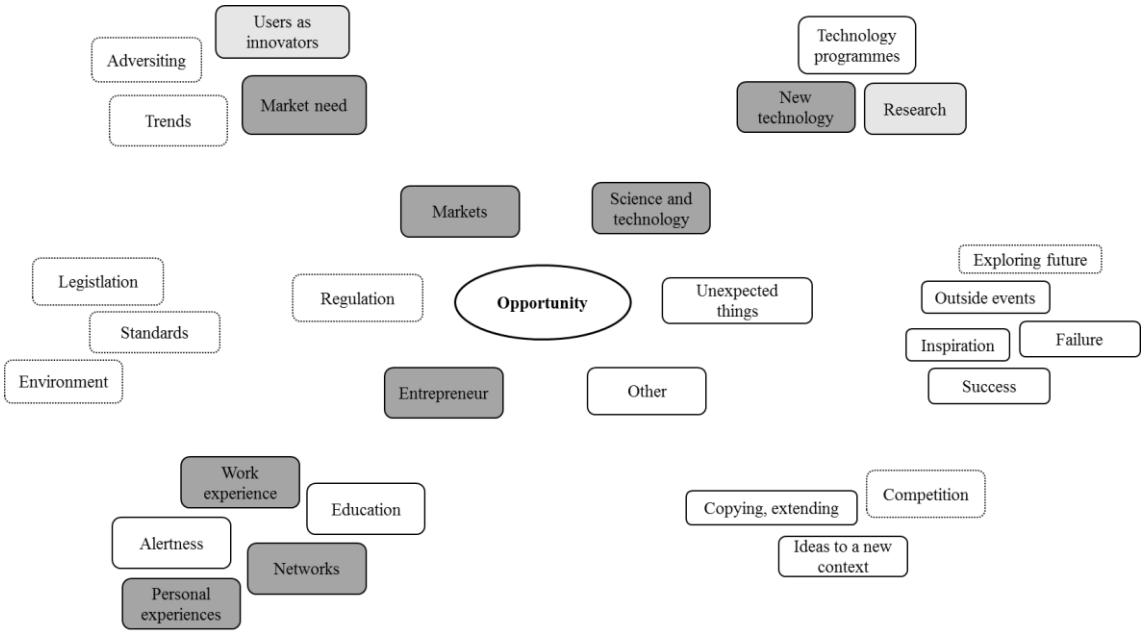

Figure 24: *Important factors that were present in the discovery of the innovation.*

In figure 26 the sources of entrepreneurial opportunity are applied to Moore's view of a business ecosystem that was presented earlier in Figure 13. Core business refers to ideas that have emerged from the entrepreneurs' personal activities such as old workplace, hobbies or needs. Extended enterprise includes also those opportunities that rise from the needs of other parties connected to the core business. Business ecosystem then expands to include the rest of the ecosystem. The figure shows that half the categories of opportunity place mostly within the inner circle, rest divided between the two outer circles. Most opportunities seem to be spotted in the entrepreneurs' current business or personal life, but the role of external sources is still relevant.

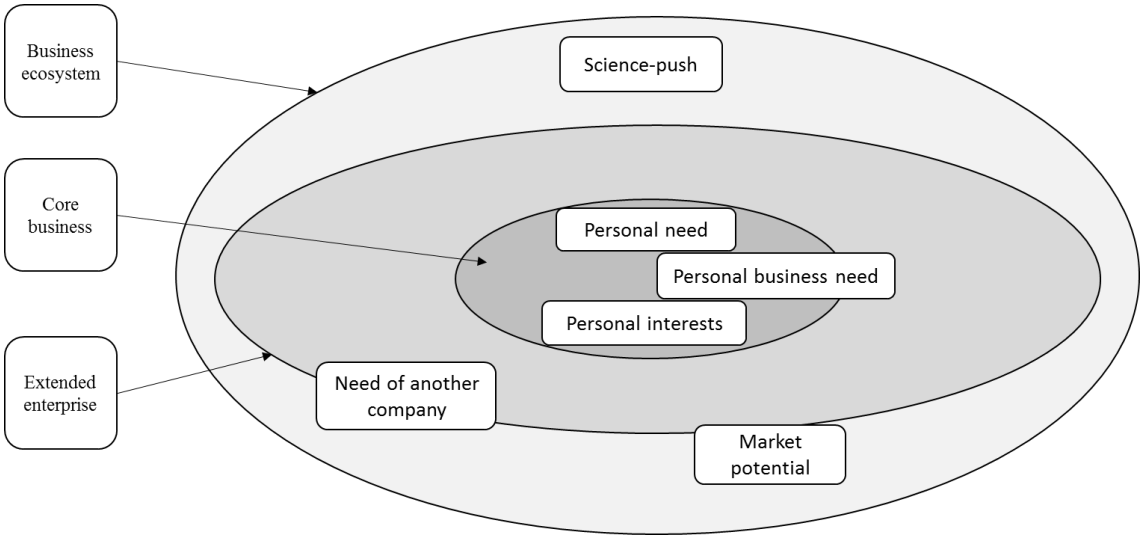

Figure 25: *Sources of opportunity in the ecosystem.*

The opportunity identification could also be interpreted in other ways. Recognizing a market opportunity or a personal need and then working towards development required varying resources. Without these resources to recognize and capitalize opportunities they would not probably have led anywhere. Therefore the experience gathered previously could be determined as the basis for finding and recognizing opportunities. This is further supported the fact that in those based on personal or business needs the technological development was present from the start by the person identifying the opportunity. Without having the resources for this the ideas may have never progressed, as it was usual for the person who identifies the opportunity to develop or lead the technological developed. Another resource particularly present was the knowledge about markets, which contributed to the identification by providing knowledge about the needs and requirements of the idea. Usually it was a combination of different resources that contributed to the discovery of an opportunity.

The discoveries can also be divided to two categories based on whether they were result of a systematic search or just happened to be noticed. Ardichvili and Cardozo (2000) and Shane (2000) both found in their studies that entrepreneurs discover opportunities by recognition instead of a purposeful search. The empirical findings in this research confirm this to some extent. In 12 out of the 21 companies the opportunity was based on identifying a personal need or market opportunity. None of these were a result of a purposeful search, and they can all be attributed to recognizing an opportunity and pursuing it. The companies that started from personal interests and fall under the resources in Figure 24 are not as straightforward. They were based on the employees having the interest and resources. They are attributed towards the recognition than search, as they are more inclined to finding opportunity to use these resources instead of systematically searching for opportunities. The three companies with the origins in scientific research can be attributed to purposeful search. These started from the search for scientific improvement and opportunities, after which potential markets have been examined.

Prior experience (Shane 2000), technical knowledge and learning abilities (Corbett, 2007) knowledge about the markets (Ardichvili and Cardozo 2000; Shane 2000) are said to enhance the recognition of entrepreneurial opportunities. The importance of prior experience is supported by this study. It could however manifest in different ways. Industry or market experience, entrepreneurial experience or experience in inventing could play a part in the recognition process, varying per case. According to Ardichvili and Cardozo (2000) this prior knowledge can exist due to work experience, personal, non-work related experience and events, or due to relevant to education related to these. The results of this study would suggest that work experience plays the most important role, while the other factors have less importance or may not be necessary at all. At least some kind of technical knowledge was present in all of the cases of the study, confirming the results of Shane (2000).

According to Shane (2000) prior ways to service markets are important in opportunity recognition, while Ardichvili and Cardozo (2000) state and it is not likely to be involved. Findings of this study would indicate that both ways can happen. In some cases this was an important factor in recognizing the opportunity, and the entrepreneurs highlighted the importance of their previous experience and their knowledge about the customer needs. In many cases however there was no experience about the markets or the ways to serve them.

A study by Ramos-Rodriguez et al. (2010) found that access to external knowledge through social networks is important in developing capacity to recognize business opportunities. Ardichvili and Cardozo (2000) also found that access the extended networks is a prerequisite of successful entrepreneurial opportunity. These did not however show up in the empirical findings of this study in relation to opportunity identification, but were more relevant when moving towards the development and commercialization.

With regards to the discussion about market-pull versus science-push, the results support the findings of Stefano et al. (2012, p. 1283) who highlighted the role of demand as a source of innovation. In this study innovations based on opportunity in figure 24 can be attributed to derive from demand, whereas science-push comes from the team. This indicates that market-pull is far more often a source of new innovative opportunities. Stefano et al. (2012, p. 1292) also concluded that resources can be a source of innovations, supported by this study as well. However their role is also present to much lesser extent in comparison to market-pull. Stefano et al. (2012, p. 1292) also discussed the interaction between technology and markets, stating and innovations originating from demand require technological competences effectively, and innovations originating from science need market related and complementary assets. This research provides further evidence for this, as market-pull opportunities were backed up by technological development after the identification of the opportunity. Also new technology itself has not been enough to generate innovation’s, but requires acquiring complementary resources and substantial efforts especially in the commercialization phase.

Like identified, there are several different ways new entrepreneurial opportunities can spawn. They be based on opportunity, resources or team, achieved via search or recognition and found close to the entrepreneur or in the wider ecosystem. The process from discovery towards commercialization has often been a time-consuming process. In some cases it has been fairly straightforward, but for some even the development phase can take years. Most companies have internationality as the goal of their business, which also makes it more challenging. The common theme in recognizing opportunities has been the background of the entrepreneurs. Consisting of a mix of different resources, the previous experience has been important in both recognizing and then pursuing the opportunities.

4.2 Team and networks

The structure of team and the company's networks were discussed with the interviewees. They were asked about their and the teams' background, key persons in the company and changes in the structure of the company. The companies in the sample have varying backgrounds when it comes to the individuals and the structure of the team. Some originate from inventor type of persons who have always developed new things. In some cases the current company operates in the same or related field as where the entrepreneurs were previously employed, but it is completely different in a few cases too.

Two of the companies are founded and still mainly run by a single entrepreneur (#3, #19). Although they have some people doing supportive tasks like production, they do not have added any external key persons to the company. Two other companies were founded by a single entrepreneur, but have since then added one or more key persons to the company (#18, #20).

The rest of the companies in the sample were founded by two or more people. In the founding phase the team consists mostly of the entrepreneurs' own network. These can be family relations (#3), neighbors (#8), friends from school (#5), colleagues from a previous firm (#9), industry connections (#17) or related to a research project (#10). The founding teams were often fairly homogenous (e.g. #14, #15, #17), but not in every case (e.g. #9). One of the interviewees mentioned that they were trying to gather complementary skills from their current network:

> *"We were looking at what we do not have and what we need more. We were looking who we have in the social circle." #5*

Nine of the companies had added key personnel to the company after founding it. They often came via investing to the company, but brought also other important assets than just finance.

> *"We only accepted those as stakeholders who would bring something to the house and had the right attitude" - #13*

However to approach investors was quite reserved in some cases. Several interviewees considered that the requirements of the investors is not in line with what they would be willing to give them, stating they require too much stake for their contribution. Some wanted to keep the core team small, between the social group:

> *"I am hoping to keep the core team quite small like it is. It is much easier like this. The kind of really trustworthy, good team." - #8*

Below are the possible ways to form teams based on the empirical results:

- Solo entrepreneur
- Relatives
- Neighbors
- Friends
- Current or old colleagues
- Connections from school
- Research project
- Industry connections
- Networks
- Pitching at events
- Scouting
- Met by chance

The key persons in the companies had varying backgrounds. While companies formed as a team were formed based on existing social networks, the background between the entrepreneurs could be either homogenous or heterogeneous. Below is a list of typical backgrounds that the entrepreneurs had according to the interviews.

- Experience in the industry
- Technical knowledge and experience
- Entrepreneurial experience in a different setting
- Entrepreneurial experience in the industry
- Entrepreneur on a different industry
- Inventor type of person
- Scientific background
- Not highly educated
- No previous experience in the industry

When expanding the team, most key persons still came through the entrepreneurs' network (e.g. #12), but also started to include completely new people too (e.g. #2) which were generally investors, which were acquired for example by pitching. New additions to the team generally had a different background compared to the existing team. They often complemented the current key persons' skills and experience e.g. in sales (#2), development (#1), international experience (#6) or legal issues (#9). Those who had started as a team and expanded it considered the team to be very valuable, and one person even considered it the most important aspect:

"The most important thing is probably the team and growing the team" - #7

Below is a list of what new key persons brought to the company:

- Finance
- Technical skills
- Sales experience
- Leads
- Connections to buyers
- Legal knowledge
- Business experience
- Support in decision-making
- Access to machinery and equipment

Most interviewees had a narrow view of the company's ecosystem. Suppliers and customers were seen important, and building relationship both ways had been important for many.

When discussing networks, few companies mentioned supplier network (#8, #9), one start up network (#1) and one discussed about the industry forums or intermediaries (#12). Several interviewees did not see that they would be part of any ecosystem, for example:

> *"We are more of an independent actor. Well, we're actually producing very little, well, we're more like creating our own ecosystem network to the world." - #16*

Although a few acknowledge the larger business environment around them:

> *"But it [ecosystem] can change, or it is living. Let's say it [the company] is not firmly there in its own place. - - we have to [be part of an ecosystem], we do not have money to produce everything ourselves" - #13*

Most companies did not have close collaboration or relationships. Interviewees mainly saw that they have transactional relationships with some specific parties, which is illustrated well by one of the answers:

> *"[There are] those partners above and below us anyway [in the chain], money flows through us in two directions." -#5*

There were some exceptions though, for example #6 highlighted the close collaboration with their supplier, which is due to them having done business before with another company.

Some interviewees stated that they do not have direct competitors, due to finding a market niche or having a superior product (#4). However it was generally acknowledged that competitors exist, but they did not seem to get much emphasis. One mentioned that although there are not similar solutions that does not mean there is no competition:

"There are always competitors. There are no similar solutions." #5

The previous seems to capture the general atmosphere. The companies saw that there is competition, but many thought that their product was very different and they did not seem to worry about the competitors or their products much. Only two companies (#3, #13) brought up the complementors to their products. Both also mentioned the importance to take them into account. One of them only acknowledged the complementors though, whereas the other said there could be potential for cooperative relationships.

There are several things that can motivate people to become form a new company. Burns and Dewhurst (1996, p.22) presented and categorized important factors relating to entrepreneurial decision. These can be found on table 18. The ones that came up as important factors in the interviews are highlighted.

Table 18: *Factors influencing on the entrepreneurial decision. (Adapted from Burns and Dewhurst 1996, p. 22)*

Antecedent influences	**Incubator organization**	Environmental factors
• Genetic factors • Family influences • Educational choices • **Previous career experience**	• Geographic location • **Nature of skills acquired** • **Contact with other potential founders** • **Motivation to stay or leave** • **Experience in small business setting**	• Economic conditions • Access to venture capital • Example of entrepreneurial action • Opportunities for consulting • Availability of personnel and support • Accessibility of customers

Based on the important factors highlighted in Table 18, factors related to the entrepreneur's skills and knowledge come up as the most important. Environmental factors were not present in the entrepreneurial decisions. Most antecedent influences did not come up, but previous career experience was highly present. The skills, experience and motivation and the contacts were important not only related to the latest employment but the ones before that too. Incubator organization in the cases may have been previous employer, university or the entrepreneurs own company. Based on the results, several frameworks are created to examine their role in more detail.

Figure 27 presents the structure of the teams at the time formation. Solo means that the operation was started by a solo entrepreneur. Champions refers to companies that have a clear lead entrepreneur. Team refers to teams that are of equal nature with no clear lead entrepreneur. Homogenous team means those that have highly similar background between the members, whereas in heterogeneous teams there is some diversity.

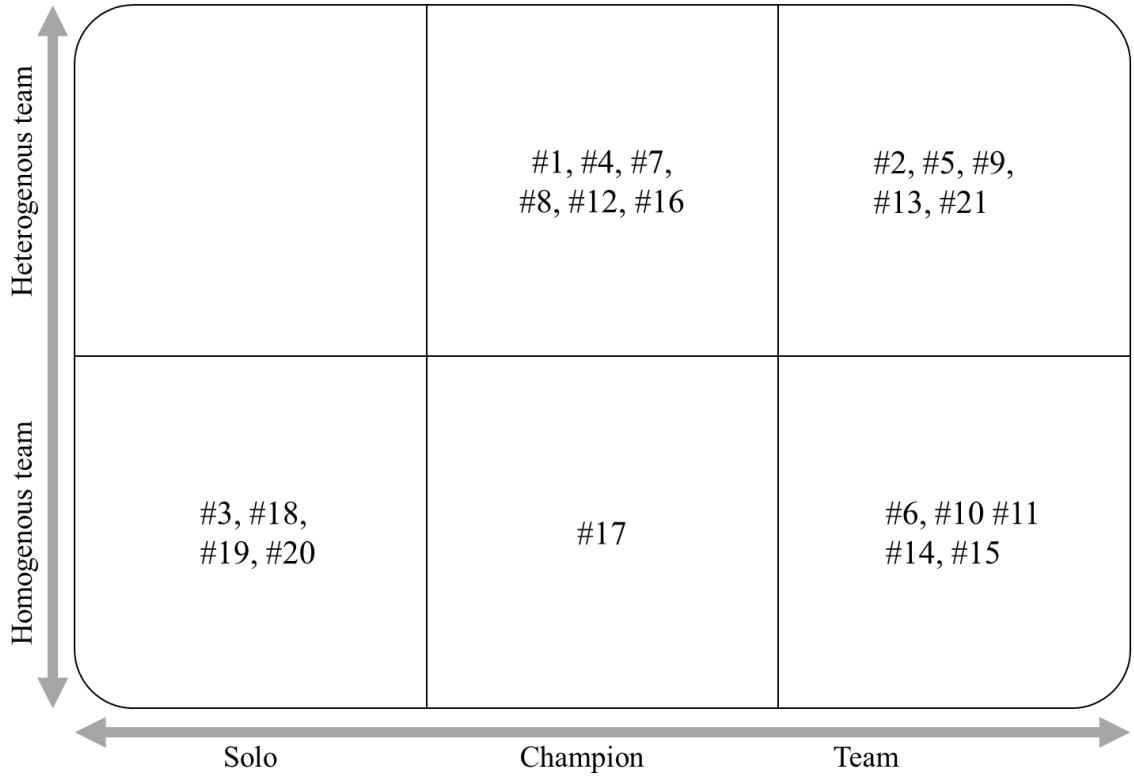

Figure 26: *The structure of the teams at the formation of the company.*

Four of the companies were founded by solo entrepreneurs, which are obviously homogenous by nature then. Those that started as team are evenly split between homogenous and heterogeneous teams, but teams with a champion tend to be heterogeneous apart from #17. Klotz et al. (2014, p. 226) claims that new ventures are usually founded by teams, which is also present in the results of this research. Furthermore this research does not find a dominant type of team within the above dimensions – homogenous or heterogeneous, team or champion. This could indicate that teams in which there is a clear entrepreneur, he or she attempts to gather a heterogeneous team to attain diverse resources. Those that started as a team then may have the team ready at the discovery of an opportunity, thus less search for members with complementary skills. Of course the structures may simply be due to the availability of certain resources, which may just happen to be either homogenous or heterogeneous.

Often the original team may change after the formation. Using the same division to solo entrepreneur, teams with champion and the rest of the teams, the changes in key persons in the team is illustrated in Figure 28.

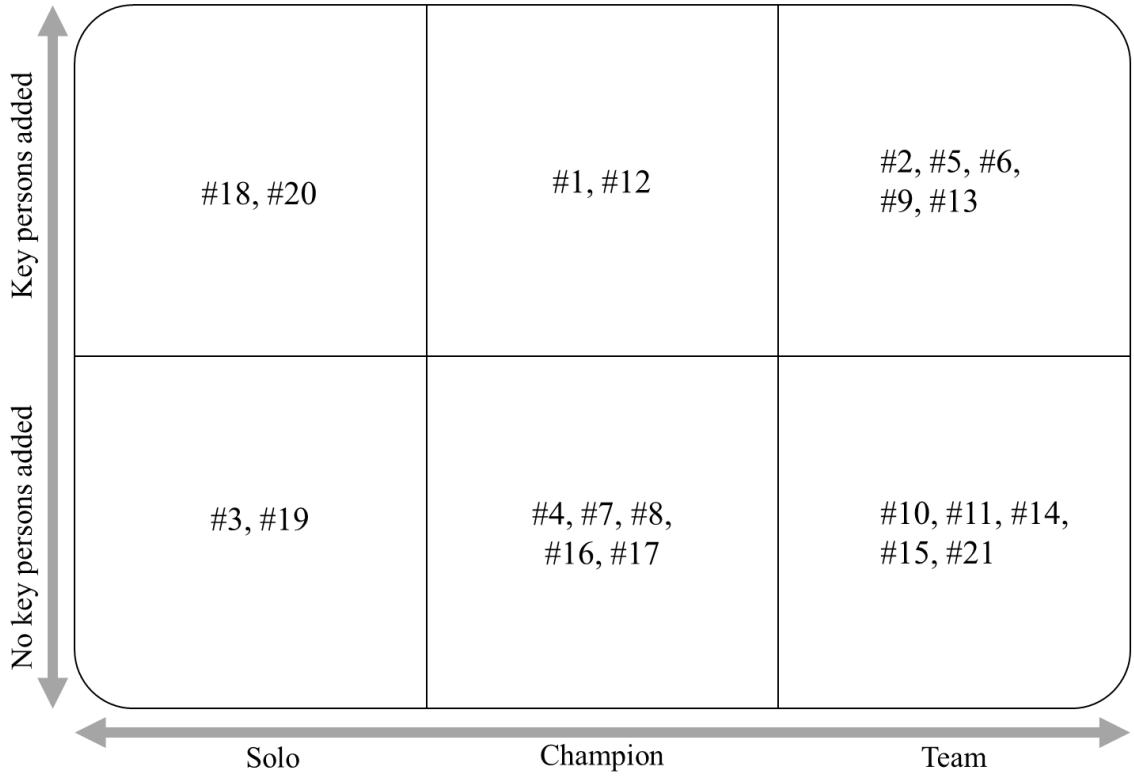

Figure 27: *The original team and possible additional members.*

Generally the results indicate somewhat even distribution between keeping the same team and adding new members. There is some difference in teams with champions however. Those teams seemed to have added less new members since the formation of the company. One possible explanation could be that the champion has already attempted to gather a team that will suit the operations of the company and there may be no need for more. The other teams may have emerged naturally and later on already had the required resources or noticed a need for complementary external skills. The research suggests that many teams attempt to gather new key persons to the team even in the early phases of the company, which is in line with the results of Vanaelst et al. (2006, p. 249) who state that teams evolve over time and can change in composition.

Figure 29 illustrates the structure of the teams in relation to how the people were found and their background. It includes the key persons and includes those that were added after the company was already founded. In many cases the founders, employees or investors already knew each other, and these are considered existing relationships. Some relationships were completely new however, e.g. investors acquired by pitching, therefore being new relationships. These are compared to the previously used categories of homogenous and heterogeneous teams.

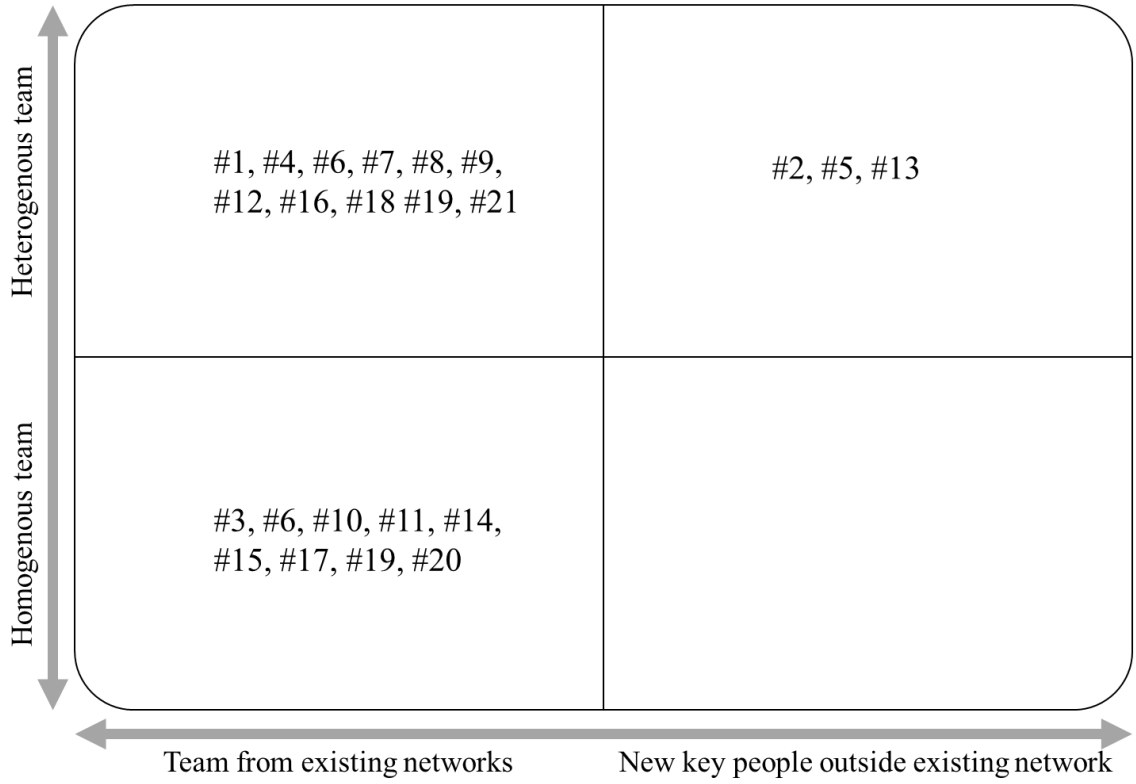

Figure 28: *Structure of the team including added people.*

The results indicate that teams mostly consist of people acquired from personal networks. The division between homogeneity and heterogeneity of the teams is somewhat close if only considering the teams formed from existing networks. People that join the teams from outside personal networks bring heterogeneity to the team, also bringing the overall number to have slightly more heterogeneous teams.

The empirical evidence suggests that many entrepreneurial teams are found though existing connections and networks. This is in line with a study by Kamm and Nurick (1993) who say that entrepreneurial teams often consist of friends, relatives or associates from former employers or educational institutions, which could all be found in this study too. Ben-Hafaiedh-Dridi (2010, p. 12) extends this by stating and a lead entrepreneur usually starts searching for members in direct or indirect network. Difficulties in forming the team or required resources then triggers a more active and impersonal research (Ben-Hafaiedh-Dridi 2010, p. 12). Similarities could be found in this research too, as the original team consisted from relationships found in the network. When specific resources were needed, people with those resources were sometimes acquired. Kamm and Nurick (1993, p .21) say that especially capital industry and financing bring new partners. This statement is supported by the study, as most people that came outside the network were people who invested in it.

Intuitively it would be logical that heterogeneity is the preferred structure for the team and leads into better performance and growth. However there has been contradictory evidence on the subject about the impact of this, Steffens et al. (2012, p. 727) finding homogenous teams perform better in the long run, while Ensley et al. (1998, p. 9) actually finding that heterogeneous teams have negative impact negative on growth. The structures of the teams may be due to several reasons. The simplest explanation is the availability of suitable key persons. Most new key persons come from existing networks, so the homogeneity or heterogeneity of the team may be just random based on who is available. In some cases it may be that the technological development or running the particular business requires extensive knowledge within the particular field, which may lead into gathering people with similar skills. Diverse tasks new to the entrepreneurs would then in turn lead into gathering complementary capabilities leading into a heterogeneous team. It should also be noted that many of the companies are still in their early phases, and some of them may have not anticipated all the future needs or gathered all the human resources they will require.

For adding new teammates, Forbes et al. (2006) found resources and interpersonal attraction as primary motives. While interpersonal attraction did not directly come up as a motive, due to most team members coming from social networks it can be concluded to play a part. Resources were widely emphasized as a reason for new teammates. These would come in the form of founders, shareholders or regular employees. The most important resources brought were capital, experience, and knowledge. Experience and knowledge was especially related to commercialization, e.g. sales and internationality, but could come in other forms too. Similar to the findings of Vanaelst et al. (2006, p. 267), different kinds of experience was usually brought to the company within new key persons. Emphasis on recruiting people with commercial experience was also identified by Vanaelst et al. (2006, p. 267) who found that commercial background is appreciated for new recruits.

Figure 30 considers the industry experience of the teams. In this case it is divided to two aspects industry knowledge and market knowledge. Market knowledge refers to knowledge about the markets related to the products, e.g. competitors or customer requirements. Industry knowledge refers more to the technical attributes behind the products, for example working in a related field in a university would grant this kind of knowledge but not necessarily market knowledge.

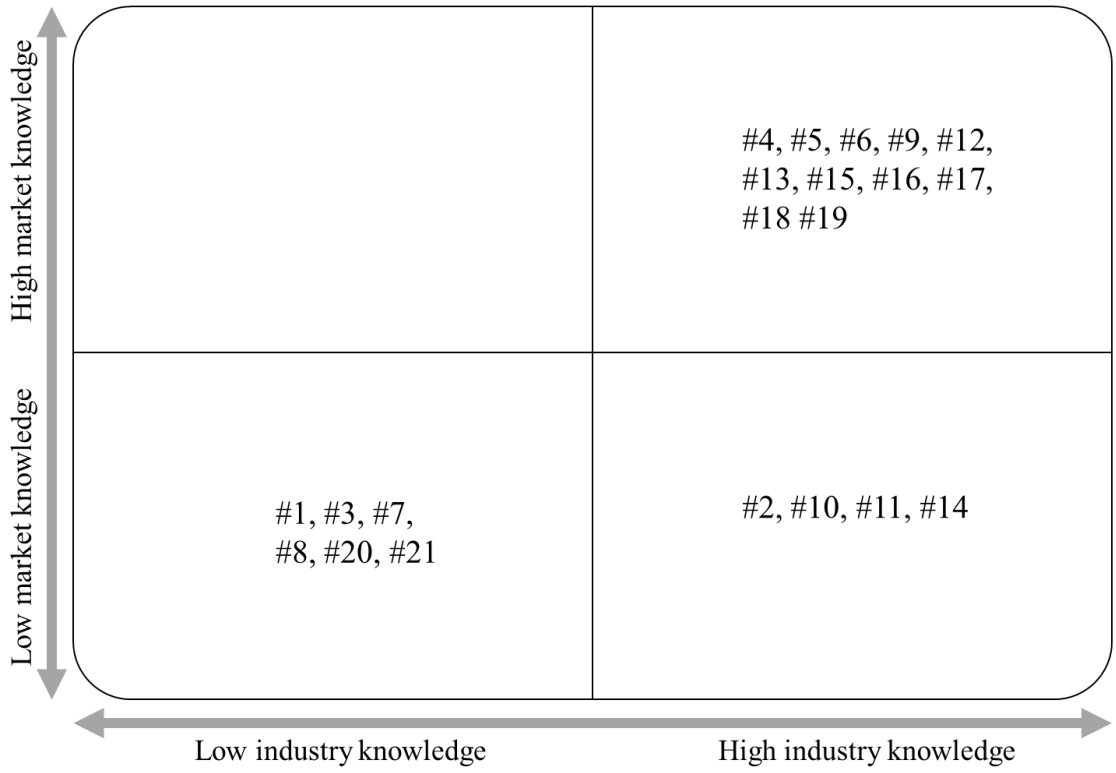

Figure 29: *Industry and market knowledge in the entrepreneurial teams.*

In most cases, 15 out of 21 (71%), there is relevant industry knowledge present, which is due to previous work experience in the industry. Market knowledge is present in about half the companies. The difference comes mostly from those that derive from research, where technical knowledge is present but market aspects necessarily not. Cooper and Park (2008, p. 45) claim that incubator organizations have an important role in shaping the entrepreneurs' technical and commercial knowledge. They also say that most new entrepreneurial high-tech ventures are established in a sector similar to in which founders have been previously employed. These aspects were present in most cases in this research too, which was usually manifested as knowledge about the markets and industry. There were also some cases where this was present mostly as technological knowledge without the presence of market knowledge, which may indicate previous technical knowledge is more important out of the two aspects.

Education and previous entrepreneurial experience are presented in Figure 31. Ten out of 21 companies had previous entrepreneurial experience, meaning they had been entrepreneurs before. This was not necessarily in the same field, which can be concluded by comparing the results with Figure 31. High education refers to university or polytechnic level, and does not need to be in a related field.

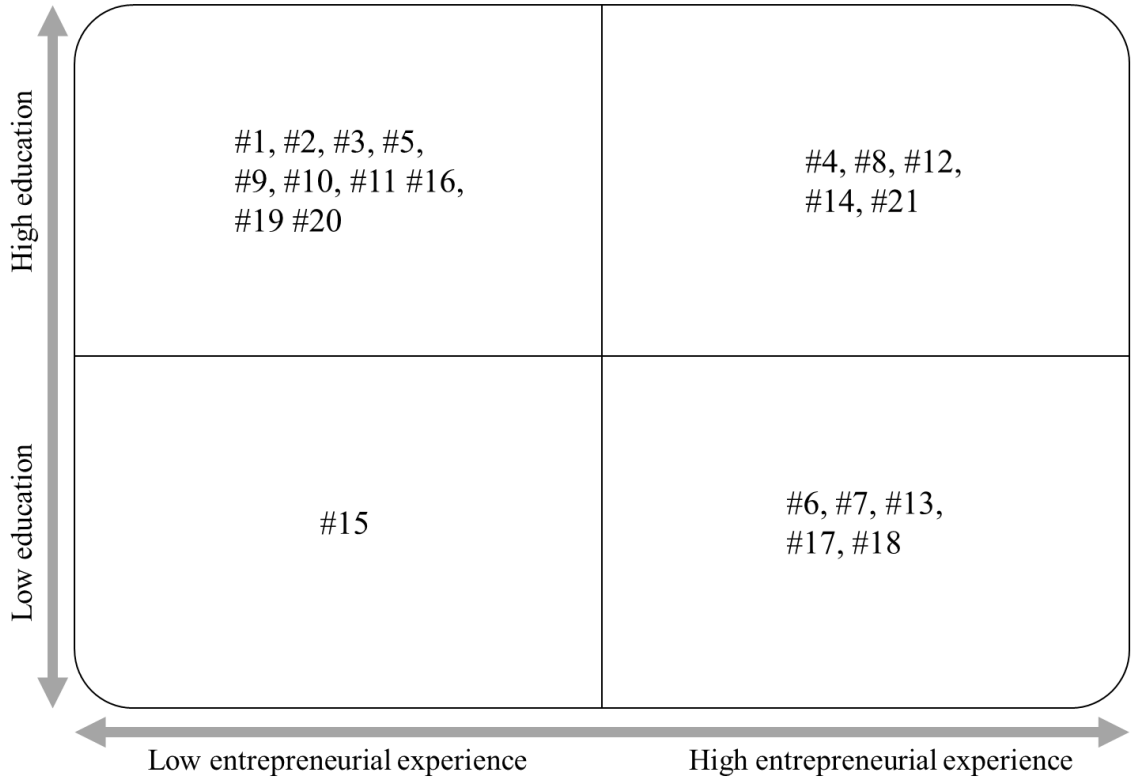

Figure 30: *Entrepreneurial experience and education in the case companies.*

The results indicate that previous entrepreneurial experience can contribute to the creation of a new company. In slightly less than half the companies there is significant entrepreneurial experience present, which is proportionally a high number. The evidence also suggests that most companies are formed by people with high education rather than low. This could be due to the nature of knowledge required in relation to technology or running a business. Stuart and Abetti (1990, p. 151) have claimed that number of the amount of previous new venture involvements and the role played on those is a significant factor in early performance. This research provides evidence that previous entrepreneurial experience may not only be important for growth, but also to the recognition and the choice to pursue the opportunities.

Vyakarnam et al. (1999) found that leadership, ability to build and manage relationships, and shared vision are important for effectiveness of the team. These were not highlighted in the empirical evidence, which was more focused on the resource aspects.

The evidence suggests there are similar elements in the composition of teams. Industry, market and entrepreneurial, education and social networks can all play a part when forming entrepreneurial teams, and the combination of this can vary. There are differences on how the experience related to these elements is gathered. It may come from previously working for another company, being an entrepreneur, research related to the topic or from interest towards inventing. All teams are characterized by motivation towards entrepre-

neurship. New key persons being acquired from personal networks may result from different reasons. The entrepreneurs' may prefer people who they can trust and whose abilities they know better. It may also be easier to get people they already know. Some may have actually preferred acquiring other people with specific skills, but do not know a convenient way of doing this. The lack of building a proper team could be one of the reasons all the innovations have not yet succeeded on a larger scale. Acquiring people based on networks may also result in unintended homogeneity or heterogeneity – if teams are formed on the basis of who is available in current personal networks, the optimal solution may not be available.

Based on the empirical evidence, Figure 32 illustrated the ecosystem where the companies operate. The thicker the line is the more important the relationships are. The role of suppliers and customers was the most important according to the evidence.

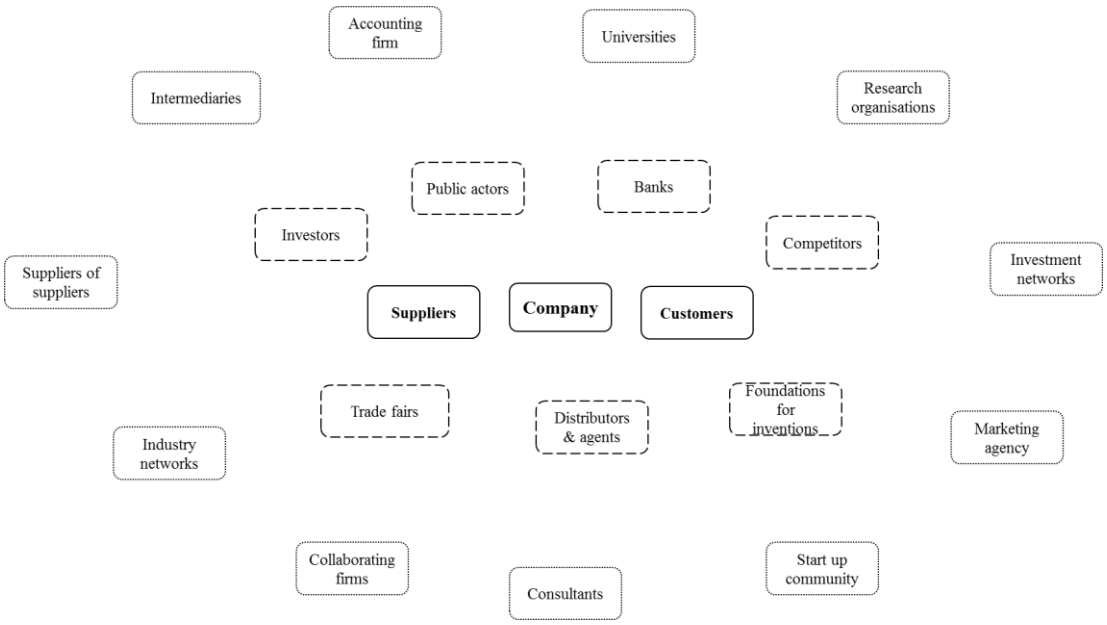

Figure 31: *Actors companies considered to be part in their ecosystem.*

Even though many actors can be identified in Figure 32, most actors did not come up regularly. Actors in the most outer sphere were only mentioned a couple of times. Also the role of the actors in the second sphere was not consistently considered important. The role of suppliers and customers were highlighted, many mentioning them as the most important. Wickham (2004) presents a framework of stakeholders in entrepreneurial venture, which illustrates the findings of this research well. Including the entrepreneur stockholders, lenders, suppliers, customers, local community and government, the framework in figure 33 presents the most present actors identified in this research too.

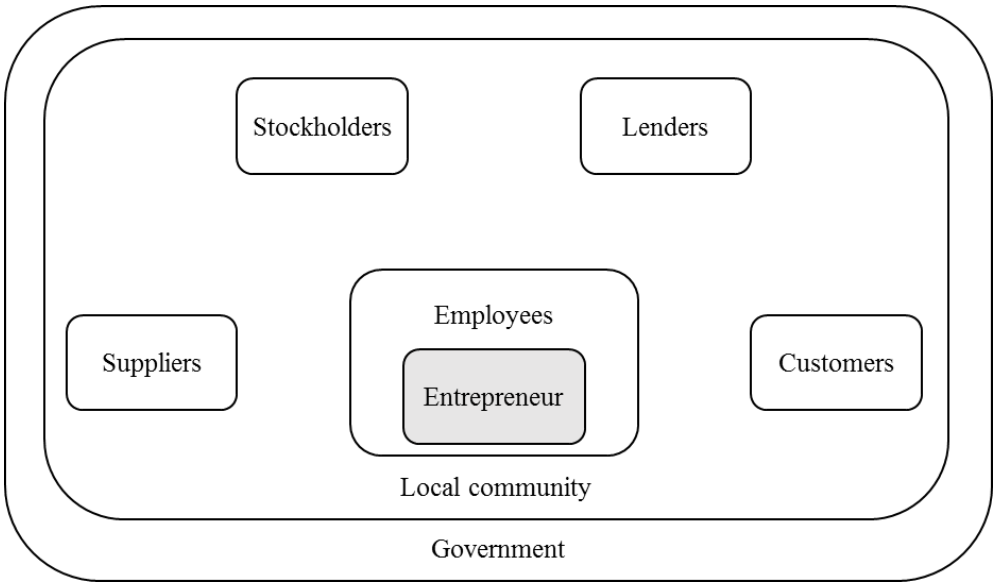

Figure 32: *Stakeholders in entrepreneurial venture (Adapted from Wickham 2004, p. 194)*

Adner and Kapoor (2010, p. 307) emphasize that innovation performance is not only about the company, but also about the challenges the external environment face. This view did not however come up in the interviews. The companies mainly saw things from their perspective and not considering the challenges and others may face in the ecosystem, with few exceptions. Adner (2006, p. 3) also brings up the risks related to complementary innovations and the adoption process across the value chain. Again, this view was not brought up by the companies. All innovations do not necessarily require other innovations, but even the role of complementary products was rarely brought up. The companies usually considered suppliers and customers as their main relationships, indicating a fairly narrow view of the supply chain.

According to a study by Eggers et al (2014, p. 1389), small and medium sized firms access extensive or specialized knowledge though networks. This networking view was not shared by the companies however. Instead of considering to have networks, they mainly considered to have separate partners or even just transactional relationships. The network aspect was discussed a few times, but then mainly focusing on supplier network, contrary to the study by Eggers et al. (2014, p. 1389) where it was suggested industry networks to support marketing and product development is a viable path for radical innovation.

Most companies focus mainly on their own operations. It is rare to consider the role of complementors or wider ecosystem, or at least consider it critical for own operations. The view was narrow focusing mainly on suppliers and customers, but their importance was usually seen crucial. Again there may be few different reasons for this. The companies may not be aware of the other actors or the risks and benefits they may bring. Complementors may also be considered not important considering the efforts. One reason could also be similar to why teams may consist of people in personal networks. The companies

may not know how to consider the other actors or build collaboration with them or they are not easily accessible.

4.3 Resources

Resources sparked the most discussion in relation to themes chosen for the interviews. The companies were asked what kind of resources had been required in order to develop the company and reach the current situation. The process to commercialize the innovation, resources required and the ways to attain them were also discussed.

Finance was clearly the most critical resources according to the interviewees. Many of them had and some still have challenges with acquiring enough finance to continue their work. It was also seen to have slowed down the development of the organization in several cases. The need for external finance as the most important resource was emphasized by several interviewees. External finance was acquired from public organizations, investors or banks. These would come in the form of financial support, loan or buying equity in the company.

The views about public financial support and investors were mixed amongst the interviewees. While public support was seen useful and in most cases there was a need for more, there are many things that the interviewees considered that could be better. Many complained about the bureaucratic nature of the whole process (e.g. #18), saying it takes too much effort compared to what you can get (#4). The support mechanisms also were not always seen to consider the needs of the firms (#13). There were also critic towards how the market research is conducted (#14), the requirement to use consultants (#1), the fact that you cannot use the support for sales activities (#5), that you need to have the money yourself first (#4), the lack of small sums of financial support (#7) and the lack of knowledge about the support mechanisms (#19).

> *" - - You have to hire some consults to do market surveys, market research. You cannot sell. - - You can do all kinds of market research but in our industry at least you can best figure it out by going to the markets and starting to sell" - #14*

Despite the critique some firms did not have any complaints towards the support mechanisms. Even those to felt that they needed improvement mainly considered the support they have useful.

> *"- - let's say that we would not be here if we had started researching this thing without any financing, we would not have had enough resources." -#1*

Investors also got mixed opinions amongst the interviewees. While one actively pitched for investors (#2), one actually preferred avoid any investors if possible (#8). Many companies would like investors as a source of finance, but also considered that they require

too much of the company compared to what they contribute. In several cases investors were important not only for the financing the other resources they brought. These were for example structured board meetings (#5), legal knowledge (#8), sparring and leads (#2) and sales and international experience (#7).

The opinion on protecting intellectual property also varied significantly. While most companies had either one or more patents and a registered design, it was not considered important in many the cases. Nevertheless some interviewees considered intellectual property as a core resource (e.g. #2, #13, #18), two emphasizing and they have to patent the ideas before discussing them with anyone. #17 also considered patents the most important resource.

> *" - - I aim to patent everything - - so that you can present and consider the idea with other inventors and people knowledgeable about the subject." -#18*

There were several reasons why patents were not considered that important, and there was criticism also amongst those who considered it a core resource. Some thought they cost too much (#13, #19), some mentioned that they would not have resources to protect them in case of a violation (#2, #), and few considered quality and brand to be best defense mechanisms (#3 #8, #19). Some of those who considered patents as highly useful still pointed out that they cost too much and the company could not probably do anything in a dispute.

> *"- - patents are not the thing, but to create a good product, doing it in a competitive way - -" #4*

> *"- - even if it [patent] would be approved everywhere we would not necessarily have the muscle to start fighting with the issue." - #2*

Especially marketing-related themes emerged in the interviews. Some public support mechanisms were also criticized for not allowing any selling with the gained money, and more support mechanisms was hoped for the marketing phase. Many of the new people the companies acquired had background in sales and marketing, some of them especially in international trade (e.g. #2, #5, #6). These people were usually considered key people for the company. Raising awareness (e.g. #9), building prototypes (e.g. #8) and visiting customers (e.g. #2, #9) were mentioned as important activities in marketing.

> *"- - there should be more support for these kind of commercial efforts - - it is the biggest thing and you should be able to put the most effort in that so you can actually sell things." -#5*

Many interviewees discussed about the physical resources of the company. Especially suppliers were considered important, and the role of materials, components and subcon-

tracting were critical for many. Some companies even had problems in this area, #1 mentioning having problems to procure materials with reasonable price while #13 and #17 had problems finding suppliers who could actually produce their components that had high criteria for quality.

The need for machinery and equipment was also mentioned a few times. Some entrepreneur's had other companies and could utilize their own machinery (#6, #18). For some companies the early financial support went at least partly to building infrastructure for the company (e.g. #5, #9). A few accessed the necessary equipment though their networks (#2, #8), as one of the interviewees mentioned:

> *"I have been lucky to have a brother with these 3d printers - - if you think about a guy who does not have a brother with a 3d printer or CNC machine, what can he do?" -#8*

None of the companies mentioned external assistance in technological development as a critical resource. Few interviewees mentioned that they had collaboration with other parties, e.g. with other companies (#18), suppliers (#3) or in a workshop (#8). However they did not mention at least that these would have played a major role in the development. Also the lack of technological knowledge during the development did not come up as a restricting resource. One interviewee stated that technological knowledge is actually their strength:

> *"To me designing for example has never been a problem. [It is] My greatest strength. I can independently execute designing and production" #19*

Few interviewees (#14, #18) mentioned testing and validation with universities or public research organizations important. This was so because of the certificates provided by the actor, which was seen crucial when selling the product to customers. In both of these cases they wished to do more of testing in the actual development phase, #14 hoping for more affordable services and #18 wishing to have the machinery themselves. Below is a list of resource needs that came up in the interviews:

- Finance
- Market knowledge
- Sales experience
- Technical knowledge
- Research
- Industry experience
- Patents
- Business and entrepreneurial experience
- Legal knowledge
- Distributors
- Knowledge about suppliers

- Materials, components, products
- Machinery, equipment
- Location
- Accounting
- Testing and validation
- Infrastructure

The importance of these resources was of course varying. The important internal and external resources that the companies either have or would require are presented in Figure 34. It is important to note that several companies have acquired external people to gain these resources, especially related to marketing and sales. The size of the letters illustrates the importance of a specific resource.

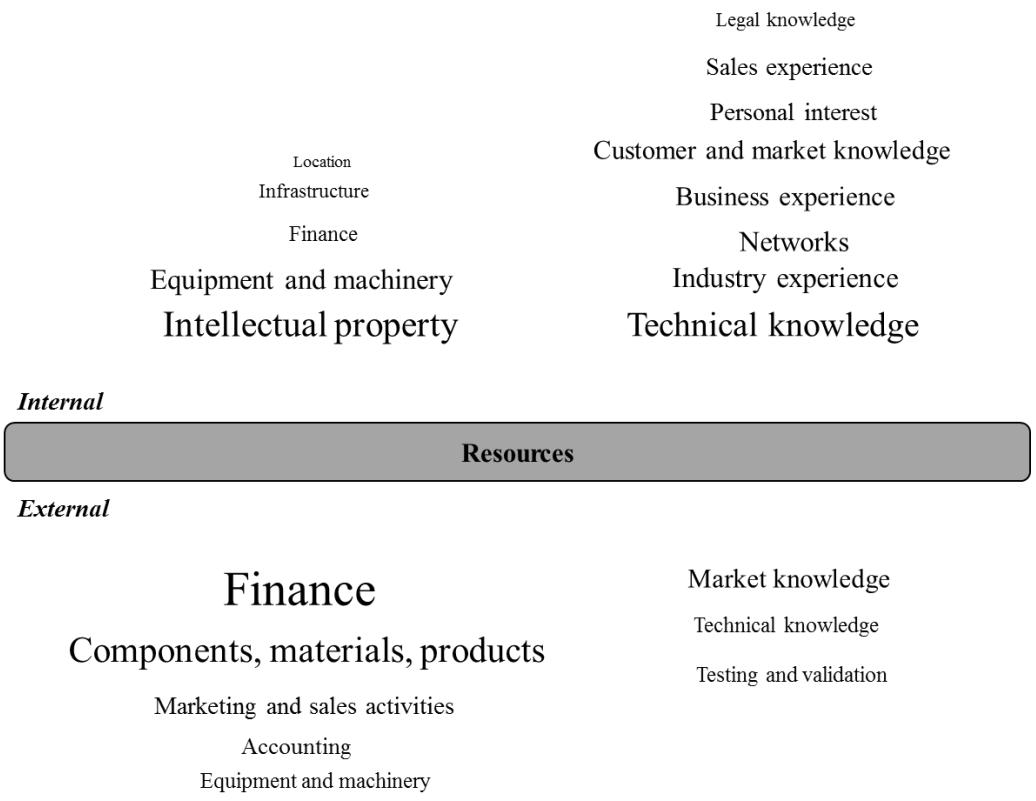

Figure 33: *Important internal and external resources of the companies.*

As mentioned, most firms brought up the importance and lack of finance. Figure 35 shows the source of growth for the case companies, referring to how the companies have grown or how they are aiming to grow. Internal finance means using the company's own cash and assets to grow. External finance means the companies require or want to grow with capital acquired outside the company, for example venture capital or public support. The figure shows that the growth of most companies is based on external finance.

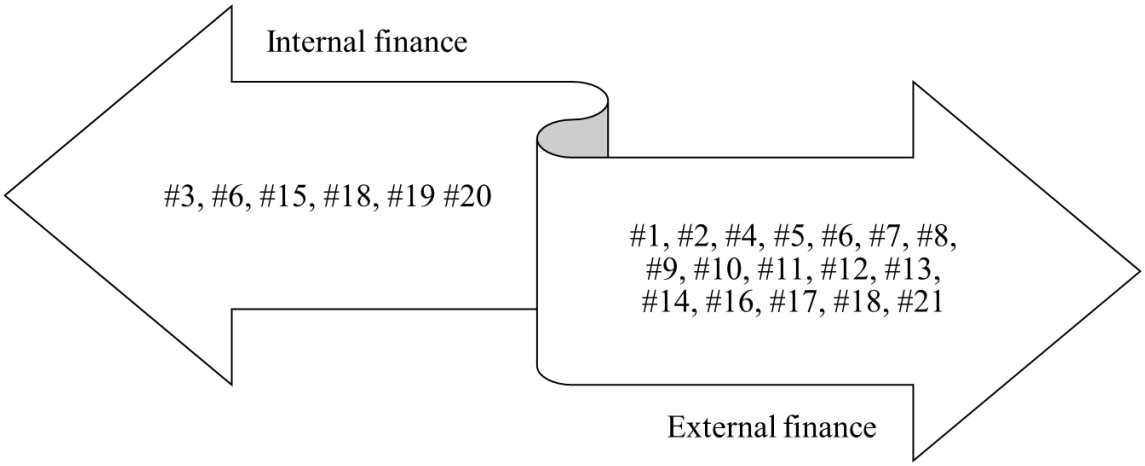

Figure 34: *Source of finance for the companies.*

Based on the empirical evidence, the external resource requirements of the companies can be divided into five categories: finance, manufacturing, marketing, technology and other. These are presented in figure 36, describing what they include or what they would be needed for. The most important ones are bolded.

Finance	Manufacturing	Marketing and sales	Technology	Other
• **Public support** • **Venture capital** • **Loan**	• **Materials** • **Components** • **Complete products** • Supplier information • Machinery • Equipment • Infrastructure • Work force	• **Know-how** • **Building awareness** • **Customer and market information** • References • Prototypes • Customer visits • Connections • Marketing material • International connections • Branding • Sales people • Distributors	• Research knowledge • Test results • Certificates	• **Less bureaucracy in support mechanisms** • Accounting • Legal knowledge • Patents • Information about support mechanisms • Infrastructure

Figure 35: *The external resource requirements and usage of the interviewed companies.*

Out of this finance was the most emphasized, most companies having challenges with. There were several areas that were mentioned with regards to requiring finance, most emphasis on development and marketing activities. Other ones mentioned were infrastructure, machinery and equipment, patents and salaries.

Figure 37 presents typical important resources required in the process of commercializing innovations based on the research. Under each resource the figure also mentions sources where or how the case companies have typically acquired them.

Discovery	Development	Commercialization
Market knowledge - Previous experience	Finance - Public support - Investors - Banks - Self-finance	Finance - Public support - Investors - Banks - Cash flow - Self-finance
Technical knowledge and development - Previous experience - New research	Market information - New employees - Investors - Previous experience	Market know-how - New employees - Investors - Previous experience - Market research - Consulting
	Machinery and equipment - Own company - Personal networks	Awareness - References - Trade fairs - Customer visits - Pitching
	Materials - Suppliers - Supplier knowledge - Supplier networks	Testing and validation - Universities - Research organizations
	Technical knowledge - Previous experience - Scientific research - New employees	
	Legal resources - Patents - New employees - Consulting	

Figure 36: *An example of the required resources and the ways to attain during the process based on the evidence.*

The empirical findings are in line with the results of funding being the main concern of as studied by Inkinen and Suorsa (2010) in high-tech enterprises, Demirbas, Hussain and Matlay (2011) in SMEs, Madrid-Guijarro et al. (2009) in manufacturing SMEs and Bartlett and Bukvić in small firms. The access to information on government programs and services was not seen as an issue, opposite to what Lorrain and Laferté (2006) found. Lorrain and Laferté also found that entrepreneurs need specific advice in some areas, e.g. marketing, management, production or accounting which can be confirmed based on this study, and the needs can vary a lot per company.

Demirbas et al. (2011) also found skill shortages as barrier to innovation. The empirical evidence of this research suggests that these are related to the later phases of the process when marketing plays an important part. The companies had often recruited new people or acquired investors to help with these challenges if they did not have the capabilities themselves. On the technological side however they generally did not mention lack of technological capabilities as a concern.

Many firms saw finance the most important thing in development and marketing phase, putting less emphasis on acquiring external capabilities in comparison. This would indicate they would rather improve internal competences, which would support the evidence of Freel's (2002b) study. He also found that lack of trust and inability to find suitable partners was a barrier to collaboration. This is supported by the evidence to some extent as those reasons were mentioned a few times in the interviews, mainly related to the supplier side.

Heydebreck et al. (2000) identified four need bundles for new technology-based firms, which are marketing, technology, financing and soft service. The role of financing and marketing also had major roles in this study, however it was more concerned about direct finance, instead of mediation of contacts to financiers which Heydebreck et al. (2000) involve in the category. They also included search for suppliers under marketing, which makes the results a bit more similar. Unlike in their study, technology-related aspects such as technology consultancy and search for R&D partners did not come up as an important need. Same can be said about the need for soft services such as seminars, information events and mentoring, which were only mentioned few times.

The need for finance and the companies' own technological capabilities were most present amongst the case companies. The companies generally require external finance in order to grow and be able to fully commercialize the innovations. Technological knowledge usually needs to be complemented with marketing and sales capabilities ones the company progresses. Although the resources required are similar, there are some differences in how the companies have been able to acquire them. Some had the required resources ready and had achieved them relatively easy via public support mechanism, investors or by recruiting new employees. However some were still struggling with this. Those who left a previous company had generally less need for external resources.

The approach towards manufacturing and intellectual property was mixed. Although many companies aim at completely outsourcing the production and focusing on core competencies, there were some who preferred to do it themselves and even saw it was an advantage. Patents and other protection mechanisms were seen very important by some, but on the other hand in some cases considered waste of money. The need for external finance was prevalent, but the uses of it had some variance. For some it was important for the development phase and building the infrastructure, whereas in many cases it was required for marketing and sales.

The lack of finance could be due to lack of available finance mechanisms, but also due to limited knowledge about the possibilities. The evidence would point towards to former option, as most discussed the support mechanisms, potential investors and difficulty to get loans, but they may also have higher requirements than what is available. Most firms require external finance and are looking for substantial growth for the company, instead

of slowly building based on the incoming cash flow. Other resources were not as important as finance, and one reason for this may be the lack of it, which then dominates the focus and leaves other ones to the background. Finance was also seen as the main way to achieve the other required resources, instead of for example collaboration or other means, thus even further increasing its importance.

4.4 Radicalness

The interviewees were also asked about the radicalness of their innovations and the potential impacts they may have on the markets. The interviewees had varying approaches when discussing the radicalness of the innovations. Some pointed out to the effectiveness or efficiency of the product (e.g. #5, #6, #18) and talked about how it can do tasks that were not possible in that way before, or doing the same task with less effort.

> *"It is radical in the sense that more power can be created with less energy"*
> *- #5*

Few interviewees talked about the market aspects. They talked about how there are similar products in the market, stating that there is big potential for their product (#1, #3, #4). Many interviewees brought up the dimension of technological radicalness. This usually discussed whether it was a new technology that was developed, or a combination of existing ones.

In most cases the interviewees discussed more than one dimension of the radicalness. They may have commended on both the radicalness of the technology and market aspects. Most interviewees considered their innovation radical in at least one of the dimensions.

Like identified in the literature review, the radicalness of an innovation can be examined in several different ways. Most definitions discussed the technological newness, although market and company-related aspects were also present. The framework by Tidd and Bessant (2009, p. 230) in figure 38 considers the technological and market dimensions of the innovations. Scoring low on both dimensions means differentiation and competing on quality and features. High novelty of markets but low novelty of technology means architectural innovation where existing technologies are combined in a novel way. New technology to current markets is about new solutions to existing problems. If the novelty of both dimensions is high, it means complexity and co-evolving with the market and technology. (Tidd and Bessant 2009, p. 230)

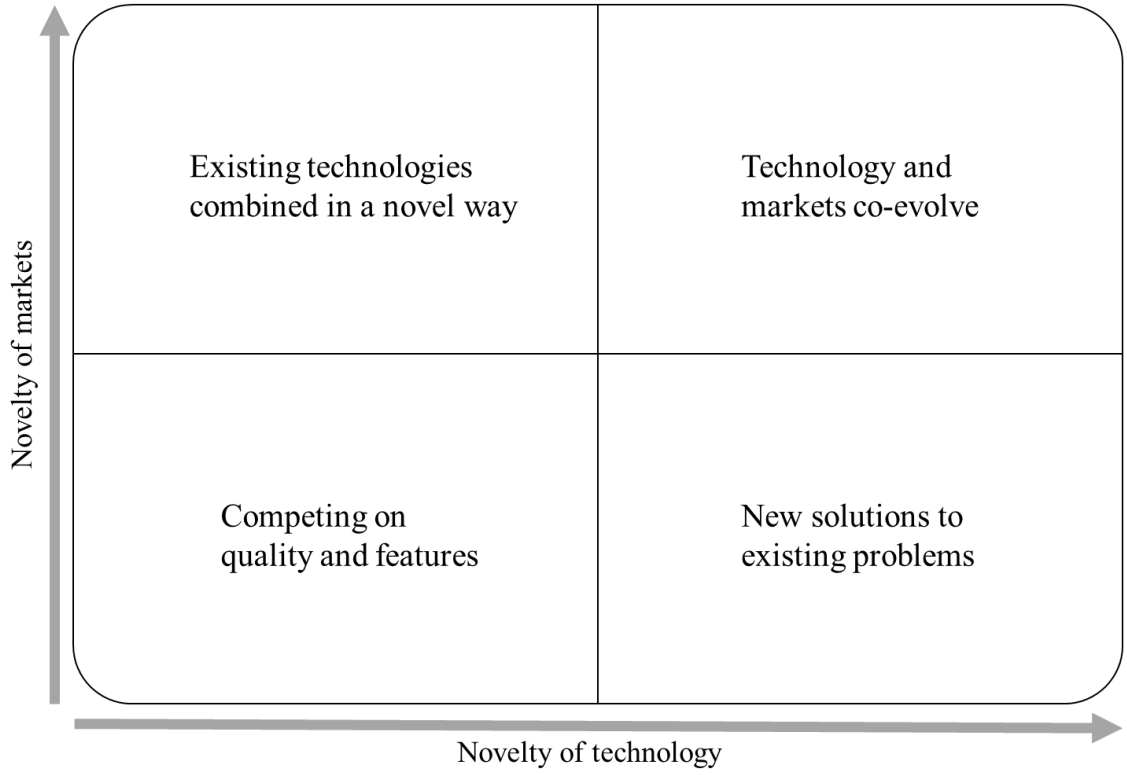

Figure 37: *Novelty of technology and markets (Tidd and Bessant 2009, p. 230)*

The case companies are placed on the framework in figure 39. The novelty of technology is assessed on whether it is mostly based on existing technology. Low novelty means it is based on existing technology that does not provide substantial improvement in performance. High novelty on the other hand can provide substantial performance improvements or enable doing things in a new way that was not possible beforehand. The novelty of markets was a bit more challenging to evaluate. In this case low novelty of markets refers to markets that are considered ready. This means e.g. that the product can replace a current product in the market by providing substantial performance improvements. High novelty means that there are no existing similar products. The product is not an alternative to existing products, but requires or can lead into more changes in the current markets. In this case existing problems are solved in a different manner compared to current solutions. Four of the innovations can be categorized into high novelty of both technology and markets. In these cases activities related to building markets such as market testing and market education was still present in the companies. Ten innovations were technologically new, whereas seven are categorized to low novelty of technology. The ones with high technological novelty either provided substantial improvement in performance, or the technology enables doing things in a different manner.

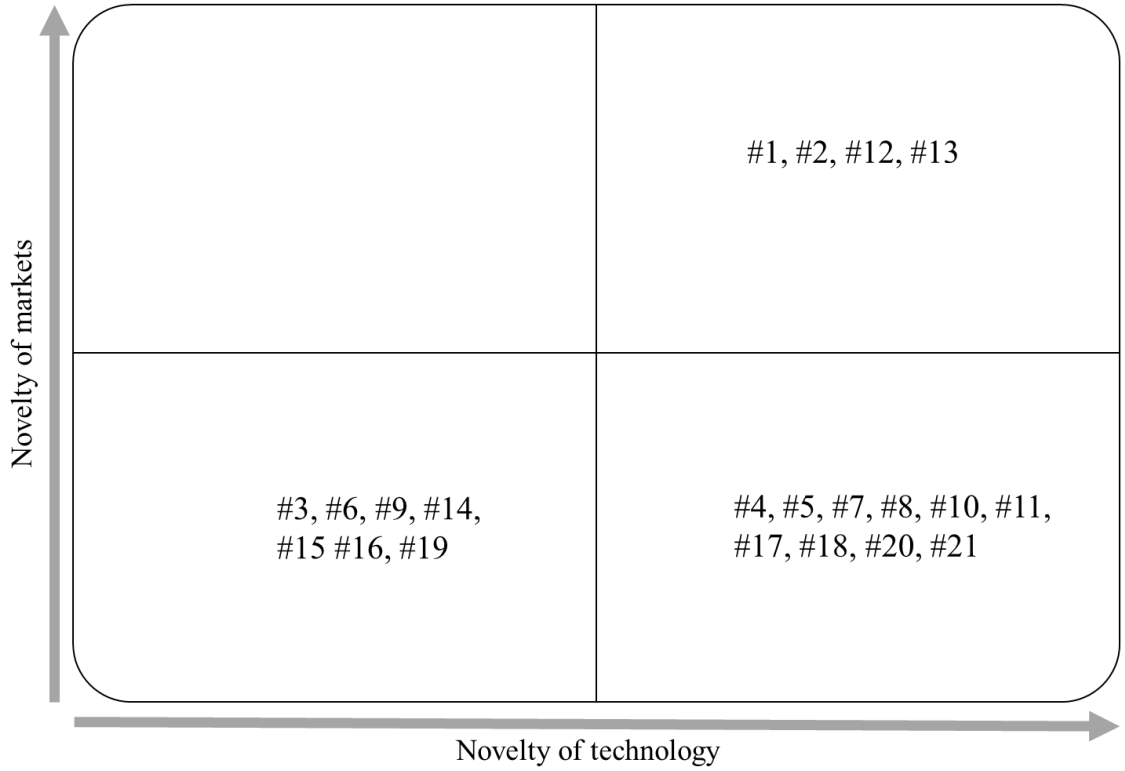

Figure 38: *Novelty of the technology and markets in the case companies.*

The radicalness of the innovations is illustrated in Figure 40. Radicalness is always a subjective view and in this case the radicalness was defined as the technology and market aspects are defined above. Instead of defining innovations strictly as incremental or radical, a third category of semi-radical innovations is presented. This helps categorize those innovations better that have both incremental and radical elements and would been more difficult to define otherwise. The innovations are divided into three categories: incremental, semi-radical and radical innovations. The innovations are categorized based on the newness of technology and markets, as defined on the framework in Figure 38. Radical innovations are those with high novelty in both dimensions. Semi-radical innovations bring new technology to current markets. Incremental innovations are those that do not have substantial elements of newness in either of the dimensions.

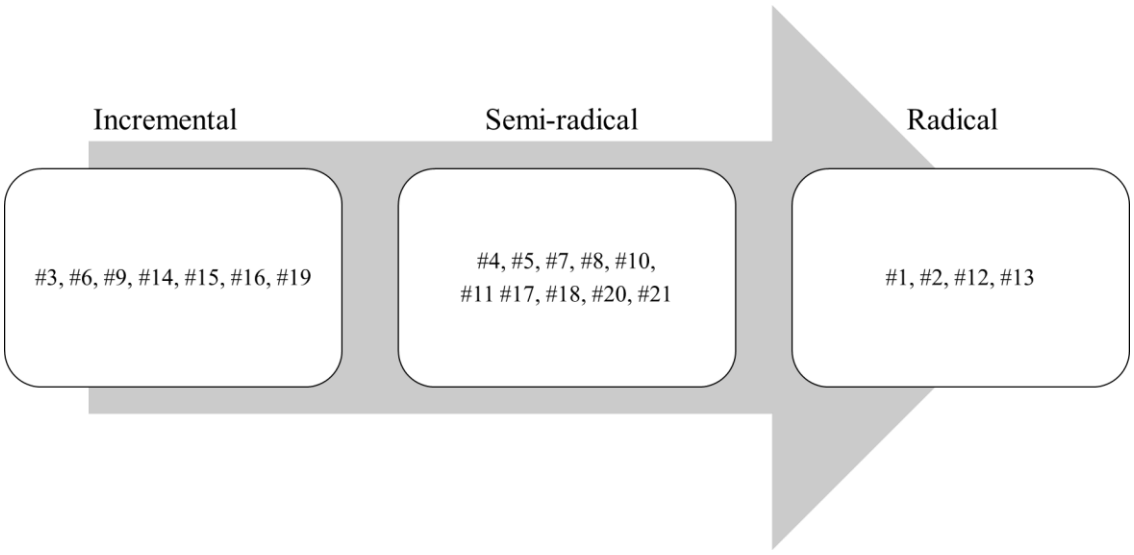

Figure 39: *Radicalness of the examined innovations.*

With the definition above, four of the innovations are categorized radical. Ten innovations fall in the semi-radical category, whereas seven are incremental. This means in 14 innovations the technology is substantially new, and in four the markets are substantially new. The small amount of radical innovations is in line with the results of Forsman (2011, p. 746) who focused on small Finnish enterprises and found that most of them do not develop radical innovations.

4.5 Connecting the Themes

As mentioned in Timmons model, entrepreneurial venture requires the balancing between the opportunity, team and resources. This interdependence was already seen when discussing the individual dimensions, as for example opportunity recognition is influenced by the entrepreneurs experience and resources. This chapter attempts to connect the opportunity, team, resources and the radicalness of the innovation in order to find similarities and between the innovations and these dimensions. Firstly the relationships between opportunity, team, resources and radicalness are examined in order to find out possible similarities or differences. After this the results are connected to the themes of the literature review. Table 19 has an overall summary of the relationships between opportunity, team, resources and radicalness. However a more in-depth discussion is required to find the similarities and differences behind them.

Table 19: *Summary of the connection between radicalness and opportunity, team and resources.*

	Opportunity	**Team**	**Resources**
Radical (4 cases)	• Science-push (1 case), business need (2) or market opportunity (1)	• At start: heterogeneous team (2) or heterogeneous team with champion (2) • Later: key persons added in all cases	• Industry knowledge (3), market knowledge (2) • Entrepreneurial experience (2), education (3)
Semi-radical (10 cases)	• Personal need (3), business need (4), science-push (2) or market opportunity (1)	• At start: heterogeneous team (2), homogenous team (2), heterogeneous team with champion (3), homogenous team with champion (1), solo (2) • Later: key persons added in 3 out 10 cases	• Industry knowledge (6), market knowledge (4) • Entrepreneurial experience (6), education (7)
Incremental (7 cases)	• Resources (4) or market opportunity (3)	• At start: heterogeneous team (1), homogenous team (3), heterogeneous team with champion (1), solo (2) • In 4 cases team from a previous company • Later: key persons added in 2 out of 7 cases	• Industry knowledge (6), market knowledge (5) • Entrepreneurial experience (2), education (5)

The origin of opportunity was divided into five different categories earlier. Science-push opportunities are based on new scientific knowledge, but it is not alone enough to create a radical innovation. Those based on personal need were characterized by inventor attitude, motivation and technical knowledge. Previous experience in the industry was not always present. They usually had some of the resources themselves and then attained complementary resources through their personal networks. Those innovations based on market potential were a similar case, although industry experience was more present, providing resources and relevant industry connections. Opportunities based on business needs had mostly elements from the previous two. Resource-based opportunities had usually their resources ready, which were attained by working in the industry for some time. Figure 41 presents important resources and characteristics that are present in spotting entrepreneurial opportunities.

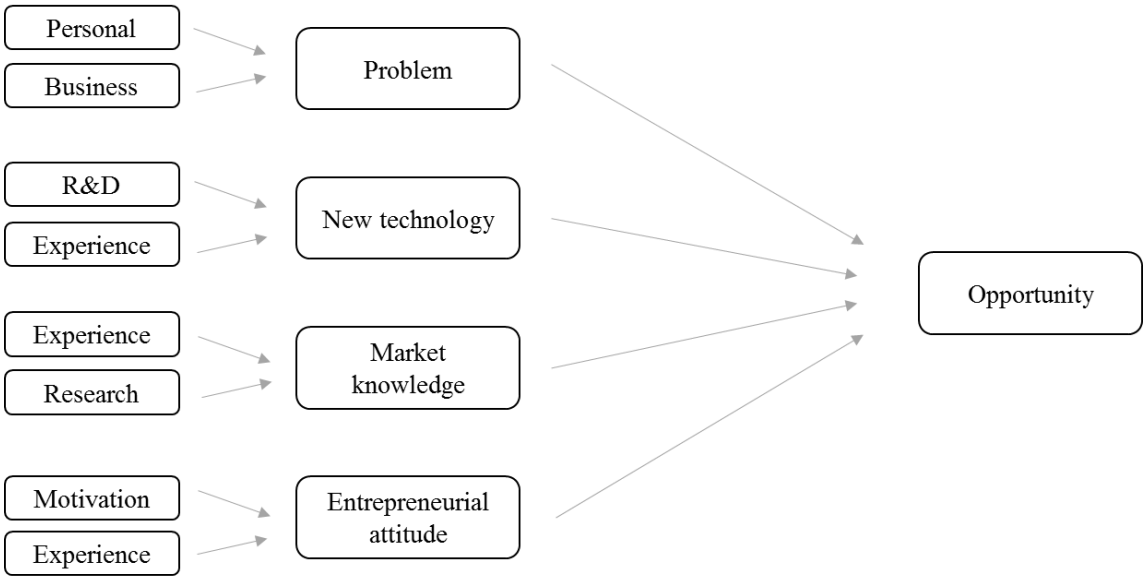

Figure 40: *The role of resources in entrepreneurial opportunities.*

There are some implications between the origin of opportunity and radicalness of the innovation. Innovations categorized as science-push are at least semi-radical, or even radical. Innovations where the initial opportunity originates from resources tend to be of incremental nature. Those that originate from identifying market potential tend to be incremental as well. Innovations originating from personal need have been semi-radical. They did find solutions by themselves and had to develop it so it sounds logical that it is at least somewhat new. If the origin of the opportunity is particular business need, the following innovation has been either semi-radical or radical. Both the previous types of opportunity require new technological developments, but the novelty of markets is not necessarily high.

If a company has mostly utilized their original resources, the innovations have been fairly incremental too, but in some cases semi-radical. The more radical the innovations were, the more important the role of intellectual property was considered. Also a few of them saw challenges with suppliers, mostly them being apple to produce proper components, which did not come up with the firms with incremental innovations.

It can be concluded that the weight of the resources in Figure 41 vary depending on the radicalness of the innovation. In radical innovations the technology was usually more based on new research and development compared to the other ones. In incremental innovations it was generally based on existing knowledge achieved in the previous tasks of the entrepreneurs. The role of specific problem was particularly present in semi-radical innovations. Although market knowledge was present in all categories of innovation, the importance of previous knowledge and experience of the markets was most present in incremental innovations. Entrepreneurial attitude is usually present in all kinds of innovations. The results are in line with the findings by Tödtling et al. (2009, p. 59) who say that firms with more advanced innovations rely more on R&D and Forsman (2011, p.

746) who concluded that technological intensity increases the degree of radicalness in manufacturing sectors. Tödtling et al. (2009, p. 59) also found that these companies with more advanced innovations collaborate more with universities and research organizations, which can be seen to some extent in this research too. While it played a relatively small role in opportunity recognition, some companies with radical or semi-radical innovations are affiliated with research organizations to considerable extent, which cannot be found in companies with incremental innovations.

Considering resources, most firms aiming to grow with internal finance tend to have incremental innovations, with the exception of few semi-radical ones. This may be due to several reasons. Firstly, they are often based on the entrepreneurs' personal interest, which may be mostly about developing new things for themselves, and growing business is only the secondary goal. Sometimes they also had the basis for the business ready from their previous employment, and they may have had the resources available and easier access to customers, and therefore less need for external finance to start the business. Clarysse et al. (2011, p. 150-151) attributes the source of finance to the complexity of the environment. In simple environments customers are easy to reach and accumulating resources is financed with internal cash flow, whereas in complex environments customers are difficult to reach and external finance is required. As incremental innovations were defined based on the novelty of technology and markets, a possible interpretation of the results of this research is that low novelty in both dimensions makes the environment less complex and reaching customers easier, thus being able to use internal finance.

Incremental innovation was also characterized by keeping the manufacturing within the company, which may also be due to previous resources acquired. The more radical the innovation, the more focus was on the core competences. There is also a connection between incrementalism and attitude towards intellectual property. Companies with incremental innovations did not hold patents in high regard and focused more on quality, whereas in the case of semi-radical and radical innovations patents were seen important or even as the core. It is not surprising however as those are defined to have substantial improvements in the current technology. This finding is similar to that of Tödtling et al. (2009, p. 59) who say that companies that introduce more advanced innovations also rely on patents to a higher extent.

There was a need for marketing resources in all the innovations, regardless of radicalness. However it was more emphasized when the degree of radicalness increased. Incremental ones tend to have more emphasis on selling, while others also discussed marketing, e.g. market education, building awareness and testing products and markets, and also faced more obstacles in the commercialization part of the process. In incremental innovations the markets were often considered ready, and one just has to go there without the need to build them. The development phase also took longer for non-incremental innovations, and path was usually even longer. The more radical the innovation was, the more need there were for acquiring external resources to support the innovation process.

While studying evolution paths of manufacturing start-ups, Lubik et al. (2011) found that technology-push start-ups often changed to a market-pull orientation and vice versa. The former was due to new partners, net market information or shift in management priorities. The latter was because of early market experiences that required improving processes to increase productivity, meet partner specifications or meet a demand for complementary products. (Lubik et al. 2011, p. 10). The interaction with these two orientations was visible in the empirical evidence of this research. Although the opportunity could spawn from needs, market niches, resources or technology and teams were often orientated towards the markets, the resources most teams had were more technology-focused at the beginning. This was mostly due to their previous experience related to the industry, products or technical development in general. In several cases they also had access to machinery and equipment as they had it themselves or accessed those though personal connections. The process towards market resources was embodied different activities such as acquiring new employees, guidance from investors, market research, customer visits and putting more emphasis on sales activities.

Radicalness was approached via technological and market aspects. Figure 42 considers the opportunity in relation to these two aspects. Technological novelty is defined in a similar manner as earlier, however the novelty of markets is attempted to be examined in more detail. It was previously based on whether the innovation can lead into changes in the market structure. To examine the market aspects in more detail, it is now divided into three categories. The definition of highest novelty stays the same. Lowest novelty means technical improvements and products that are similar to current offerings. The gap between these includes new products to current markets, meaning it is not similar to a current product, but replaces it. Compared to radicalness of the innovations in Figure 39, only two innovations are on a different novelty/radicalness slot (#3, #5).

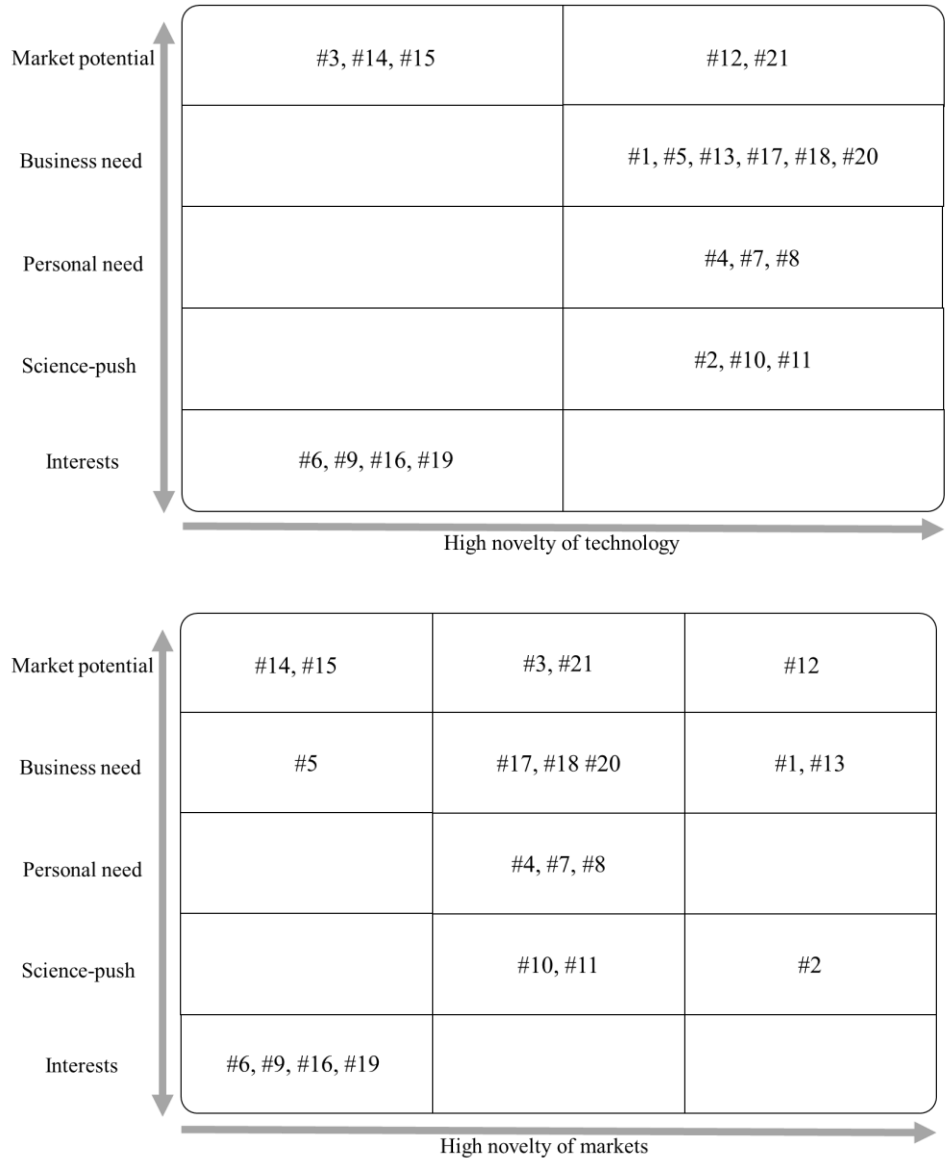

Figure 41: *Origin of opportunity and novelty of markets.*

Some connections can be found between the radicalness of innovation and the structure of the team. All radical innovations have key persons added afterwards, after the initial team formation. Teams with radical innovations generally have heterogeneous skills too. This may be due to the nature of resources required. Whereas in incremental innovation the technology and markets may be ready, radical innovations require deeper technological knowledge and building the markets. The more radical the innovation is, the more people tend to be gathered outside existing networks, although only few have done that. Both companies formed and still run by sole entrepreneur can be categorized to incremental innovation.

No major connections could be found between the homogeneity of skills and radicalness. The slight notation that hints a connection between radicalness and team size might also be due to the development of technology and novelty of markets requiring more people

for development and educating the markets. The homogeneity of teams with incremental innovations can derive from at least two factors. Firstly, homogenous resources may be enough for incremental innovations. Secondly, they are more often formed by a person or a team that has been working in the field previously so the learning about the product and markets has been done in the previous company. Companies with incremental innovations usually had both high industry and high market knowledge. In more radical innovations the starting team usually had steep technological knowledge but less about marketing, which means they have to be build or acquired. These may also contribute to the fact that reaching the markets has been easier with incremental innovations.

New key persons that were added after the formation were either investors or regular employees. New key persons often had vast experience related to sales and were usually important for having connections, leads and international experience. In few cases key persons also brought legal knowledge to the firm, and the key persons were mainly added for the commercialization phase of the firm's innovation. Social networks were important source of these new persons. The results are similar to a study by Jenssen (2001) who found in his study that social networks are important for the success of a start-up and are especially important when considering them as channels to gaining resources. The role of networks to access resources was present in this study too, but more than that networks were especially important in the formation of the team, and the team brings important resources for the company. The lack of relevant social networks and thus access to resources could be one reason why some of the case companies have been and are still struggling. Less than half the teams have added key persons since founding the company, and in many cases the structure of the team is homogenous.

There are no clear connections identified between the origin of opportunity and the team. The background of the team or entrepreneur was highly important, especially the experiences and technical knowledge. However those based on resources seemed to have less new key persons added for the company on average. It may because of having most of the required resources ready within the original team.

The connection between the team and radicalness can be broken down too. Figure 43 considers the different team structures and novelty of markets and technology. The results would indicate that the most novel innovations have teams with heterogeneous resources, which may be due to the nature of innovation requiring diverse resources as mentioned.

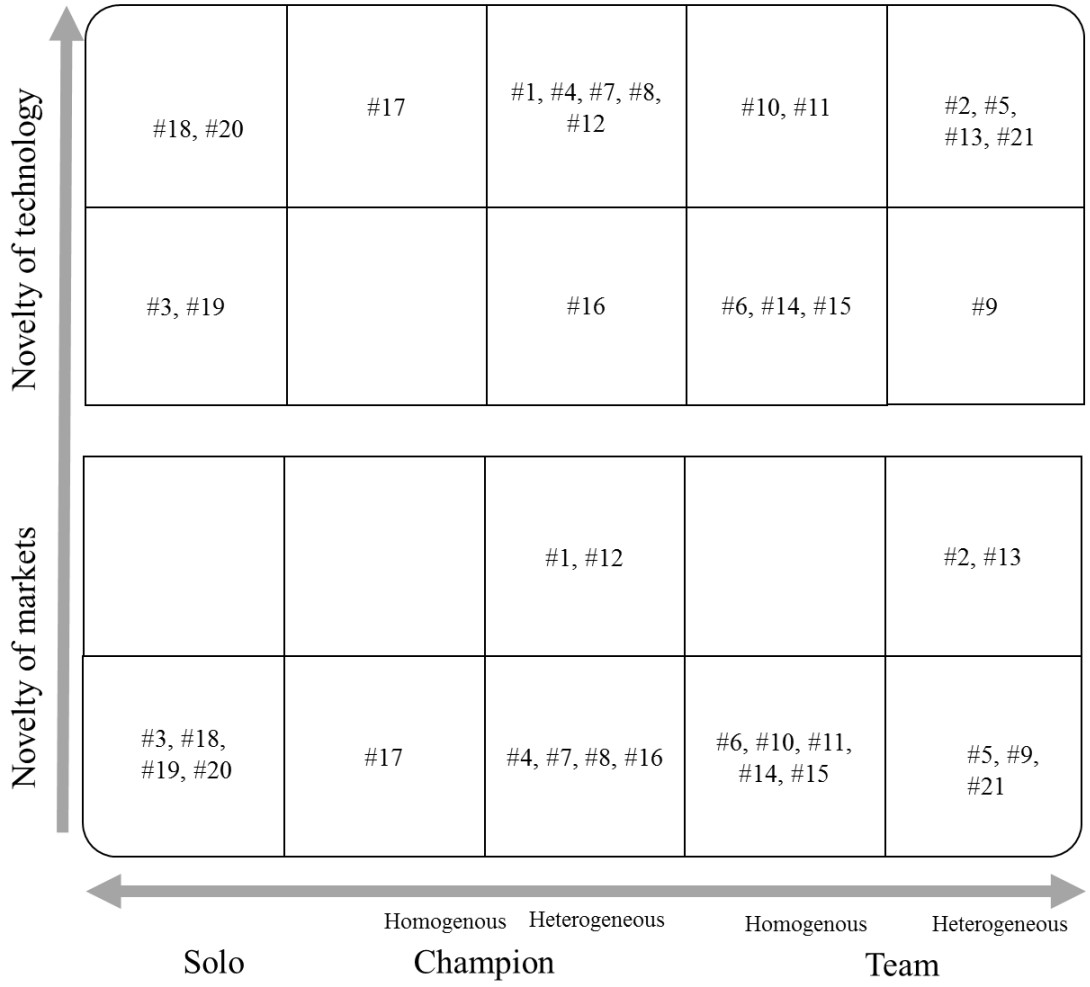

Figure 42: *Structure of the team and novelty of technology and markets.*

Even though there are different types of paths behind the different innovations, some common characteristics can be identified. The typical characteristics for radical, semi radical and incremental innovations are presented in Figure 44 below.

Incremental

- Based on previously acquired knowledge
- Relatively straightfforward and short path
- Markets easily accessible
- Teams often homogenous
- Opportunity based on market niche or current resource

Semi-radical

- New technology or combination of old ones
- Markets may be known but requires siginificant efforts in commercialization
- Opportunity often based on entrepreneurs' needs or science-push
- Much need for external support

Radical

- Technology completely new
- Markets may not be known and requires siginificant efforts in commercialization
- Heterogenous teams with key persons added since formation
- Much need for external support

Figure 43: *Typical characteristics of different innovations according to the empirical evidence.*

In the literature review the theoretical background was approach from three themes: innovation, new venture and ecosystem. Next the results of the research are discussed more specifically in relation to these themes and frameworks brought up in the literature review.

Jolly's technology commercialization process was discussed in chapter 2.1.2, and most of the steps in the process were discussed by the companies. The challenges the companies faced located particularly in mobilizing resources for demonstrations, mobilizing market constituents and promotion and adoption. This is illustrated in figure 45.

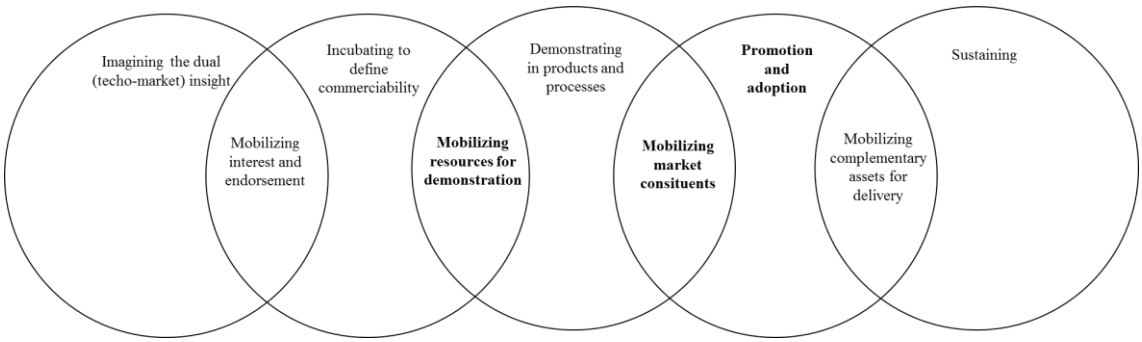

Figure 44*: The phases with most challenges in the technology commercialization process.*

The two important mobilization bridges are about acquiring resources, the first one focusing in the development of the product and the latter one focusing on development the

markets. As small and even medium sized firms rarely have all the resources themselves (Kessler 2007, p. 4), and considering the empirical evidence it seems there can be major challenges in acquiring them elsewhere. According to Jolly (1995) mobilizing resources for demonstration is about transforming generic technology into marketable products, including seeking cooperation from more actors. The firms saw financial resources as their main need, although accompanied by many other resources, such as suppliers or machinery. One reason for challenges could be the lack of search for collaboration and the attempt to do as much as possible themselves. The second bridge with challenges includes building acceptance of the product with early customers and a host of market constituents. Many companies emphasized about needing more resources to reach the markets. Some mentioned the importance of references, and few stated that once they break in to a big customer the whole market can open. Similar things came up related to promotion, and getting people to try and accept the new products or methods were important. Promotion and adoption were more highlighted in the case of radical innovations, which is most likely due to the newness of the markets. In incremental innovations these were not always mentioned. It might be that for those companies the markets have been ready as the entrepreneur has often worked in the same tasks or even markets before. In semi-radical innovations it was somewhat varying – in some cases it was seen as a big barrier, whereas sometimes it was not brought up.

The last parts of marketing – mobilizing complementary assets for delivery and sustaining did not come up very often in the interviews. A few companies mentioned about potential new products and potential competitors were discussed related to sustaining but not in much detail. This may be due to the companies being fairly new and many still focusing on actually getting to the market.

The early phases of the process are characterized by the entrepreneurs' own background. As mentioned earlier, identifying the opportunity was often based on opportunity getting combined with potential technology. According to Jolly (1995) the first gap of mobilizing interest involves assembling R&D resources to take the idea further. The firms often had these resources themselves or accessed them through social networks. Incubating activities did not get acknowledged much. They were based on entrepreneurs' own views of the potential of the technology and markets, often based on their experience on the field. Demonstrating relates to product development, which again was something the firms considered to be one of their strengths. They often considered to have the knowledge and capabilities to build the things themselves, but needed finance to actually do it. How the development happened had differences depending on the radicalness. Incremental innovations characterized by low novelty of technology were based on previous knowledge and capabilities attained by the entrepreneurs. There were less challenges and the development path was usually more straightforward. Radical innovations required much more new technological development, having strong basis in science. They have also taken a long time to develop, and have not been straightforward. Semi-radical innovations have

usually had a lengthy technological development path too. The technological development however varied by quite some extent. While some were based on scientific research, some were more about combining existing technologies in a novel way.

The similar thinking of mostly needing finance appeared with mobilizing the markets too to some extent, with some firms stating they would rather do the market research themselves as consultants cannot do it as effectively. This would hint towards larger thought process in the companies – they would rather attain finance and do the things themselves, rather than use e.g. consultants. This is in line with the fact that mobilizing resources had bigger challenges than actually doing the things. The fact that the companies did not emphasize the challenges or requirements in the early phases could also be due to most of them already overcoming those situations, whereas marketing may currently be a crucial thing.

Timmons (1994, p. 95) states that opportunities should not start from strategy, financial analysis or estimations about the company's worth. Instead he emphasizes the importance of industry and market issues, such as size, structure, growth rate, capacity, attainable share and cost structure (Timmons 1994, p. 96-98). This was generally the starting point for many companies and most of them had a market-based approach when evaluating the opportunities. This was however usually related to evaluating the markets, but not how they can actually be reached to commercialize the innovation. In the science-based opportunities the starting point was technology, and market potential followed at some point afterwards. Strategy or financial estimates were not mentioned in relation to the opportunity identification.

Timmons (1994, p. 257) also discusses the formations of entrepreneurial teams. He states that not all the ventures start with a full team, but it may some time for the team to form as the firm grows. The empirical evidence in this research would suggest there are several approaches to team formation. Some companies have had the team they intend to have from the start. They gathered the team before formation of the company, already knowing some of the resources that will be needed. This may be a sole entrepreneur or a team that has been gathered particularly for this opportunity. In some cases this might be enough, and the team may stay the same afterwards for quite a long time. In some cases however there will arise new needs as the firm evolves, and the team needs to acquire new key persons.

According to Timmons (1994) teams can form for example by based on geography, common interest, working together or past friendships. These were already discussed and confirmed earlier. Although in some cases new key persons came outside personal networks, they may not always be part of the actual team, although providing valuable resources and considered a key person.

Timmons (1994) finds two distinct patterns in the evolution of teams. In the first one a person has an idea, and then later on three or four associates join the team as the venture starts to shape. In the second one the team forms in the beginning, based on mutual interest, experience, friendship or so on. Both these patterns can be found in the empirical evidence, however these do not include all the cases and can be built further. The patterns of emergence in entrepreneurial teams have been presented earlier in Figure 27. First addition is that the entrepreneur may continue as a solo operation, however in the context of this research it is important to note that addition of new employees requires them to be key persons. The second addition is that these teams have often grown by acquiring new key persons in the early phases. This has been the case more in those that have been formed as a team with a clear lead person, as illustrated in Figure 28.

Timmons (1994, p. 258) also brought up the role of founder, stating that the nature of team is influenced by the opportunity and what the lead entrepreneur brings to the venture. This can be seen to some extent in the empirical evidence. While in some teams gathering complementary skills that suit the opportunity, in some teams the basis was the previous relationship, which in some cases was homogenous.

In relation to resources, Timmons (1994, p. 333) mentions that in the early phases of the venture it is important to obtain other people's resources. These can be money invested or loaned, people, space, equipment or other material loaned, provided by inexpensively or free by customers or suppliers, or exchange for future services (Timmons 1994, p. 333). This was present in this research too to some extent. Other people's resources consisted mostly of money but in some cases were also used to access equipment or machinery. Out of these money was mostly related to investors, and it was rare to receive financial support from other people. There were also some mentions of close collaboration with suppliers enabling to do things better. Timmons (1994, p. 21) state obtaining outside resources is important and that people actually seek to control resources rather than own them, which can happen in the form of borrowing, renting, or leasing for example. This was present especially related to supply side of the company. It was goal for many to outsource at least some production, and eventually even the whole production while controlling the suppliers. On the other hand there was contradictory evidence too, as some preferred to have the resources to manufacture themselves. Present in the empirical evidence, but to a less extend, was also using other outside resources such as consultants and demand-side aspects such as distributors and agents. However in these areas there was more interest to do the tasks themselves. In marketing and sales for example, generally the companies more often hoped for financial support to do this themselves, instead of outside consultancy.

In order to succeed, the entrepreneurial process also requires continual, careful and real-time analysis of the three driving forces (Timmons 1994, p. 17). Timmons and Spinelli (2008, p. 116) also discuss the constant balancing act of the entrepreneurial process, describing it to consist of trial and error and being at the same time intuitive and consciously

planned. This empirical evidence of the research supports this statement. For many companies the commercialization process has taken many years, with mistakes and turnarounds on the way. The structure of the team and the acquired resources had also changed depending on where the venture has been in the commercialization process. The firms have identified different needs between the development and commercialization phases, and have aimed to act accordingly. Especially the change in required resources came up, which was in many cases approached with additions to the team. Changes in the nature of opportunity were also present. The importance of timing and time window of the opportunity was discussed, but concrete implications to resources or team were not mentioned. For many ventures the whole nature of opportunity was present from the start, but slowly evolved to the current one, which then was seen more static. In some cases the opportunity has spawned further plans for future directions, which included more related products, service concepts and different markets.

To assess one's ecosystem, Adner (2012, p. 85) suggests making a map he calls a value blueprint, which makes the ecosystem and a firm's dependencies explicit. By making the relationships clear, it forces to confront the challenges that are beyond a firm's own responsibilities and consider the risks that are present in collaborative efforts. Solving the possible problems may require different scenarios, e.g. managing incentives, eliminating problematic links and identifying the most optimal paths. (Adner 2012, p. 87-88). The steps for creating the value blueprint are the following:

1. Identify your end customer
2. Identify your own project
3. Identify your suppliers
4. Identify your intermediaries
5. Identify your complementors
6. Identify the risks in the ecosystem
7. For every partner, define the status and understand the problem
8. Update the blueprint on a regular basis

Figure 46 illustrates the companies' consideration of the ecosystem as identified above, in comparison to the current status of their business. Those whose status is labelled as established are considered to have found their place in the ecosystem. The ones who are

still building may be still looking for the exact operational model or finding ways to penetrate the market.

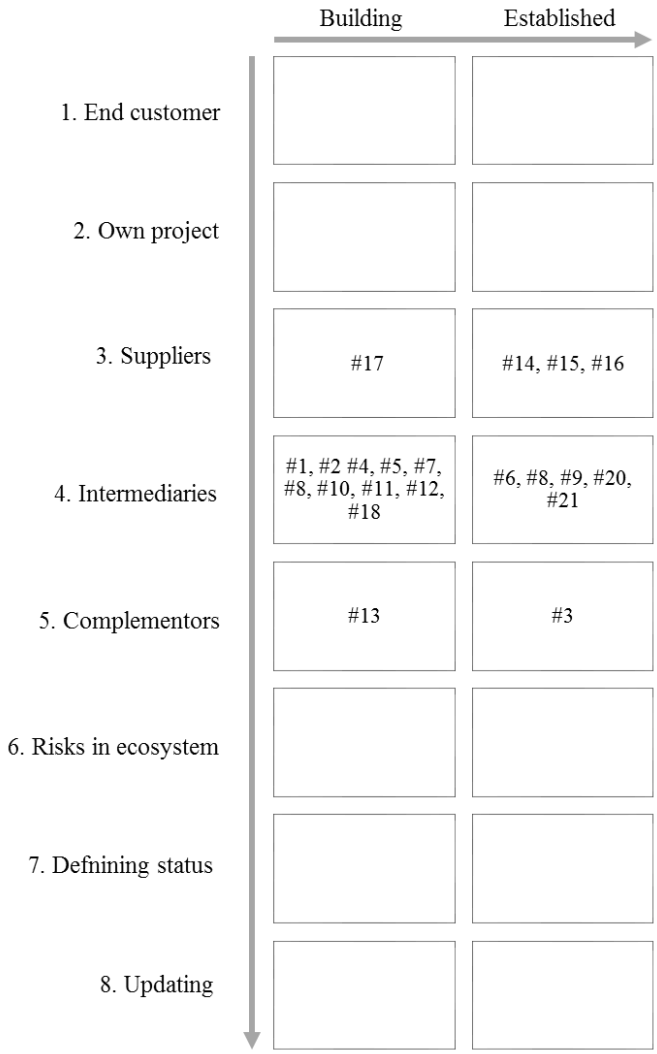

Figure 45: *The companies' current phase and view of the ecosystem.*

The first three steps were well identified by the companies. A lot emphasis was put on customer needs, e.g. considering the potential markets customers and evaluating the needs and how they can be fulfilled. The companies also focused on identifying what they need to deliver to cater these needs. The role of suppliers was also present and were seen important for the firms' operations. These three elements were highlighted in the empirical evidence, concluding that the firms are well aware of the closest connections in their ecosystem.

The role of intermediaries and complementors was less present. Intermediaries were mostly related to distributors and retailers. These did not however come up in most of the interviews. A reason for that might be that the demand-side of the supply chain could be fairly straightforward for many companies. Many firms still sell the products directly themselves too. Complementors were seldom brought up by the ventures. This can be

attributed to several reasons. First of all, they firms may simply not be aware of the complementors for their product. They may have focused on developing their own product without considering the environment it is used in. The second reason is that the firms simple do not see the complementors important or crucial for their own development or operations. They may think that if their product is good enough it will get used anyway, regardless of complementary products. The role of complementors did show up few times in the interviews however. In these cases the view was either acknowledging that they exist but not making any concrete actions based on this or a bringing up their importance and the attempt to collaborate with them.

Risks were mostly seen as company-related. The most noted risks related to finance, product and personnel. Ecosystem-based risks were not mentioned as major risks related to the company's operations, e.g. risks related to complementors or intermediaries did not come up.

There are several reasons why the examined ventures do not consider a big picture of their ecosystem. It is important to note though that the research focused on new firms in the equipment and manufacturing industry. Some of these firms can be in the early phase and have not considered the ecosystem aspect. Even if the company is forming it would probably still benefit from recognizing the ecosystem and its implications right from the start. The companies that are considered to be already established also consist mostly of incremental innovations, where entering the markets with similar products can be an easier task. Ones the companies with more radical innovations are more established, they may be considering more actors in the ecosystem, and in few cases it was even mentioned saw that the ecosystem around the company is still forming. The different phases can also explain why some consider the demand-side aspects more important and have less emphasis on the demand-side intermediaries. It is also possible that the firms simply do not think about this and focus mostly on their own operations.

Nevertheless the firms would probably benefit from considering the larger environment and its impact on the firm's innovation, and Van Beers and Zand (2013, p. 308) found that the effects of collaboration are even stronger in relation to radical innovations and manufacturing firms. Also even though the companies felt they have strong technological competences, it does not necessarily mean they would not have benefited from external help. For many companies the development phase took a long time, and there is a possibility that it would have been more efficient or effective with collaboration.

5. CONCLUSIONS

5.1 Answers to Research Questions

The research question of this study was the following:

How do new technology companies emerge?

The question was divided into following two sub-questions:

What kinds of resources do the firms require from the discovery of opportunity to commercialization?

How do they attain these resources?

These questions were answered by conducting semi-structured interviews in the Finnish equipment and machinery industry. Interviews (n=21) were conducted in order to gain in-depth knowledge about the different themes and issues behind the formation of these companies. Based on the empirical evidence findings in each of the themes were presented and then discussed. The connections between the themes were also analyzed and discussed.

The research found several ways in which new opportunities have emerged. The origin of the opportunity, the most important related elements and the interaction between these were identified. It was found out that most opportunities have started from market-pull, but technological development, entrepreneurial motivation and industry experience were usually present. The interaction between these elements usually provided the push to start the venture.

Entrepreneurial teams usually consisted of people attained through social networks. The teams often consisted of friends, relatives, previous colleagues or acquaintances from school. At the beginning of the formation the background of the team could be either homogenous or heterogeneous, but if new key persons were brought to the team as the venture advanced, they brought in complementary skills to the team. New key persons after the formation usually had complementary skills related to especially in the commercialization, and came in the forms of investors or regular employees.

The entrepreneurs considered to have strong technological capabilities themselves. In the early phases they did not usually require external help in the development of the technology. However towards commercialization they started to have more difficulties, and chal-

lenges related to marketing and sales came up. As the companies started to orientate towards to demand side, they often acquired new personnel with previous experience in sales activities.

The most important resource at their current situations of the companies was finance, and most of them have had or still have substantial difficulties with. The importance of finance was present throughout the process, not in relation to a particular phase. Without a few exceptions, the companies could do not have coped with only internal finance. External finance was crucial for the growth of most companies and usually acquired through public support, loans or investors, and it was mostly granted for the development phase.

5.2 Theoretical Contribution

The theoretical contribution of this study comes from the empirical evidence acquired during the study. Building on the Timmons model, this study provides findings to the roles of opportunity, team and resources in new ventures.

Several different ways in which new entrepreneurial opportunities can spawn were identified. Especially the demand-side aspects were highlighted as the origin, however the role of technology also came up as an important factor in the early phases. Demand-based opportunities require the appropriate development in technology, implying both play an important role when finding and evaluating opportunities. This contributes to previous findings, confirming the importance of market-pull over science-push as a source of innovation (Stefano et al. 2012) in the context of new firms. Also in line with the studies of Ardichvili and Cardozo (2000) and Shane (2000), this study concludes that entrepreneurs do not systematically search for opportunities, but instead entrepreneurial opportunities are usually discovered. However this also extends the discussion by further identifying where these market-side aspects are noticed. The findings show that opportunities are often identified in environment close to the entrepreneurs, often arising from particular problems or interests.

When building the entrepreneurial teams, the role of existing social networks was particularly prevalent, as suggested by Kamm and Nurick (1993). Entrepreneurs may prefer people who they can trust and whose abilities they know better. It may also be easier to get people they already know. Some may have actually preferred acquiring other people with specific skills, but do not know a convenient way of doing this. The lack of building a proper team could be one of the reasons all the innovations have not yet succeeded on a larger scale. Acquiring people based on networks may also result in unintended homogeneity or heterogeneity – if teams are formed on the basis of who is available in current personal networks, the optimal solution may not be available.

In the literature there are several aspects suggested to be important for the team, such as industry experience (Kor et al. 2007) and entrepreneurial experience (Teal and Hofer

2003). This study examined the commonness of market, industry and entrepreneurial experience and high education in new ventures, concluding that none of these is a critical factor by itself, and that teams usually possess a mix of these. Industry experience and high education were most prevalent, but many companies still possessed relevant market and entrepreneurial experience. All of the teams were characterized by motivation towards entrepreneurship. The entrepreneurs' own background also played an important role in the recognition and decision to pursue the opportunity, and the different factors mentioned above were all important, depending on the case. The teams bring important resources, and the importance of team was emphasized in the opportunity recognition and early development and later in the commercialization phase. When new key persons were added to the team since the formation, they usually had expertise to support in the commercialization phase, which was also were many companies struggled.

Contrary to what Adner suggests, new firms do not see themselves as part of an ecosystem. They have a relatively narrow view, emphasizing the role of suppliers and customers. They mainly see things from their own perspective and do not bring up the role of complementaries as important. The risks they identified are also mostly related to their own product and operations, not considering the larger environment. Again, there may be several reasons behind this. The companies may not be aware of the other actors or the risks and benefits they may bring, or not considered important enough considering the efforts. One reason could also be similar to why teams may consist of people in personal networks. The other actors may not be easily accessible and thus focusing only on their own operations. The companies may also be aware of them but do not know how to build collaboration.

The needs of the companies were most critically realized in when acquiring resources for development and commercialization, pointing out crucial phases in Jolly's technology commercialization process. Particularly the market-related aspects were emphasized by the companies, and challenges related to the adoption of the technology were prevalent. The companies faced several challenges in acquiring resources, and especially the role and lack of finance came up, as previously identified by Demirbas et al. (2011) and Madrid-Guijarro et al. (2009). Most companies require external funding for growth, and acquiring this has been a challenge. Other resources were not considered as important as finance, and one reason for this may be the lack of it, which then dominates the focus and leaves other ones to the background. Finance was also seen as the main way to achieve the other required resources, instead of for example collaboration or other means, which makes it even more important for the companies.

Demirbas et al. (2011) found the lack of skill shortages as a barrier to innovation in small firms. However this study suggests skill shortages are not mainly related to the technology, contrary to what Heydebreck et al. (2000) found. The companies considered themselves to have strong technological capabilities, whereas often lacked in the marketing side. Particular challenges in marketing were acquiring finance, building awareness and

reaching the customers. The companies do not bring up collaborative efforts with other parties as important ways to access resources. Instead, they are interested in accessing finance or developing internal capabilities and conducting the tasks themselves, which only increases the importance finance plays in the ventures. Some potentials reasons for the focus solely on the company's own this were already discussed in relation to ecosystems. In addition the entrepreneurs may be attached to their own ideas and want to commercialize their invention without external help, which was mentioned in one case.

This study also suggests that companies with radical innovations more often add new key persons to the company and have heterogeneous teams. They also face more challenges especially in commercialization. The results also point out to a somewhat small amount of radical innovations created in the Finnish equipment and machinery industry, in line with the finding of Forsman (2011) in the Finnish manufacturing industry overall. There may be several reasons for this related to the themes of this study, such as not being able to identify demand-based opportunities, challenges in developing the accompanying technology for the need, inability to find markets for a technology or lack of resources to support the process. Challenges of radical innovations in the commercialization phase identified in this research may also be a factor contributing to this, but further research on the topic is suggested.

5.3 Practical Implications

This study provides some practical implications too. It can help new ventures to prepare for the upcoming path on their way to making their inventions into innovations. The research has examined the roles of opportunity, team and resources and their implications in the formation of the new company.

While most opportunities arise from demand, it is essential to consider both the importance of market aspects and the accompanying technology. To seize market opportunities the entrepreneurs need technological capabilities. The other way around, it means technology by itself will not create opportunities. When creating new technology it is important to consider what implications it has on the markets and where it can be utilized.

The importance of the team also came up in the study. When creating new teams, entrepreneurs should consider the kind of characteristics the team should have for their situation. Complementary skills, industry knowledge, market knowledge, entrepreneurial knowledge and education can all contribute to the success of a new venture. Social networks were found important for the creation of a new team. For potential entrepreneurs it can be beneficial to build and expand their networks, and when a team needs to be created, entrepreneurs can evaluate their networks to find suitable people for the team.

The study identified that new ventures have a narrow view of their ecosystem. New companies could benefit from evaluating their ecosystem using the approach by Adner (2012),

which was presented earlier in the study. This helps companies identify potential barriers, opportunities for collaboration and risks present in the ecosystem.

This study can also aid new ventures by identifying important resources and providing potential ways to attain them. The companies can prepare for their upcoming needs, especially concentrating on the potential challenges in finance and marketing. The orientation changes in the process, and preparing for commercialization already in the early phases can help in reaching the markets. Even if the technology and products are new and innovative, they still require substantial efforts in marketing.

By studying the paths of emergence of new technology companies, this study also provides several implications for public policy. The ventures have been lacking especially in finance, and most companies grow on the basis of acquiring external finance. This would call for policies to improve the firms' possibilities in gaining access to external finance. This can happen in several forms, such as providing direct financial support or helping in bank loans. Overall the public support seemed work well in the development phase, but as firms progress towards commercialization acquiring government support tends to become more difficult. However it is important to note that Timmons (1995) suggests that bootstrapping can actually be a significant competitive advantage for entrepreneurial companies. The lack of resources may have actually been to a contributing factor in the innovations, and the correct balance between scarcity and support can be the best solution to enhance the creation of innovations.

The ventures think that they have strong competences in technology, whereas they may be lacking resources in commercializing where many of the difficulties are faced. This would point out to placing more emphasis in marketing activities. Apart from direct financial support the public policy could introduce ways to connect new ventures and investors more easily. New ventures find new people more easily through their networks, and enabling to build these networks but may grant access to investors.

However, the role of technological development should not be completely forgotten. Most radical innovations were accompanied with substantial technological development, and even in less radical ones the role of new technology was a key aspect. In many cases new technology was incubated within the entrepreneur or a single firm, and in several cases the technology was developed in a university. Therefore the findings would imply it is important to support both of these ways – encourage collaboration with firms and universities, and also support internal development activities in new ventures.

The bureaucracy and amount of work involved in applying for public support gained a lot of criticism. Even though the requirements exist for a reason, based on this it should be considered whether the support mechanisms should be made easier to access in order to take less effort to apply for them. The suitability of some mechanisms was also criticized, especially related to market research. Several companies stated market research could be

done more effectively by themselves, which calls to examine further whether in some cases instead of hiring consultants to market surveys, it would be more beneficial to financially support the venture's marketing activities. Overall this would point towards more flexibility in government support, which would enable the mechanisms to suit the needs of the companies more.

As mentioned, the lack of cooperation with external partners may be due to lack of knowledge by the companies. The firms may not be aware about opportunities or know how to organize collaboration. If this is the case then the public policy could focus on building networks and facilitate companies in join efforts. As the issue is not completely clear, this offers potential for future research. Lack of knowledge as a reason would be supported by the fact that very few even mentioned the idea of working with universities or competing firms.

5.4 Limitations and Further Research

There are some limitations to this research. The context of the research, research methods and the researchers are the factors that can influence the study. This research was conducted in the Finnish manufacturing of equipment and machinery industry. This context has several implications on the generalizability of the research. Cultural factors in Finland may have an influence on how firms operate and thus new firms in Finland may face different situations and challenges compared to firms in other countries. Also public policies differ per country, making the conditions for creating and operating new companies different, meaning the results cannot be generalized outside Finland.

The research questions were studied in the specific context of equipment and machinery industry. This creates another limitation to the generalizability of the findings. This rules out other sectors where new technology companies can emerge and play an important role, and conducting similar research in those settings could result in different findings. The research also focused on new firms within the equipment and machinery industry. The criteria of the research also excluded companies formed before 2010, and public policies and the environment can change over time. This means the results are not generalizable over time, and cannot necessarily be applied outside the time frame used in the research.

The methods used in the research cause limitations to the study too. Explorative interviews were chosen as the data collection method and included a limited number of cases. Qualitative case study interviews often lack in terms of generalizability due to a small sample. The findings of this research cannot be generalized to all new ventures. However the aim was to interview as many companies as possible within the research context, and out of the originally identified 34 companies 21 were interviewed.

Purposive sampling was used to form the sample for the research. In addition to purposeful sampling not being statistically representative to total population (Saunders et al. 2009, p. 239), this may include bias in the selection of the case companies. The evaluation of potential case companies' suitability for the research was up to the researchers' subjective assessment based on the defined criteria. This bias was reduced by presenting and discussing the potential case companies with other researchers within the research group before deciding on the final sample. The sample represented a wide variety of companies within the research context, thus implicating that the companies were reached well and the answers come from a diverse set of companies.

In semi-structured interviews specific themes are chosen and discussed with the case companies. This may leave out some important themes that can provide interesting insight into the research agenda. This risk was reduced by deriving the themes from the literature and validating the interview outline within the people involved. After the first interviews, notes of the interviews were made including the main points. This was done in order to ensure the research outline will yield useful insight about the themes and answers to the research questions. The interviews were also flexible and allowed the interviewees to bring up topics and issues important to them. The aim of the research was to interview someone present from the formation of the company, so that the interviewee would have extensive knowledge about the issue and expertise to know what to focus on.

There may be bias related to both the interviewee and the interviewer in semi-structured interviews (Saunders et al. 2009, p. 326). Interviewees may want to give a particular picture of their firms or not discuss certain things. This research focused on new firms, including many entrepreneurs who are passionate about their companies, and may not want to bring up negative issues as much. If there was a lack of evidence for certain themes, it could simply be that the companies did not want to talk about those issues. In contrast, they may also have an overemphasis on what they are good at or highlight particular issues that would benefit them. In addition, the interviewees may understand some questions differently from another. They may have misinterpreted some of the questions or have different interpretation regarding the definitions.

Some bias may also be caused by the fact that the companies were at different phases on their life cycles. Some had the business established and running, whereas some were still developing the business. This means some firms may have faced different challenges and currently be at a different situation, which can lead into bias within the sample.

The interviews were conducted by three researchers, which can lead into observer error. As the interview outline was quite loose for the semi-structured interview, there may be differences in how different researchers asked the questions. The questions were not strictly formulated which means even the same researcher may ask them in a different way in different interviews, which weakens the reliability. To reduce this, the outline was shared beforehand and the option to suggest changes was given to make sure everyone

understands it. While conducting the interviews the researchers may have guided the interviewees with their responses, non-verbal cues or tone of voice, which could cause bias in the answers.

The data gathered during the interviews is analyzed subjectively by the researcher, which may cause bias when interpreting the results. This is caused by the subjective views and experiences of the researcher about the topic, and was reduced by conducting a literature review beforehand and also connected the results to literature about the themes. Observer bias related to the analysis of the results was also reduced by recording and transcribing all the interviews.

This research focused especially on asking 'what' and 'how' type of questions. More specific research could focus on the 'why' side of questions to gain further knowledge behind the acts the firms make. Why do not many firms collaborate with universities or other firms? Why do they have limited view of the ecosystem? Why do they have challenges especially in the commercialization phase? The research could help explain the rationale behind the decisions these firms have taken and give further insight about the choices new technological ventures face.

Another interesting point for further studies could be to move into another context. This research was conducted in the equipment and machinery industry in Finland. Similar research could be conducted in other industries too. This would enable cross-industry comparison to define similarities and differences in the emergence of new technology companies. With the same idea the research could also be conducted in other countries too, which could provide insight about cultural and political differences and their impacts to new technological companies.

Considering a different time span could be another theme of interest. The case companies in this study were formed between January 2010 and September 2015. Studying firms that have been formed at a different time span could bring up differences due to public policies and environment of that time. This could help identify desirable policies that contribute to the creation of new firms and foster innovative behavior.

Based on the research many firms have problems in acquiring finance during their life span. There are also challenges especially relating particularly to the commercialization phase. It would be interesting to examine ways to solve these problems, which has also been studied before. However an interesting point of further research would be to study these especially in the context of the equipment and machinery industry. A closer look could be taken for example at those firms that have been particularly successful in the commercialization phase. Identifying why particularly those firms have succeeded may help other companies to follow the same path.

Another point of research could be to combine the findings with numerical data. Comparing the radicalness, origin of opportunity, team structures and resources with data

about growth and expansion could be used to evaluate the implication of these about company performance. For example growth in revenue, changes in personnel employed and ratio between domestic sales and exports could be interesting figures that provide more insight into the topic. In some cases this would have to wait a few years to make the results more applicable for the most recent companies in the sample.

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APPENDIX A: INTERVIEW OUTLINE (IN FINNISH)

1. Yrityksen perustamisvuosi

2. Kehittääkö/Onko yrityksellä omaa teknologiaa

3.Haastateltavan asema yrityksessä

4.Haastateltavan aika yrityksen toiminnassa

5. Yrityksen avainhenkilöt

6. Merkittävät muutokset yrityksen toiminnassa perustamisen jälkeen

7. Yrityksen keskeiset tavoitteet (kasvuhakuisuus ja kansainvälistyminen)

Mahdollisuus

- Metodi tai materiaalit joita hyödynnetään kaupallisen tai teollisen tavoitteen saavuttamiseksi – eli mitä tehdään
    - Teknologia, teknologian synty, kehitys ja riskit
- Perustuuko yrityksen synty ”mahdollisuuden” havaitsemiseen, ja jos näin
    - Millainen tämä tunnistettu mahdollisuus on/oli?

Tiimi & verkostot ja kilpailijat

- Yrittäjä & yrittäjätiimi, minkälainen tämä on, mikä heidän taustansa on
- Verkostot ja kumppanuudet
- Kilpailijat

Resurssit

- Mikä on polku keksinnöstä innovaation, innovaation elinkaari / syntyprosessi
- Mitä resursseja yrityksen kehittämiseen on tarvittu (rahoitus, teknologiat, materiaalit jne.)

Radikaalius, innovaation merkitys (nyt ja tulevaisuudessa)

- Onko kyseessä tässä vaiheessa keksintö vai innovaatio?
- Yrityksen onnistuessa tavoitteesaan muuttuuko olemassa olevat kysyntä/tarjonta suhteet merkitsevästi