Halmstad University
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MASTER THESIS

School of Business and Engineering

The Entrepreneurs prior Knowledge of Entrepreneurship

- A qualitative study of innovative Swedish SME:s.

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Abstract

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Purpose:	The purpose with this thesis is to describe which role the entrepreneur's knowledge of entrepreneurship has played in the process from opportunity discovery to opportunity exploitation in innovative Swedish SME:s. The aim is to give a deeper understanding of what knowledge has been used by the entrepreneur in the process of development of the firm, to increase the understanding of how a person's knowledge of entrepreneurship contributes to his or her entrepreneurial process, thus contributing to the field of research of entrepreneurship and entrepreneurial knowledge.
Research method:	We have chosen a qualitative case-study approach by conducting semi- structured interviews. Because of a large amount of prior research in divided fields within our research subject, we have mainly adopted a deductive approach.
Empirical study:	Our empirical study has been performed on four companies; Rolling Optics, Peepoople Graphensic, and SensAbues. Through in-depth interviews with one of the founders from respective company.
Conclusion	We found a general shift from firstly knowledge tied close to the entrepreneur and knowledge concerning external environment of the company throughout the entrepreneurial process. We also noted a difference between companies, if the innovative product was born from a market perspective and market need or research perspective which later need to find an applicable market to the invention

Key words: Entrepreneurship, Knowledge in Entrepreneurship, Entrepreneurial Knowledge, Entrepreneurial capital, Human capital, Qualitative study.

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1. Introduction

In this chapter, we will describe the background to our subject and discuss it further in problem discussion which will result in our research question. We will then explain the purpose and delimitations of this study. Last we will explain the outline of this thesis.

1.1 Background

"The basic economic resource - `the means of production,´ to use the economic term – is no longer capital, nor natural resources (the economist´s `land´), nor `labor´. It is and will be knowledge" (Drucker, 1993, p. 8).

There has been an observation of a transition in advanced industrial nations from the focus on manufacturing to a focus in services and knowledge (Powell & Snellman, 2004). And as we find ourselves in an information age, post capitalist society and post- industrial era, information and knowledge becomes more important (Bell, 1976). Knowledge is an example of intangible resources which can give the firm sustained competitive advantage. "Knowledge is a critical organizational resource and an increasingly valuable source of competitive advantage" (Hitt, Ireland & Hoskisson., 2009, p.12). It also helps the firm to more precisely foretell the character and commercial potential of environmental changes and how to strategically meet these (Cohen & Levinthal, 1990). Further this knowledge makes organizations more capable to discover and exploit new opportunities (Wiklund & Shepherd, 2003).

In response to changing customer demands and in order to exploit opportunities from, for an example technology, organizations need to innovate. Innovation is also central when creating value and achieving sustained competitive advantage (Baregheh, Rowley & Sambrook., 2009). Innovations based on new knowledge usually demands many sorts of knowledge´s and is the instrument with which the entrepreneur creates new combinations or enhancements on already existing resources (Drucker, 1998).

In this knowledge age there is also an acknowledgment of the importance of knowledge to increase economic growth (Powell & Snellman, 2004). But also the successes of entrepreneurial firms are critical because they are one of the engines of economic growth (Hitt & Bartkus, 1997; Gorman et al., 1997).

"It is now widely recognized that entrepreneurship provides benefits in term of social and economic growth and development; providing the seedbed of new industries, renewal of industrial base, job and wealth creation and social adjustment" (Jack & Andersson, 199).

Entrepreneurship creates new jobs through company creations, explores new markets and raises new skills and capabilities. With other words you could say that entrepreneurship is the shape of which knowledge is being used. On the other hand entrepreneurship is a very fuzzy field of research with different opinions of how to define entrepreneurship which has affected the conclusions that's been drawn from the research (Davidsson & Honig, 2003). You can either concentrate on trying to define entrepreneurship by a person's trait and attributes (Gartner, 1989), or only look at the environment and opportunities such as market structures (Shane, 2003). But a more adopted view is to see entrepreneurship as a process with the presence of lucrative opportunity and enterprising individuals that together in the nexus

creates entrepreneurship (Shane & Venkataraman 2000). This identifies phases the entrepreneur goes through from opportunity discovery to exploitation of the opportunity and is referred to as the entrepreneurial process (Corbert, 2005; Davidsson & Honig, 2003; Shane, 2000). "It is characteristic for entrepreneurs that they need different knowledge in different growth periods and thus continuously develop their need for knowledge" (Omerzel & Antoncic, 2008, p. 1184).

A knowledge based view can be found in the heart of the resource based perspective of the firm, which is all about privately owned knowledge as a competitive advantage (Conner & Prahalad, 1996). This because knowledge is difficult to imitate which leads to firms being able to differentiate (McEvily & Chakravarthy, 2002). For SME:s[1] knowledge is becoming one of the most central resources when the competitive environment turns more global and is seen as a source of competitive advantage (Omerzel & Antoncic, 2008; Nonaka & Takeuchi, 1995). Further it is also essential for economic performance (Nonaka & Takeuchi, 1995). In SME:s the company's growth is mainly influenced by the entrepreneur which in turn makes the entrepreneurs knowledge very important (Zorn, 2004). Knowledge as a resource also influences the organizations ability to be entrepreneurial when searching for opportunities (Galunic & Eisenhardt, 1994).

"Entrepreneurs with more knowledge will be able to learn and notice changes on the market faster" (Omerzel & Antoncic, 2008, p. 1183).

1.2 Problem discussion

When discussing the entrepreneur's knowledge, one often talk about the entrepreneur's human capital, a theory originally from Becker (1975). In the theory of human capital, one distinguishes between investment in human capital and outcomes from the investment. Investment can be education and experiences while outcomes of the investment are the specific knowledge's and skills the person obtain from the investments (Becker, 1993).

Through the human capital perspective, education increases a person's stock of information and skills that are necessary to pursue an entrepreneurial opportunity successfully. Information about labor and product markets, skills used to sell, bargain lead, plan, make decisions, solve problems, organize and communicate are factors that influence the entrepreneurs ability to assemble resources, develop a strategy, organize and exploit opportunities. Also, the likelihood of a person exploiting a business idea that he or she has discovered increases if the person has general business experience since before. Such as basic aspects of business that are relevant to opportunity exploitation such as finance sales, technology, logistics, marketing and organization (Shane, 2003).

Today, there are a lot of investments in entrepreneurial activities and entrepreneurial education both on national level but also on EU level where EU is trying to coordinate the regions entrepreneurial actions to strengthen the national and regional competiveness in a globalized market (Regeringskansliet, 2012). This somehow presumes that knowledge of entrepreneurship will increase or enable future entrepreneurs to better meet challenges such as participate in entrepreneurial activities. Several researcher has concluded that education in entrepreneurship do matter regarding the potential entrepreneurs attitudes and perceptions towards starting their own business (Lee, Chang & Lim., 2005; Matlay, 2006; Peterman &

[1] SME's, small and medium sized enterprises consists of enterprises which employee number fall below 250 people and which annual balance sheet do not exceeds 43 million euro and/or turnover of 50 million euro (European Commission, 2003).

Kennedy, 2003; Pittaway & Cope, 2006) and that rudimentary of entrepreneurship can be taught (Garavan & O´Cinneide, 1994; Henry & Leitch, 2005; Jack & Anderson, 1999; Kuratko, 2003; Neck & Greene, 2011).

The drawback here as we see it that these researches have been self evaluating questionnaire or literature reviews with no real depth. Also that entrepreneurship is an enigma, "(…) each entrepreneurial event is unique and probably idiosyncratic and the entrepreneurial process is the crystallization of complex and contingent variables" (Jack & Andersson, 1999, p. 112). This begets the question of how one can teach or evaluate something which the nature we don't know everything about. This is why we inquire for a more in depth research of entrepreneurial knowledge that is supposedly an outcome from entrepreneurial education and experience.

In prior research within the framework of human capital, knowledge have been treated on a shallow general level and usually measured quantitatively through questionnaires or through literature review using years of education or years of work experience as measurements of human capital (Colombo & Grilli, 2005; Erikson, 2002; Iversen et al., 2009; Obschonka, Silbereisen, & Schmitt-Rodermund., 2012; Omerzel & Antoncic, 2008; Unger et al., 2011; Zorn, 2004). But the nuances of which role the entrepreneurs' knowledge of entrepreneurship has played and where, is according to us missing.

Small and medium sized enterprises have an important role in the economy which is why Omerzel and Antoncic (2008) executed their research on SME:s and we agree with their statement. And to reconnect to the discussion in the background, innovation has an important role and close connection to entrepreneurship as the entrepreneur's tool with which the entrepreneur creates opportunities (Drucker, 1998). Therefore Innovative SME:s is of great interest for us. A qualitative research investigating the role of entrepreneurial knowledge in the entrepreneurial process will not only fill a research gap because there has not been any qualitative research that deals with this as we know of. But also contribute to the field of research with an increased and deeper knowledge of the nuances and nature of the entrepreneurial knowledge being used by the entrepreneur within the entrepreneurial process. This in turn can also be of value for institutions to better adjust investments in entrepreneurial activities, for an example in education to meet the role that entrepreneurial knowledge plays by the entrepreneur within the entrepreneurial process.

Therefore, with the lack of prior qualitative research on the subject to highlight presumed differences during the entrepreneurial process of knowledge usage we want to research:

What role does the entrepreneurs´ knowledge of entrepreneurship play in the entrepreneurial process in Innovative SME:s?

1.3 Purpose

The purpose with this thesis is to describe which role the entrepreneur's knowledge of entrepreneurship has played in the process from opportunity discovery to opportunity exploitation in innovative SME:s. The aim is to give a deeper understanding of what knowledge has been used by the entrepreneur in the process of development of the firm, to increase the understanding of how a person's knowledge of entrepreneurship contributes to his or her entrepreneurial process, thus contributing to the field of research of entrepreneurship and entrepreneurial knowledge.

1.4 Delimitations

To capture the entrepreneur's knowledge we will use the framework of Human capital that is a part of Entrepreneurial capital together with Social capital. We will only focus on Human capital when this concerns the entrepreneurs existing knowledge, not the entrepreneurs social capital and external knowledge such as networks and external ties. Still because social capital is a part of human capital we will mention it in one paragraph to make it clear to the reader how the framework of entrepreneurial capital is constructed. A sampling limitation we have choose to adopt in consideration of the discussion above, in both background and problem discussion, is that we will conduct this research on innovative SME:s.

1.5 Disposition

This master's dissertation consists of 6 chapters.

First chapter:	In this chapter we are presenting the introduction and discussing the theoretical background and the research problem that leads to our purpose and research question. Here we will also define our limitations.
Second chapter:	This chapter will describe the theoretical framework used as a basis for our analysis, namely entrepreneurship and the entrepreneurial process which will lead us to theory about the entrepreneur and further narrow down to the entrepreneurs' human capital and our frame of reference and knowledge of entrepreneurship.
Third chapter:	In this chapter we present our research method, such as research approach, case selection and sampling, data collection, data analysis and research criteria such as validity and reliability.
Fourth chapter:	In this chapter we will present the data collected, through interviews, from the research sample of four company founders.
Fifth chapter:	In this chapter we will analyze the data collected with the help of the theoretical framework presented in chapter two, through case analysis and cross case analysis. In the cross case analysis we take the liberty to freely discuss the differences and similarities between the companies we previously analyzed with the help of the theoretical framework.
Sixth chapter:	In this chapter we will highlight the main finding of our analysis and present the answer to our research question. We will also explain theoretical and practical implications of this study.

2. Literature Review

In this chapter, we will describe the underlying assumption of this thesis regarding entrepreneurship, entrepreneurial process and the entrepreneur. By discussing prior research within these subjects we will explain what they signify in this thesis and their assumed meaning in this context. This will create the glasses and perspective of which one interprets the broad field of entrepreneurship.

2. 1. Entrepreneurship

Entrepreneurship is a broad field of research where the definitions of entrepreneurship are many and elusive of nature. The reason why the research of entrepreneurship has continued failing in a commonly agreed upon definition is because research has been carried out in different disciplines such as psychology, economy or sociology (Zorn, 2004). But researchers have only looked at one part of the entrepreneurial process. Either trying to define entrepreneurship by a person's trait and attributes (Gartner, 1989), or only look at the environment and opportunities for an example market structures (Shane, 2003).

One should instead look at the whole picture; the presence of lucrative opportunity and the presence of enterprising individuals as two phenomena in which the nexus creates entrepreneurship (Shane & Venkataraman, 2000). Entrepreneurship is created based on the existence, discovery and exploitation of entrepreneurial opportunities which also is known and referred to as the entrepreneurial process. As the wordings suggest, entrepreneurship is viewed as a process (Hisrich, Peters, & Shepherd., 2005; Shane, 2003; Zorn, 2004). A broad definition of entrepreneurship is*; "entrepreneurship as business ownership and active management"* (Unger, Rauch, Frese & Rosenbusch., 2011, p. 346) in line with Stewart and Roth (2001) who base their research on Carland (1984) proposed framework of different entrepreneurs. Though we want to investigate entrepreneurship as a process and also use human capital as our central theoretical framework with main influences from Zorn (2004), we will apply the definition from Zorn (2004) investigation of the influence of entrepreneurial capital in entrepreneurial dynamics. This definition is also more defined regarding human capital in comparison to Stewart and Roth (2001) and supported by the definition of Hisrich et al., (2005) as we will present below.

Definition of entrepreneurship

Considering the above discussion one can define entrepreneurship as; a process which through engagement of human and financial capital is creating new ventures and where the entrepreneur is taking a risk but in return is rewarded financially or through personal satisfaction (Zorn, 2004) which we further also will adopt. This definition is also supported by other used definitions in prior research for an example such as, "Entrepreneurship is the process of creating something new with value by devoting the necessary time and effort, assuming the accompanying financial, psychic, and social risks, and receiving the resulting rewards"(Hisrich et al., 2005, p.8).

The entrepreneurial process is central both in how we interpret entrepreneurship in this thesis and in our definition of entrepreneurship, therefore we will next explain the different parts of the entrepreneurial process.

2.1.1 Entrepreneurial Process

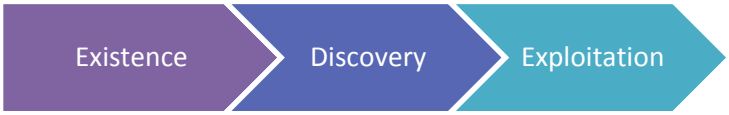

Figure 1 Entrepreneurial Process, own illustration.

There are different divisions of the entrepreneurial process, where for an example some researchers include evaluation as a step (Shane & Venkataraman, 2000), while other use the three phases; existence of the opportunity, discovery of the opportunity and the exploitation of the opportunity (Corbert, 2005; Davidsson & Honig, 2003; Shane, 2000).

We will use the latter division because of the following reasons; evaluation is something that occurs mentally, it tangents psychology such as mental schemes, how the entrepreneur perceive the world and cognitive constructions which is not the aim with this thesis. Still the evaluation step is present as a part of the entrepreneur so we are not dismissing its influences but we are not focusing on evaluation as a step either.

One can also interpret the entrepreneurial process as many small continuous processes within the big process of discovery and exploitation of an opportunity. We acknowledge that. But regarding this thesis we choose to look at the main big process from discovery to exploitation of one main opportunity of the companies in this study.

Existence

The existence of entrepreneurial opportunities considers situations in which new goods, services, raw materials, and organizing methods can be sold or introduced at a greater price than the cost of their production (Shane & Venkataraman 2000).

There are three sources of entrepreneurial opportunities; 1) demographic sources, 2) changes in perception as a source and 3) new knowledge as a source. The demographic is the most predictable, this include changes in population, size, age structure, composition, employment, educational status, and income. The second source of innovation, changes in perception, is considered mood and meaning that open up innovative opportunities in business, politics, education and elsewhere. The last source, knowledge based innovation means that both scientific and nonscientific are innovations characterized by their time span, casualty rate predictability, and the challenges it possesses to the entrepreneurs (Drucker, 1985).

Of all the three sources, knew knowledge is considered the fanciest of all the opportunities and the one that gets all the publicity and money. And it is innovations that are the instrument with which the entrepreneur creates new combinations or enhancements on already existing resources. But to succeed, innovations based on knew knowledge usually demands many sorts of knowledge´s (Drucker, 1998).

Innovation is not only the occurrence of a new invention but a system that links the idea to the market, production or use. Innovation can be divided into five classification; new product or new processes, new method of production, new source of supply, the exploitation of new markets and new ways of organizing businesses (Schumpeter, 1934). In economics, most of the focus has been between product and process innovation where product innovation is characterized by the development of entirely new products or new variants of old products, while process innovation is characterized by new or improved ways of producing existing products (Fagerberg, Mowery, & Nelson., 2005).

In accordance with above discussion, this thesis we will investigate opportunities that can be defined as sources of new knowledge and considered innovations.

Discovery

There are two opposites of theory whether opportunities are discovered or created. This is based on the notion if the opportunity exists independently of our perception ready to be discovered or created by our actions (Alvarez & Barney, 2007). These polar should not be seen as exclusively, rather as two perspectives one can apply on the phenomenon. In this thesis we will assume that opportunities seldom present themselves prepacked and ready to exploit, that they often needs to be discovered and neatly packaged before they can be taken to the next step, the same as Venkataraman (1997) states.

As we mentioned before, changes in perception, demographic changes and the generation of knew knowledge makes it possible for opportunities to be discovered (Drucker, 1985) but taking this thought one step further it also allows the underlying assumption for a given decision to proceed with an opportunity to change (Kirzner, 1997). Because the ability to valuate an opportunity is a subjective assumption, for an example to value what a given product would be worth and what he or she is willing to give to obtain it, there are those who make the wrong assumption which in turn makes it possible for others to discover the opportunity and offer a better solution (Shane, 2000). The decisions an entrepreneur is making is never made in a certain environment, one never know if the decisions one is making is based on the right assumptions, the judgment that influences the decision can be flawed (Harper, 1996). Further, to be able to identify the opportunity, the entrepreneur must find it more valuable than it costs (Casson, 1983).

This assumes competitive imperfection and that information in a market varies from person to person (Alvarez & Barney, 2007). Without information, opportunity discovery cannot happen (Fiet & Patel, 2008). Uneven information distribution in the market allows people to discover and valuate different opportunities differently. Information processing skills also called entrepreneurial alertness is identified as one of the driver of the opportunity identification process (Gaglio & Katz, 2001). This raises another discussion, whether entrepreneurs actively search for opportunities or if they just happen to discover them, and many researchers have concluded that it is not possible to systematically search for unknown discoveries and that many discoveries are found while the entrepreneur is not searching (Fiet & Patel, 2008). Also that, when an entrepreneur discovers an opportunity it may follow a developmental process and that the final opportunity emerge over time by accumulating knowledge and information (Ucbasaran, Westhead, Wright, & Binks., 2003b).

“An entrepreneurial discovery occurs when someone makes the conjecture that a set of resources is not put to its "best use" (i.e., the resources are priced "too low," given a belief about the price at which the output from their combination could be sold in another location, at another time, or in another form)” (Shane & Venkataraman, 2000, p. 5).

To summarize the discussion above and to clarify how we will define the discovery phase we use the definition from Shane and Venkataraman (2000) and define the discovery phase as; when someone makes the conjecture that a set of resources is not put to its "best use" and starts to neatly package the idea.

Exploitation

After the entrepreneur discovers the opportunity, he or she could choose to proceed to the exploitation phase. This notion of whether or not to exploit the opportunity depends on the nature of the opportunity but also on the entrepreneurs themselves (Venkataraman, 1997). A person who exploits a specific opportunity do so because he or she believe that the specific opportunity will lead to value that exceeds the opportunity cost and time spent on exploiting the opportunity, namely the greater the expectance is by the entrepreneurs on the opportunity the more likely the entrepreneurs is to exploit it (Shane, 2003; Venkataraman, 1997).

For an example, individual differences of the entrepreneur such as self efficacy, optimism, internal locus of control and perception differences can influence the entrepreneur. The opportunities can also be different and the perceived value can make one or another opportunity more appealing to exploit. For an example, a cure for a severe disease might have a higher expected value than an opportunity's characteristics of a corner kiosk (Shane & Venkataraman, 2000). Exploitation of opportunities are more common when, and examples of high expected value, when the anticipated demand is large (Schumpeter, 1934), there are high industry profit margins (Geroski, 1995) and the life cycle of the technology used is still in the early stages (Christensen, Suárez, & Utterback., 1998).

One can choose to exploit the opportunity in two ways, either start a business or sell the discovery. A commonly agreed on conjecture is that the entrepreneurial activities mainly occurs through newly founded companies. But employees can also pursue an opportunity for the sake of the company, independent stakeholders sell the opportunity to already operating companies or companies can found a new branch to pursue the opportunity. The choices that are made depend on business organization, nature of the opportunity and the organizations quality of being imitable (Shane & Venkataraman, 2000).

When it is complicated for independent entrepreneurs to obtain financial means from the capital market, the opportunity is less likely to take the form of a newly founded business. On the other hand entrepreneurship is to be more expected when the learning curve (Levin, Klevorich, Nelson, & Winter, 1987), head start and scale of economy is not advantageous to already operating firms (Cohen & Levin, 1989). Low entry barriers (Acs & Audretsch, 1989), the nature of the opportunity is uncertain (Casson, 1982) and the opportunity consider information that is hard to protect by for an example patent, trademarks and industrial design rights (Cohen & Levin, 1989) are conditions that is pointing towards the form of newly founded businesses.

To summarize this discussion, the decision to exploit an opportunity depends on many things and there are also different forms this exploitation phase formally can take; starting a business or sell the idea. But one can start a business without selling a product or actively using the company until later and instead continue packaging the opportunity. Therefore this phase can overlap with the previous phase and the distinction is not always clear. This is why we define the exploitation phase as; the entrepreneurs' actions to take the discovered opportunity to the next level by either start a business and actively selling the product or sell the opportunity.

2.1.2 Entrepreneur

Entrepreneurship, as we discussed earlier, is the nexus of valuable opportunities and enterprising individuals (Venkataraman, 1997), which also should be seen as a process (Hisrich et al., 2005; Shane, 2003; Zorn, 2004). And as we already have discussed the entrepreneurial process, and how we perceive it including the existence of the opportunity, the discovery of the opportunity and the exploitation of the opportunity (Corbert, 2005; Shane,

2000). We will now continue to explain how we perceive the entrepreneur and his or her role in the entrepreneurial process.

The entrepreneur is a key factor of a company´s growth and success (Zorn, 2004). Which is also supported by other researcher who identifies; the entrepreneur and his/hers decision to grow (Bauman & Locke, 2004) and the entrepreneurs characteristics such as innovativeness (Drucker, 1998). But the entrepreneur´s decision to grow is by itself not enough, knowledge and skills are also needed (Penrose, 1995; Timmons & Spinelli 2004).

Until recently, it has been understood that entrepreneur is something you are born to and that your success is independent of education and for those who´s not born entrepreneur, they cannot be taught the skill (Jones & English, 2004). But now there is an increasing acceptance that rudiments of entrepreneurship can be taught (Henry, Hill, & Leitch., 2005; Kuratko, 2003). By means of formal education and experience an entrepreneur is made (Zorn, 2004). In accordance prior research in entrepreneurship identified as a trait approach and suggests another perspective that rather treats entrepreneurship as a role someone plays in different stages the firm goes through (Gartner, 1989). Commonly identified traits by other researcher that supposedly distinguished between entrepreneurs and non entrepreneurs are, for example, need for achievement, locus of control, risk taking, values and age. But overall the attempts to distinguish between entrepreneur and non entrepreneur by traits has generated in no significant differences. "In the trait approach the entrepreneur is assumed to be a particular personality type, a fixed state of existence (…)" (Gartner, 1989, p. 48). So in contrast, a behavioral approach is suggested, which stresses the entrepreneur as a role, something someone does and not who they are. "The entrepreneur is not a fixed state of existence, rather entrepreneurship is a role that individuals undertake to create organizations" (Gartner, 1989, p. 64).

In small businesses the entrepreneur has a central role in entrepreneurship that is creating and developing companies (Zorn, 2004). But also, "The entrepreneur is a part of the complex process of new venture creation" (Gartner, 1989, p. 57). In accordance with these two definitions and the discussion that entrepreneurship can be taught and the entrepreneur as a role we adopt a more defined definition; the entrepreneur is a person who goes from an idea to an act, and turn new technologies, new products and new industries into action where new jobs and value is created (Timmons & Spinelli, 2004).

A company´s success and growth is dependent on the entrepreneur which makes the factors influencing the entrepreneur vital (Zorn, 2004). We will therefore next discuss the entrepreneur's entrepreneurial capital.

3. Theoretical Framework

We will in this chapter explain the conceptualization of entrepreneurial knowledge as an outcome from entrepreneurial education and entrepreneurial experience within the framework of human capital. Within this, we have developed our own knowledge model which will be presented in 3.1.1.3 Entrepreneurial Knowledge. Last we illustrate this research with the help of a research model, where we apply the framework of entrepreneurial knowledge with in the entrepreneurial process.

3.1. Entrepreneurial Capital

Information and knowledge becomes more important and serves as a competitive advantage for organizations in this information age we live in today (Powell & Snellman, 2004). In SME:s the company's growth is mainly influenced by the entrepreneur which in turn makes the entrepreneurs knowledge very important (Zorn, 2004). To catch the notion of a person's knowledge and skills, one can talk about human capital, and in this thesis we focus on the entrepreneur's human capital. Different divisions of human capital have been made in prior research but we will take our starting point from Zorn (2004) and his research of entrepreneurial capital. A similar division of entrepreneurial capital (Zorn, 2004) is the division of existing knowledge and external knowledge of the entrepreneur (De Clercq & Arenius, 2006) and how they tangent can be seen in Figure 2, Entrepreneurial capital consists of human capital and social capital from where we will work our way down to how we specify knowledge of entrepreneurship.

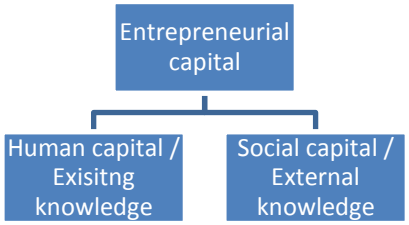

Figure 2 Entrepreneurial Capital, own illustration.

(Zorn, 2004; De Clercq & Arenius, 2006)

To further explain the model of entrepreneurial capital, human capital consists of the entrepreneur´s knowledge and skills acquired from education and experience, While Social capital consists of the entrepreneur´s network such as family and friendship ties and membership in different organizations, and the entrepreneur's social skills such as impression management, persuasion and reputation and social adaptability (Zorn, 2004). Because we investigate which role the entrepreneur's prior knowledge such as the entrepreneurs existing base of knowledge within entrepreneurship play in the entrepreneurial process, we will further focus on Human capital rather than Social capital and the entrepreneur's usage of external knowledge.

3.1.1 Human Capital

Human capital enhances the entrepreneur's abilities of discovering and exploiting opportunities (Unger et al., 2011) but also aid accumulation of new knowledge and skills (Ucbasaran, Wright, Westhead, & Busenitz., 2003a). It is a component of a person (Nonaka & Takeuchi, 1995) and it generally imply knowledge from formal education and experience (Zorn, 2004). Human capital consists of knowledge and skills that make it possible for a person to take action (Coleman, 1988). Further an entrepreneur's knowledge can be viewed as consisting of skills and knowledge such as technical-, business management - and personal entrepreneurial knowledge related to the function of the entrepreneur (Hisrich, 1992).

Apart from outcomes and investment of human capital differentiates between task-related human capital and human capital not related to tasks (Becker, 1993; Unger et al., 2011). Task-related human (Becker, 1993) through an entrepreneurial perspective is similar to the functional knowledge (Zorn, 2004). Human capital is more important when being task-related knowledge and skills such as running a venture and entrepreneurial knowledge. Non-task related human capital is more general such as general education and employment experience that has little to do with the existing work of the business owner. Task related knowledge is also more important than past experiences (Unger et al., 2011). This because the task related knowledge is more directly related to the entrepreneur's behavior than pure past experiences (Davidsson, 2004).

Functional knowledge or task related knowledge of entrepreneurship can be seen as knowledge of environmental scanning, selecting opportunities, formulating strategies, organizing, management and leadership (Shane & Venkataraman, 2000; Unger et al., 2011) and furthermore that the human capital needs to be related to these knowledge's (Unger et al., 2011). This in turn generates better knowledge and understanding of customers, suppliers, products and services that concerns the business (Gimeno, Folta, Cooper, & Woo et al., 1997). The task related human capital is therefore vital when discover and exploiting opportunities (Unger et al., 2011). Human capital enhances the entrepreneur's ability to execute the generic entrepreneurial activities such as discovering and exploiting opportunities (Shane & Venkataraman 2000). A person's entrepreneurial alertness is also affected by prior knowledge (Westhead et al., 2005). One can distinguish two components of human capital such as generic human capital and specific human capital (Becker, 1975). Generic human capital refer to general knowledge from education and experiences while specific human capital pin point capabilities the entrepreneur can directly apply to the firm such as knowledge of the industry and knowledge of how to operate a business. The specific human capital is therefore further consistent of industry specific human capital and entrepreneur specific human capital (Colombo & Grilli, 2005). Entrepreneur specific human capital is obtained through leadership experiences such as managing and directing employees (Brüderl, Preisendörfer, & Ziegler., 1992).

Functional human capital (Zorn, 2004), task related human capital (Unger et al., 2011) and entrepreneurial specific human capital (Colombo & Grilli, 2005) all relates to human capital that directly concerns the firm, such as running a venture and entrepreneurial knowledge (Unger et al., 2011), knowledge related to the function of the entrepreneur (Zorn, 2004) and how to manage a new firm (Colombo & Grilli, 2005). We will therefore consequently refer to these aspects of human capital as **entrepreneurial knowledge**, including both functional knowledge such as skills but also theoretical knowledge as in awareness and understanding of entrepreneurship.

Various researchers have pointed out human resources as critical and vital in entrepreneurial businesses (Florin, Lubatkin, & Schulze., 2003; Pfeffer, 1994; Unger et al., 2011). And many researcher consent in that knowledge as an outcome from formal education and experience is one of the vital element of human capital (Coleman, 1988; Davidsson & Honig, 2003). Therefore, we will next go through outcomes from education in entrepreneurship and prior experience of entrepreneurship to result in a research model of knowledge of entrepreneurship used in this thesis.

To summarize the discussion above we will illustrate the relation between investments of human capital; education and experience of entrepreneurship and the outcomes from the investment namely entrepreneurial knowledge in a model.

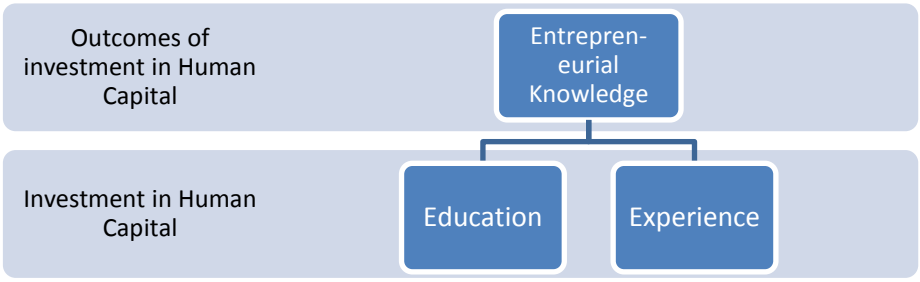

Figure 3 Relation between investment in human capital and outcomes from the investment, own illustration.

An important assumption and standpoint we make in this thesis is that entrepreneurial knowledge is still entrepreneurial knowledge independently if it comes from education or experience. That means that the knowledge derived from education in entrepreneurship will also be able to be obtained through experience of entrepreneurship. We do not put into any valuation of what is better than the other, only conclude that our definition that will be presented later in the chapter of entrepreneurial knowledge is applicable for both investments in human capital.

3.1.1.1 Entrepreneurial Education

Education is one component that increases a person's stock of explicit knowledge and provides skills that are necessary for entrepreneur when exploiting entrepreneurial opportunities. Information about labor and product markets, skills used to sell, bargain, lead, plan, make decisions, solve problems, organize and communicate are factors that influence the entrepreneurs ability to assemble resources, develop a strategy, organize and exploit opportunities (Davidsson & Honig, 2000; Omerzel & Antoncic, 2008). Education also improves the person's entrepreneurial judgment though an increases analytic ability and an understanding of the entrepreneurial process (Shane, 2003) but also gives an understanding of the market and environment (Oosterbeek, van Praag, & Ijsselstein., 2010). Furthermore, the information and skill accumulated through education increases their expected return on opportunity exploitation thus, people that have the relevant information and skills should be more likely to exploit opportunities than people who do not (Shane, 2003).

People who receive provision of management training and a supply of educational material on start-ups have an increased understanding of how to start a business, through reducing the perception of the difficulty of starting a business and enhancing the expectations of the value of exploiting the entrepreneurial opportunity (ibid). Education also provides people with specific types of knowledge such as marketing and product development skills (Omerzel & Antoncic, 2008) that are useful to opportunity exploitation, there by increases the person's expectations from opportunity exploitation (Shane, 2003). The same information and skills that increases the entrepreneurs expectations also improves their process of exploitation, the performance of the entrepreneurial opportunity, growth rate of the venture and the profitability of the venture, positively (ibid).

Jones and English (2004, p. 416) defines entrepreneurial education as; "Entrepreneurial education is the process of providing individuals with the ability to recognize commercial opportunities and the insight, self esteem, knowledge and skills to act on them". This also includes teaching opportunity recognition, how to commercialize a concept, how to organize resources in a risky environment and how to start a business (Kourilsky, 1995). But it also concerns teaching in other disciplines such as management, marketing, information systems

and finance (Jones & English, 2004; Omerzel & Antoncic, 2008). The entrepreneur should be seen as having a balanced set of knowledge of everything rather than deep knowledge of one specific area (Iversen, Malchow-Moller, & Sorensen, 2009). A definition used in research about entrepreneurship programs when comparing European and American definitions of entrepreneurship identifies is "A collection of formalized teachings that informs, trains and educates (…)" *(*Bechard & Toulouse, 1998, p. 320). Entrepreneurial education is further about combining business differently and in a new way (ibid). This touches up on the subject of creativity which is a cornerstone in the creative entrepreneurial process (Johanisson, 1991).

When explaining entrepreneurial education, many researchers do this while compare it to business education programs. Where entrepreneurial education stresses imagination, creativity and risk taking (Oosterbeek et al., 2010; Porter, 1994) while business programs stress quantitative and corporate techniques at the cost of the more creative skills (Porter, 1994). The traditional business schools focuses more on the large established firm and foster the follower rather than the leader, creator and risk taker (Chia, 1996). Which is important knowledge for the entrepreneur (Shane, 2003). Still the skills taught in business programs are also needed by the entrepreneur but generally concerns important issues of running a business instead of issues of how to create one (Jones & English, 2004). Entrepreneurship curriculum can also be divided into three elements; opportunity recognition such as identify unfulfilled needs, organizing resources, and the creation of an businesses such as financing, management and marketing skills (Kourilsky, 1995).

This discussion of outcomes from entrepreneurship education will be consolidated in chapter 2.2.1.4 Frame of References, in a table of concepts of knowledge of entrepreneurship together with the next chapter of entrepreneurial experience.

3.1.1.2 Entrepreneurial Experience

Entrepreneurs with prior entrepreneurial experience tend to not analyze ideas to death because "(…) the problem is not to identify the idea but to obtain capital and other resources (…)" (Ucbasaran et al., 2003b, p.11). Prior business experience also gives the entrepreneur a better understanding of the environment and industry the future company will operate in (Chandler, 1996). When starting a business, the entrepreneur gain experience and knowledge such as; tactics, distribution channels and how to handle personnel (Ucbasaran et al., 2003a). They also gain knowledge of supplier relationship, customer relationship, and relationships with regulators which in turn can be used when discover opportunities (Rerup, 2005).

"During their work, entrepreneurs develop various practical skills, aimed at understanding of business situations and problems, e.g. understanding the market, developing their vision, shaping and structuring the organization of the enterprise and introducing the factors for the promotion of company culture" (Omerzel & Antoncic, 2008), p.1184).

If the current venture ownership is similar in for an example industry or the nature of the task/ technology used, this will affect the entrepreneur's discovery and exploitation of opportunities (Chandler, 1996; Rerup, 2005). Similarities could help the entrepreneur to discover and exploit opportunities, but also hinder the entrepreneur from seeing new things (Rerup, 2005; Reuber & Fisher, 1999). Generally, the overall perception is that, those with prior experience of entrepreneurial activity will manage better than those with no such experience (Alsos & Kolvereid, 1998; Rerup, 2005). Entrepreneurial experience gives the entrepreneur knowledge of what need to be done, what is important and how to do those things. Further that it is not the amount that matters but the nature of the experience (Stuart & Abetti, 1990).

With other words, knowledge of entrepreneurship can be obtained by the experience of owning a venture (Zorn, 2004), and contains management experience (Bates, 1990). This can be used to innovate and discover new resources and product combinations (Ucabasaran, Westhead, Wright, 2008). Entrepreneurs also scan their environment, choose potential opportunities, being familiar with the market and formulate strategies (Chandler & Jensen, 1992).

Being new and having a longer learning curve than competitors can be a liability, though prior research suggests that prior experience of the industry but also prior experience of starting a new business positively affect the learning curve (Alsos & Kolvereid, 1998; Bates, 1990; Delmar & Shane, 2006; Otani, 1996). "The more that entrepreneurs start firms or work in an industry, the better they become at organizing firms, acquiring resources, attracting customers and suppliers, and hiring employees" (Delmar & Shane, 2007, p. 220). Pre-ownership experience can also give the entrepreneur a better understanding of the customer and suppliers (Chandler, 1996).

Entrepreneurial experience also gives the entrepreneur more resources than those without the entrepreneurial experience and can be divided into ownership experience, managerial capabilities, technical capabilities and entrepreneurial capabilities (Ucbasaran et al., 2008). Both ownership experience, managerial and entrepreneurial capabilities are connected with the probability to identify and exploit opportunities. These skills are also found being needed in the later stages of the process from idea to venture (ibid). In the discovery phase prior industry experience can improve the entrepreneur building relationships, identify new products, new markets and find funding. In the exploitation phase prior industry experience can help the entrepreneur considering how to operate a business (Rerup, 2005).

In their study of Entrepreneurs experience, expertise and firm performance, Reuber and Fischer (1994) distinguish between stock of experience and streams of experience and used measures of the entrepreneur's experience that are typical for the topic; "(…) supervising managers (management experience), working in firms which provided similar products or services (industry experience) (…)" (Reuber & Fischer, 1994, p. 368).

3.1.1.3 Entrepreneurial Knowledge

Because the field of entrepreneurship is broad and lack a common framework of entrepreneurial knowledge, we have chosen to develop our own framework of entrepreneurial knowledge, on the basis of the outcomes from entrepreneurial education and entrepreneurial experience as in line with the theory of human capital. From the discussion above of entrepreneurial education and experience we have conceptualize the outcomes from investment in human capital into a model of entrepreneurial knowledge as can be seen in Figure 4. We have based our conceptualization on Knight (1991) framework of entrepreneurship as concerning different levels such as society and industry, firm and group, and individual level. We have distinguished three major level of knowledge derived from the discussion in previous sections as in; 1) Knowledge tied close to

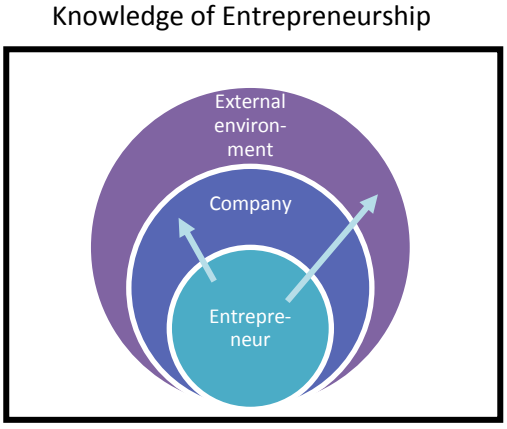

Figure 4 Entrepreneurial Knowledge, own illustration

the entrepreneur, 2) knowledge concerning the company and 3) knowledge concerning the external environment.

Category	Knowledge concepts
1. Knowledge tied close to the entrepreneur	**a) Knowledge of unfulfilled needs** such as identifying opportunities.
	b) Creative knowledge that emphasize boundary free tendencies rather than strictly knowledge within limits such as; imagination, creativity, problem solving and risk taking.
2. Knowledge concerning the company	**a) Managerial knowledge** such as; leadership, organizing, strategy formulation, tactics and vision, employees, finance and acquire resources, planning and decision making.
	b) Functional knowledge such as; how to start and operate a business, commercialize a concept, communication and information systems, product development and understanding products.
3. Knowledge concerning the external environment of the company	**a) General external knowledge** such as; environmental scanning and industry knowledge concerning competitors, suppliers and distribution channels.
	b) Marketing knowledge such as; customers, bargaining, sell and service.

Table 1 Knowledge of entrepreneurship divided into concepts

These levels of knowledge are overlapping because they are a part of a person and sometimes a part of a person in relation to other actors such as employees and one might use a combination of different knowledge's at the same time. But the main thought of this model is that the knowledge being used can be seen as derived from the core and goes out depending on the situation. The rough division of the knowledge's as seen in the table is divided from the standpoint of who they mainly concerns; the entrepreneur, the company or the external environment.

Aside from building on the same assumption as Knight (1991) that entrepreneurship concerns different levels from industry and environment to individual level our conceptualization carries similarities with European Commission (2012) definition of outcomes from entrepreneurial education within EU. But also with Chandler and Jensen (1992) identified roles the founder assumes and the entrepreneurs experience.

Why we haven't purely chosen to adopt these frameworks is because 1) the European Commission (2012) definitions is not considered as pure research, on the other hand whole of European Union is affected by these directives and investment through the educational institutes that is following these decisions indirectly from the national pronouncement. Therefore we are not totally dismissing these classifications but neither do we totally rely on them as a frame of references either. 2) Similarities with Chandler and Jensen (1992) research

only concerns half of our frame of reference, namely entrepreneurial experience and therefore we are not totally adopting their framework either. Also they do not purely focus on entrepreneurial knowledge and that is why we choose to develop our own frame of reference derived from prior research within the field of entrepreneurship where Chandler and Jensen (1992) are a part in. Finally worth mentioning one more time; there is no complete framework of entrepreneurial knowledge what we know of which is the strongest reason why we choose to develop our own model of entrepreneurial knowledge.

The similarities between our models divisions of entrepreneurial knowledge and the European Commission (2012) and Chandler and Jensen (1992) divisions are that European Commission (2012) has a category called "Taking the initiative and risk taking, critical thinking, creativity and problem solving" and we see a direct connection with our category "Creative Knowledge".

European Commissions (2012) category of "Practical exploration of entrepreneurial opportunities" and Chandler and Jensen (1992) "The Entrepreneurial role" can be connected to our category of "Knowledge of unfulfilled needs". European Commissions (2012) category "Economic and financial literacy" can be connected to our category of "Functional Knowledge" but also with Chandler and Jensen (1992) category of "The technical-functional role".

European Commissions (2012) category "Knowledge of business organization and processes" and Chandler and Jensen (1992) "The Managerial role" can be connected to our category of "Managerial knowledge". European Commissions (2012) category of "Knowledge of career opportunities and the world of work" can broadly be applied on our concept of external knowledge to the company.

Otherwise, our two categories within that concept are not as profound in European Commissions (2012) divisions. Those where the similarities between our developed model and scattered divisions of entrepreneurial knowledge from European Comission (2012) and Chandler and Jensen (1992).

Now, if we zoom out a bit from our theoretical framework, we want to illustrate our study with a model where we combine the entrepreneurial process and our theoretical framework namely entrepreneurial knowledge to show what we are researching.

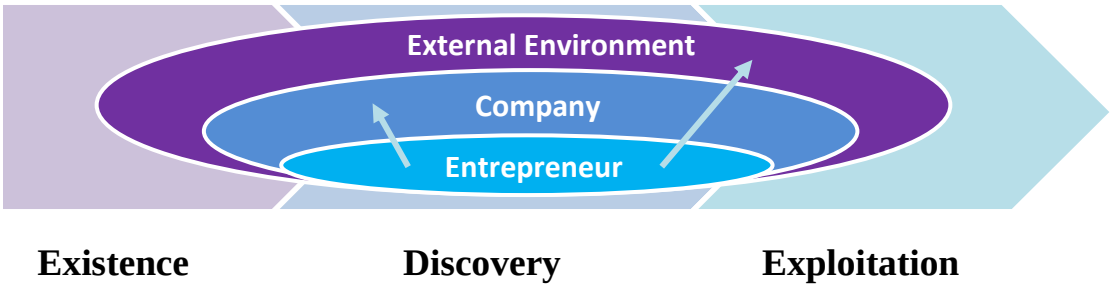

Figure 5 Research Model, own illustration.

What this model illustrate is the entrepreneurial process in the background in the shape of an arrow divided into three phases namely; existence, discovery and exploitation.. Applied

within this process is how we have chosen to illustrate the levels of entrepreneurial knowledge. This is in the shape of a circle with three levels of who they foremost concerns. The entrepreneurial knowledge that can be tied close to the entrepreneur is in the middle, knowledge of entrepreneurship that foremost concerns the company is in the second circle and entrepreneurial knowledge that concerns the external environment of the company can be seen in the outer circle. What we want to show with this model is how we will investigate which role the entrepreneurial knowledge play in the entrepreneurial process. But because existence is a state of being and not an action from the entrepreneur, we will from now on refer to discovery phase, also include the existing phase. Therefore in this thesis we will use the divisions of Discovery and Exploitation.

4. Methodology

In this chapter we will discuss the underlying methodological approach of this research. We will provide with an explanation to our choice of research method by discussing from a theoretical view of methodology to a practical execution of gathering empirical data, how we executed the analysis and the implications this have had on research criteria such as reliability and validity .

4. 1 Research Approach

Because we want to research which role the entrepreneur's knowledge of entrepreneurship play we see it advantageous to use a qualitative approach to capture both a nuances and in depth data of the phenomenon. To accomplish this we will adopt a multiple case design (Yin, 2003) with four companies.

A qualitative study consists of conversations and interviews where the researchers ask the questions and listens, while the respondents answer (Warren, 2001). This is done by asking broad and open questions, as can be seen in our interview guide, which is generated through a conversation. The goal here is to carefully listens so that to hear the meaning of what is being communicated. The objective of most qualitative studies is not to obtain facts or laws from the respondents but rather their interpretations of different events (ibid). There are many different types of interviews, each with its own advantages and disadvantages.

We will in this thesis focus on in-depth and life story interviews (Johnson, 2001) to capture the entrepreneur's interpretation and be able to describe what role the entrepreneur's knowledge of entrepreneurship has played. Life story interviewing is an in-depth qualitative research method which studies the individuals' life. It is used for gathering information about a persons' nature and looks at a persons' life as a whole (Atkinson, 2001). In-depth interviews usually involve one on one, face-to-face interviews between a researcher and a respondent, where the conversation tends to be of a relatively long duration. This type of interview aims to build the kind of intimacy that lets the respondent reveal his or her thoughts (Johnson, 2001). The respondents we have chosen for this thesis are spread over a large geographical distance from one another, within Sweden and have therefore presented limitations for us concerning face-to-face interviews. However to meet our criteria and solve this issue we have conducted the interviews through Skype. Skype is an internet service which allows users to communicate with peers by voice, video and instant messaging over the Internet. This was beneficial as it made it possible for us to conduct our research on the sample despite the geographical distances, not to forget that we could replicate the conditions of a real face to face interview since we could see the respondents and they could see us. Because our aim was to get as much information and in-depth understanding about the entrepreneur and his role during the entrepreneurial process as possible we choose to split the interviews and conduct two interviews per person, so that the respondent would not experience any stress or fatigue during the long sessions and thus have the energy to give good answers on the questions. As Johnson (2001) explains that this type of interview tends to lead the respondent to a greater expression of the persons self, and also a personal commitment of participation for several interview sessions.

Existing literature within our research is limited. However there is some prior research in separate fields; entrepreneurship, prior knowledge and human capital, but none complete set of models or theories we can directly apply on our research question. This had the

consequence that we deductively derived theory from different areas and combined them into our own model of entrepreneurial knowledge. Our approach is not fully deductive though, because we do not aim at falsify or accept any hypotheses (Kovács & Spens, 2005) but with an open interview guide research the nuances of what role knowledge of entrepreneurship has played in the entrepreneurial process. Usually, deductive approach is associated with a quantitative study (Bryman & Bell, 2007) but also with areas that is thoroughly researched and there is a lot of theory about. As is the situation in our fields, they are well investigated quantitative but lack the qualitative view. An inductive approach is mostly associated with qualitative research (ibid) and we have these influences mostly evident in our empirical collection where we try to as openly as possible catch the entrepreneur's notion of entrepreneurial knowledge used in the entrepreneurial process. Still in the analysis part we have used the frame of reference deductively developed in our theoretical framework when analysis the empirical data and therefore our approach could be seen as mostly deductive with inductive influences to catch the essence of a qualitative study and qualitative collection of empirical data.

4. 2 Case Selection and Sampling

The sample in this study will consist of innovative SMEs that have successfully established a company and gotten public recognition for being an innovative company. The sample will also only consist out of Swedish companies, this is because the authors are both Swedish and the thesis is written within Swedish higher education. Further, this made it easier to gain access to the companies and ultimately also the opportunity to conduct good interviews and get good data, unlike if the authors would have chosen for example companies based in Belgian. We have taken a sample of four different companies, similar in the case that they are all four startups and have proven to be very innovative companies, so that we can compare them and analyze possible differences. All four companies concerns university research though their market entry was from two different ways. Two companies started with a need and found a solution through university research, while two started from an innovative product from university research and wanted to find a market and customers where the products was applicable.

In a qualitative interview study such as this, the respondents in the different companies have been chosen based on theoretical sampling. In use of a theoretical sampling the researcher should seeks out respondents who are more likely to personify the analytic criteria in which the interviewer is interested in (Warren, 2001). In order to highlight or contrast patterns the researcher can also try to minimize or maximize the differences among respondents to better distinguish meaningful patterns within the thick description, common for a qualitative interview (ibid).

Our criteria are:

1) The company should be considered as an SME. Where SME's, small and medium sized enterprises consists of enterprises which employee number fall below 250 people and which annual balance sheet do not exceeds 43 million euro and/or turnover of 50 million euro (European Commission, 2003).

2) The company should build on an innovation, where we define innovation as: *"Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace"* (Baregheh et al., 2009, p. 1334).

3) The founder, in this case the entrepreneur should still be active working in the company.

We have chosen to interview the founders of each company as we believe they are most likely to posses the information necessary to answer the research question. But also because all the founders chosen in this study can be considered key personnel during the development of the company and innovation. They have been crucial in the process and they also fit in our adopted definition of the entrepreneur: *The entrepreneur is a person who goes from an idea to an act, and turn new technologies, new products and new industries into action where new jobs and value is created* (Timmons & Spinelli, 2004).

The companies chosen for this study are:

- **Rolling optics** – Axel Lundvall, Founder and Vice President, head of R&D
- **Peepoople** – Anders Wilhelmson, Founder and board of director
- **Graphensic** – Mikael Syväjärvi, Founder
- **Sensabues** – Bo Hammarlund, Founder and CEO

We will further describe the companies in the empirical chapter.

Because we are adopting a case study strategy we use a non-probability sampling to be able to answer our research question (Saunders et al., 2007). And regarding our sampling criteria, 1) the company should be classified as a SME, 2) be classified as innovative and 3) have the founder still in the company, one can say we use a purposive sampling technique (ibid). As we mentioned above two of the companies market entry was from the product development side and two companies came from a market need. This can be seen as a variation in sample, at the same time all four companies concerns university research and by that they are also similar and homogenous (ibid).

4. 3 Data Collection

When it comes to data collection, two types of data are mainly distinguished, that is Primary and secondary sources of data (Myers, 2009). The two types of data can function as complementary sources of data, making up for the others inadequacies or to provide conformation. So when using primary data, secondary data can increase the credibility of a research finding (Cowton, 1998).

Primary data are those sources of data which the researcher has collected himself (Myers, 2009), and which is gathered and assembled specifically for the study at hand. That is data which is unpublished, such as minutes of meetings, and which the researcher has gathered directly from the people or organization, through interviews and fieldwork. The interviewer collects the data through different methods such as telephone or internet or face to face, based on communication with the representative sample of respondents (ibid). According to Myers (2009) the primary data is the type of data which ads richness to the qualitative manuscript, and represents part of the added value the researchers bring to the study. This makes it particularly important that one is familiar with the use of different qualitative data collection techniques as the skill with using them will, to a large extent, impact the richness of the data collected (ibid). Our study builds on a qualitative approach with in depth semi- structured interviews as method when collecting our data.

Secondary data however can be defined as sources of data collected by others, thus not specifically for the research question at hand (Cowton, 1998). This includes data such as previously published books, newspaper and journal articles, that is data not gathered by the

researcher. These types of data are often generated from primary data gathering techniques as one persons' primary data becomes another persons' secondary data (Rabianski, 2003). In some cases, secondary data can be more preferred as a source of data than primary data, the biggest reasons for this is that secondary data is often less costly, might be less biased, or that the primary data is inaccessible. However secondary data also means a great disadvantage for the researcher as it entails less control of the data collected as well as the inability to manipulate the data into a useful form (Cowton, 1998). We have used secondary data in the form of articles collected to build our theoretical framework. The companies' websites have also been used when structuring the background information of the companies in the empirical chapter.

Interview Guide

The interviewer should ask questions that lead the respondent to tell their own story, thus the interviewer should go along with the interviewee in whatever direction the discussion might lead. A qualitative interview research should be open-ended where the focus should be on who is answering the questions rather than directing the questions toward one specific goal. In the design of a qualitative interview the researcher should also take in consideration the time available to complete the study, access to respondents, and the financial and emotional cost to complete the study. Because it is an open-ended and exploratory nature, the emotional costs are particularly relevant (Warren, 2001).

As a research question has been developed, partially generated from a review of literature, the interviewer should develop 10 to 12 questions along with a descriptor, asking for background information about the respondent such as age and gender. Further, qualitative interviews can be described as a use of three kinds of questions (1) Main questions that begin and guide the conversation. (2) Probes to clarify answers or request further examples, and (3) Follow-up questions that pursue the implications of answers to main questions. Also important during a qualitative interview is that the interviewer is flexible observant to the different meanings that may emerge as the interview progresses. This openness includes being alert to development in the conversation that may make some of the previously constructed questions irrelevant, as the context changes meaning (ibid).

Once the respondents have been selected and contacted, the researcher must ask them if they agree to be interviewed, and also choose a time and place for when the interview can be conducted (ibid). The four companies were stationed at very large distances from one another, so we came to the decision that Skype would be the most effective and best option to perform the interview, in which we could both se and talk to the respondent. According to Couper and Hansen (2001) despite different concerns against using computer assisted interviews, most concerns against interviewer's ability to conduct computer assisted interviews are unfounded. However often stated positive reactions towards the technology are the respondent's sense of increased professionalism and relief that the work is done when the interview is completed. The interview began as we set up the recording device and greeted the interviewee, creating a social context for the interview conversation. The four interviews lasted approximately 90 minutes each, in total, where all the questions were answered, the recording was later processed so to be analyzed at a later time.

Two interviews per person have been conducted with a representative from each company. This because the entrepreneurial process is a complex activity and can span over several of years, therefore it is a lot of information which can take a lot of time to cover and to spare our respondents and keep a fresh mind we divided the interview in two parts. Another benefit

from this approach is that the respondents is already familiar with us the second time and can feel confident in sharing more information. The interview was conducted in Swedish because both the interviewees and the respondents speak Swedish and we thought it would be more natural and easier for them to express themselves and by that make the interview less tough and stressful and generate answers of higher quality. When translating the transcript to English we made sure that both of us agreed that the underlying meaning was still in the language and we also asked a third party help us with the translation of the interview guide to make sure there was no inconsistencies in the meaning of the questions.

4. 4 Data Analysis

When analyzing the empirical data collected one can start classifying the data from the theoretical framework and by that use existing theories to shape the analysis. This in turn connects the study to already existing body if research in that field (Saunders, Lewis, & Thornhill, 2007). Because there is an already existing body of knowledge of the separate fields concerning our subject, we found it suitable to further build on this and use a deductive analytical approach. One method when applying a deductive approach to a qualitative data analysis is Pattern matching (ibid), which we have applied by finding pattern in our data that matches the pattern in the frame of references, namely the entrepreneurial knowledge that has been used. We will further conduct both a within-case and cross-case analysis to find similarities and dissimilarities among the companies (Yin, 2003) and by that have a richer theory building.

4. 5 Reliability and Validity

Reliability concerns whether or not one person's observations are the same as another's, thus weather the results of a study are repeatable (Bryman & Bell, 2003). In other words if another analyst draws two or more samples from the same population and the estimates are approximately the same, than the data and sampling process can be considered reliable (Rabianski, 2003). In reliability, two types of reliability are often discussed, external reliability and internal reliability. *External reliability* means, in which degree can a study be replicable, this is often a hard task in qualitative research such as this as it is impossible to freeze a social setting and circumstance to replace it in this sense (Bryman & Bell, 2003). Still we have tried to explain in detail how we have conducted this research to improve the chances for other researchers to recreate it. *Internal reliability*, concerns if there is more than one observant, meaning whether the members of the research team can agree on what they see and hear (ibid). We are two individuals who conduct this study and have been agreeing with what we have seen and heard and by that argue that we have an internal reliability. But as we understand a qualitative study can never reach full reliability, though that is our goal we will not fully reach it as a quantitative study might.

Validity is the process made to check that the right procedures were followed in the collection, organization and analyzing of the data (Rabianski, 2003). It concerns whether or not you are observing, identifying or measuring what you say you are, thus the integrity of the a conclusion that is generated from a research (Bryman & Bell, 2003).

The validity of a study can be seen as a the most important criteria of research, the main types of validity that are typically distinguished are *measurement validity*, meaning whether or not a measure developed from a concept really does reflect the concept, and indicates what it is supposed to be indicating (ibid). Because we have 1) derived our theoretical framework from prior research and 2) our developed model of knowledge concepts bear resemblance with other divisions for an example European Commission's (2012) divisions and the divisions

made by Chandler and Jensen (1991) and 3) because the interviewees, that is the founders are still active within the companies, we argue that we have high measurement validity. To see exactly which prior articles the measurements are derived from one can further look in appendix 1 where the measurements are summarized in a table with associated authors from both; outcomes from entrepreneurial Education and entrepreneurial Experience. *Internal validity* meaning if there is a good match between the observations made by a researcher and the theoretical ideas they develop. Ton increase our internal validity and the quality of the interviews made, we choose to conduct two interviews per person. We argue that this decreases the stress on the respondents, help build up a relationship and avoid fatigued answers when it can be tiresome with too long interviews. Through our long participation and constant contact with respondents, we were able to increase the level of congruence between concepts and observations, thus increasing the internal validity. *External validity* meaning to which extent our finding can be generalized across social settings (ibid). To increase the external validity of this study we have selected more than one company in our sample and we also sought out the individuals that possess the information needed to answer our research question, namely the founders of the companies.

5. Empirical data

In this chapter we will be presenting the companies chosen for this study; Rolling Optics, Peepoople, Graphensic and Senseabeus. We will start each case with a short background presentation of the company and its founders; Axel Lundvall, Anders Wilhelmson, Mikael Syväjärvi and Bo Hammarlund. After each presentation of the companies and respondents we will present the interview developed into discovery phase and exploitation phase. These have been divided from the definitions we concluded in the theoretical framework.

5.1 Rolling Optics

Background of Rolling Optics

Rolling optics is a business to business company which develops and sells optical film application, used for labeling, over-laminates, window and sealing and package film, to companies, in need of increased security, authenticity and reduced risk of counterfeited products. The company was founded in 2005 by Axel Lundvall and Fredrik Nikolajeff and consists today of 12 employees with a turnover of 9 MSEK.

Axel Lundvall, VP, co-founder and today head of research and development of Rolling Optics stumbled upon the idea in 2005 when studying optical microstructures, optical material and light scattering in thin foil, together with a team headed by assistant professor Fredrik Nikolajeff, at the Ångström laboratory, Uppsala University. However not until 2008 the decision was taken to start a company around their discovery, resulting in the assemble of a team consisting of a rare mix of scientific and industrial backgrounds, which enabled them to open up a faster and efficient volume production which has resulted in today's Rolling Optics patented production technology.

Other holographic images can easily be faked, however the 8 year development by Rolling Optics 3D material creates products with such a depth and clarity, as well as the possibility of both displaying printed and covert graphics which makes them easy to authenticate and practically impossible to copy. The optical film produced by rolling optics reflects light in such a way that the right and left eye see different images, as the brain puts the two pieces together the illusion of real depth is created.

Corporate form	Joint-stock company
Main owners	Founders, Uppsala university, RP-ventures.
Discovered through	University and research
Number of founders	2
Number of employees	15
Turnover	8 938 000 SEK
Number of founded businesses	1
Founders age	37
Company age	2005

Table 2 Rolling Optic summary table

Background of Axel Lundvall

Figure 6 Axel Lundvall, Founder and Vice President, head of R&D on Rolling Optics

Axel Lundvall is 37 years old, born and raised in Dalarna Sweden. When Axel graduated from high school he decided to do military service and then to study at the Technical University of Uppsala, where he underwent a master's degree in Engineering Physics in 1996. During his studies, he took a number of courses in geology and geophysics a topic he was very interested in since childhood, and after a while he decided to drop physics for a few semesters to study Master of Science in Environmental and Water Resources Engineering. But as the years went by his study funds started to run out and he decided to complete his master's degree in engineering physics. In his final three years at the university, during his spring breaks, he also worked on a paper factory where he got his first look at various processes of mass production of large-format volumes.

By the last year of his studies, to get more in depth into a specific topic of science, he was given the choice to focus on either material science or microstructure technology where he choose the latter. Axel explains that in material science the focus was on material processing in different ways while micro-structure technology was more specifically tied to the electronics industry in one way or another. Eriksson was a popular employer for newly examined students but there were also many start ups and small businesses within microstructures and microelectronics as potential employer.

Towards the end of his studies, it was time for Axel to start his thesis. With the focus on micro-structure technology, he would have to choose a thesis related to this field. Through the University's network he heard about a thesis laid out for students who were in need of good research topics and he contacted the professor Fredrik Nikolajeff who was an associated professor at Uppsala University in micro optics.

The thesis aimed to develop a new type of retro-reflective material, with other words reflective material which could be used for road signs, this was done in collaboration with a smaller Uppsala company called Åmic, which also was a startup company at that time. The aim of the project was that the retro-reflective material was going to become part of their product line. Axel approached Fredrik Nikolajeff in 2002 and through this entered the subject of reflective material. During this time Axel also describes the research field in which he did his thesis, as an environment that had distinguished itself very much for having resulted in many newly started enterprises. It was not unusual that someone who had graduated three years earlier from the same program as Axel now had his own company with three employees. And by that it was easy to see role models.

5.1.1 Discovery

The story is that during the thesis of reflective material Axel stumbled on a reflective effect he had not seen before.

"The thesis we did with the reflective material was based on making a lens structure on a surface, the same idea which we have for the three-dimensional images today. So it was during the work with my reflective material that I discovered this effect, but the effect was very diffuse and improper so I did not know what to make out of it at that time".

(Axel Lundvall, Founder of Rolling Optics, 2013).

However, this proved to be enough for Axel to consider if there was something more interesting behind his discovery. After his work with the reflective material Axel had graduated and now was unemployed. As Axel had finished and got his degree, the IT crash was in full swing and companies around the country began to cut back on staff, companies such as Eriksson, it meant fewer jobs for people like Axel and the people in the sector with the same education, the jobs remaining was often taken over by more experienced people.

The idea from the beginning was to continue and be a part of Åmics development team, but as they also was affected by the recession and therefore decided to abandon the project, Axel then decided to push the idea forward without Åmic together with Fredrik Nikolajeff. This was before he had figured out how the technology really worked. However Axel pushed on, made prototypes and after some tests slowly but surely understood how it worked and by this the concept for the company was established. Axel together with Fredrik managed to get the rights for commercialization and went there after on the mission to seek money from various organizations and institutes such as Almi[2], Innovationsbron[3] and VINNOVA[4], to be able to pursue the idea further. Axel also managed to get a space and access to the university lab where he could make prototypes and apply for money for further research.

Early on they got in contact with a company in Gothenburg called Geveko, a company that bought up a number of smaller companies in the construction and road sector in the early 2000s, which generated large profits. The company had an idea that they would take over a number of businesses to raise technology levels within their own company, so they purchased a lot of interesting small businesses which contributed greatly to their development. Eventually Axel and Fredrik ended up visiting them but Axel new at once that what they were looking for in the form of reflective materials did not match what Axel and his team had.

"So I developed a completely new product, a product that we could just as well have patented and licensed on our own, that I developed theoretically in one seating meeting with the customer".

(Axel Lundvall, Founder of Rolling Optics, 2013).

Axel and Fredrik Nikolajeff ended up not collaboration with the company as they did not accept the business terms and conditions, still Axel explain that it is a good example of how the desire to find a solution drives the development of their products to a great extent.

The year was 2004 and Axel and Frederick Nikolajeff who worked with the idea of reflective materials on their own came in contact with the two students Anders Ullstrand and Fredrik Blomquist, who wanted to make market research for the company. Anders and Frederik later turned out to be crucial for the future of the company. They got along so well with the two

[2] Almi is an organization which exists to promote entrepreneurship across Sweden and is owned by the state. Almi helps innovators, entrepreneurs and business owners who want to develop their ideas by for instance offering different types of financial help and advice on how to start businesses.

[3] Innovationsbron (now owned by Almi) is the most active seed investors and operates the country's national incubator program, BIG Sweden. Innovationsbron identifies, develops and invests in future growth, and has done so since 1994. Today they have invested in nearly 300 companies, with an annual investment rate of about 30 to 40 new companies

[4] VINNOVA is a Swedish innovation agency with the mission to promote sustainable growth by improving the conditions for innovation and fundingneeds driven by research. Each year, VINNOVA invests approximately 2 billion SEK in various projects

students that asked them if they would want to be involved in the startup as partners, if it came down to establishing the business. Something that both Anders Ullstrand and Fredrik Blomquist agreed on.

The same year, Axel got a new job at Micronic Laser Systems in Täby Stockholm, so he could earn a living while developing his idea. Micronic Laser Systems produces and sells laser pattern generators for microlithography to the electronics industry. This was a great job for Axel, a project employment which later would lead to a permanent job. Here Axel got the chance to works with microstructures and nanostructures which gave him an insight in extremely small details and an understanding of how microstructures actually works in an industrial perspective, also, how to use this knowledge and how to measure such small differences in things. He compares it with the paper factory he worked on during his spring breaks which gave him an insight on the major processes and the 200-metres machines.

However how good the job was Axel still could not let go of the idea of reflective materials.

"When I want something, I just have to do it".

(Axel Lundvall, Founder of Rolling Optics, 2013).

So Axel chose to take a job as a consultant within the company to be able to manage and add hours as he wanted and to be able to continue working on what would become the Rolling Optics.

Axel now had to find people, customers and build a good network, he describes the situation as a period in which he had to go outside of his comfort zone so that he could evolve and engage with people in different fields to solve problems. He further explains that if one cannot socially behave the person can easily be seen as intrusive, but if one have some basic sense of how to behave that person will be perceived more as a curious fellow. During this time, Axel used Fredrik Nikolajeff contacts at the university and felt that they were dependent on a network. This is why it is important to focus only on the possibilities, ask someone if there is something he or she doesn't understand and by that either use one's own network or a friends' network.

During this period Axel needed capital to pursue the project further, so Axel together with Fredrik managed to convince Uppsala University, their holding company called Uppsala University development stock-companies to invest 250 000Skr together with a counter-financing from HH-Foundation, to evaluate the potential of a possible mass production technology for their products. This also made it possible for them to establish the company in 2005. According to Axel it was a really exciting experience to go ahead with starting a company, and felt like a great adventure to start a business.

5.1.2 Exploitation

Through the years, Axel actively looked for companies, primarily in Sweden, which had processes that were close to what Rolling Optics needed. This search gave him a broad knowledge about many machines and processes. He further describes that by looking at processes which involves material that is similar to what they are doing, quickly leads to the development of new ideas. But also that inspiration and information searching occurs in periods and sometimes one needs to go home and let it simmer before doing some tests. Because sometimes it will show that these processes will only work on that specific product.

"I prefer to try things in practice, and draw conclusions based on the tests I see, I do it in my head and practically rather than only on paper."

(Axel Lundvall, Founder of Rolling Optics, 2013).

Axel realized that for the business idea to become something and achieve its necessary goals, they needed an idea of how to mass produce the materials, that is why they did a lot of searching. Finally they found a company in Finland who had the technology necessary to produce micro-structures in a rolling process. The technology found in Finland showed to be crucial for the concept to get started and they began planning cooperation with the Finish company, as a result they got an additional investment, this time from Vinnova of 3.6 million in 2006 to develop the production process. With the grant from Vinnova it became possible for Axel to get a salary from Rolling Optics and thus resign from Micronics Laser Systems and instead work full time as an industry PhD for Rolling Optics. Three weeks before they started Rolling Optics Axels first child was born. He reflects on the situation and explains that it is not everyone who resigns from a good job to troughs himself into an unsure, start-up business life 3 weeks after he has become a father.

When starting on Rolling Optics Axel also took with him two employees from Micronic Laser Systems, who became the first two employees of Rolling Optics, they still work within the company today and belong to the core group within the company. The first CEO of Rolling Optics Anders Ullstrand is also an old CEO of Micronic lasor system. Axel ironically explains that the old work experience came to a good use.

The founding of Rolling Optics gave Axel the opportunity to take courses at the university, which included a course in innovation and entrepreneurship of 10 credits (7.5 credits in today's value). Here he got a chance to apply his own journey of starting a business. Through this course he also was able to meet with funders and funding sources.

2007 Axel went traveling with Anders Ullstrand to, as he describes it, all the people in the north who had money. They went traveling around the country looking for companies, contacts, rumors anything that could help in the development of Rolling Optics. They met Saab Barakuda, a company that makes equipment for the Swedish army force in Västervik. They were to a textile company in Ullrishamn, to see if they could use ROs products in their machines. Outside Göteborg they found a company who manufactures a positioning system for driverless trucks. And they met a lot of commodity companies that produced film and sheet materials, but eventually they ended up more and more towards the printing and packaging industry. Their purpose was also to present their ideas for venture capitalists, wealthy private investors and various institutions, to increase the interest in their products.

Axel's ability to pitch their ideas had probably the most importance in 2007, when they went out and searched the first major financing, not only to finance their salaries and prototypes but also to build the production system. During the year they managed to get 14 million SEK, Axel describes the situation as never been afraid to present his ideas, he rather sought audiences in different ways, and he really felt at home when standing and presenting in front of a crowd. Challenges motivate him, as soon as someone doubts the concept it gets him going. However when everything goes well, then his motivation decreases, on the other hand when something breaks for example a machine or if anyone doubt his ability to accomplish something, then that is it, his motivation increases a lot. His ability to motivate others he explains is mostly because he has a positive outlook on things, he find it hard to see when people just perceive the bad sides of things. Many times he use pep talk and positive

sentences. His ability to be very happy, forward, and active, is what helps people to get motivated he thinks.

Unfortunately, it was soon discovered that the technology in Finland was not the right production technology, however it soon lead Axel to find another production Technology which was better suited than the first, but just the fact that they came to the point and evaluated this idea and technology found in Finland fully enabled them to develop the concept further.

Another roadblock that Rolling optics encountered was the difficulty to get through on the marketing side and reach potential customers, so in 2007 Axel found a new use for the technology and chose to completely change tracks, first now they went into the business idea they have today, namely to produce the three dimensional images.

The connection and the money from Vinnova enabled the development which meant that they eventually found the right production technology which was very critical. In 2008 a number of employees were hired, and it was not until now that Axel had to delegate tasks to the employees'.

"It's a challenge and a direction in which one must grow if it is to remain in these kinds of projects, be able to delegate and to release time in the beginning of a business so you don't have to do everything yourself, even if you know it all yourself".

(Axel Lundvall, Founder of Rolling Optics, 2013).

By 2009 and 2010 they made great progress in marketing their products, for instance publication of their first product in a magazine by Iggesund paperboard, which is a company that manufactures paperboard products, thus targets the same customers as Rolling Optic, and distributes their magazines in 20 000 copies, sparking a large interest in Rolling Optics products.

Iggesund was the perfect customer, they were interested in the product and provided both PR at the same time as they were our customer. Next step was to find someone who could apply the product as they wanted it to be applied. Because at that time, the production was not in a continuous band but more like stamping units from a single roll which was a major problem. Still Axel was sure that he could make the process more efficient. Eventually he found a book printer in Åtvidaberg, a window application machine as it is also called. Axel went with his team to make the application and had all the materials prepared, the company in Åtvidaberg had brought a man who had been operating this machine for 30 years who was recently retired, he was considered an expert and his role was to supervise the usage of the machine. The man though was skeptical and did not believe the machine could do what Axel wanted it to do. The man decided to run a process just to prove his point, which went totally wrong as he had expected. Then Axel decided to try it himself and at first it did not go well either, but after some time he started to get the hang of the process, he stood there for almost 16 hours and turned on the dial until all 20 000 units they had brought to the company were printed.

"It is probably pretty symbolic in how I refuse to give up in any way, and need to find a solution. I don't except that an old man tells me it is not possible just because he has not done it himself. If you believe in something and have made an assessment where you think you know that it is possible, then you also should test it, and not rely on someone else's words."

(Axel Lundvall, Founder of Rolling Optics, 2013).

By 2010 Rolling Optics had gotten the attention of major European companies, and was now in the position of evaluating a number of partners. Gazette of Sweden became their first volume customer when they used Rolling Optics label for their hair care range of 500 000 items. Rolling Optics sales increased by 90% over night which made a big buzz in the industry. The next year they had gotten several volume customers, among these several very large brands and brand owners. It was a challenging but very educational year for Rolling Optics as they struggled to find the right materials and a continuity of suppliers. But the organization grew from 7 to 15 people.

Axel goes on to describe that they now have a confidential co-operation with a company that had the same product concept in mind about 20 years ago that Rolling Optics have today, but only in theory. However they also made the effort to mass produce the same products but failed. Now, instead of making it themselves, they chose to contact Axel and Rolling Optics to start a collaboration, and Rolling Optics became the manufacturing partner. Axel explains Rolling Optics success in relations to the other company, as a result of not taking no for an answer, they did not hesitated, just simply made it, Rolling Optics unlike them who were a larger corporation, had more to gain and less to lose.

Axel claims to have received an increased performance need over time, a characteristic which he believes have been part of him since he was young. He explains that he cannot resist a challenge and that he expects the best performance from himself in general. If he wants something, he just does it, a tendency he explains has increased after 2005. Axels overall goal for himself and Rolling Optics has been to create a successful business, it has not so much been tied to the technology itself, it is mainly his ability to contribute so that Rolling Optics becomes a successful company, so he had to make sure that the technology worked. His overall mission is more about creating a successful business, and he thinks it is less interesting whether they make reflective material or 3-D images. An attitude he thinks he has had since University.

Axel explains that they earlier tried to find their competitive edge, how to market their material, and Axel then got the idea to manufacture the labels as environmentally friendly by making them recyclable or biodegradable to the same extent as the packaging they are put on so they can be composted with the packaging. The team than made the effort to make the material of cellulose quotes with a polymer produced from forest products. The project became successful however it appeared to be difficult to get the product into the market. Axel explains that it was a great product but it did not matter in the end, because it was after all, just about price. And it is an experience he has learned from the industry. The industry is very price pressured in general and it sounds good with the environmental argument but there is no one who cares in the end and is willing to pay for it.

“My focus has always been on product development but with very close links to the market. My best product development moments have been when I have sat down with a client, in the clients working environment, seen their factory, discussed with them and gotten feedback on exactly what they need. It has not been that I have sat down in the basement, on my own, and scratched my head trying to figure something out”.

(Axel Lundvall, Founder of Rolling Optics, 2013).

5.2 Peepoople AB

Background of Peepoople AB

Peepoople is a Business to Consumer Company which was founded by Anders Wilhelmson and Camilla Wirseen in 2006 and consists today of 10 employees with a total turnover of 2 MSEK. Anders Wilhelmson was selected by Ashoka: innovation for the public, a global nonprofit organization who supports the field of social entrepreneurship, as the first Swedish Ashoka Fellow for his work on Peepoople. The company was founded in cooperation with the SLU Swedish university of Agriculture Science and KTH Royal Institute of Technology, and based in Stockholm, Sweden.

Peepoople is responsible for the development, production and distribution of the Peepoo solution and system. The company is private limited, owned by among others STING and private families and individuals from Sweden, Netherlands, and United states. The company has a commitment to solve the global sanitation crisis and their mission is to make so that all people who desire shall have access to dignified and hygienic sanitation, with the long-term goals to provide 150 million people daily with sanitation. Peepoople AB is therefore a for-profit organization in order to expand and succeed with their mission. Part of the founding team is also Dr. Annika Nordin, Dr Björn Vinnerås, Prof. Mikael Hedenqvist and Peter Thuvander.

Corporate form	Joint-stock company
Main owners	Founders
Discovered through	University and research
Number of founders	2
Number of employees	10
Turnover	2 011 000 SEK
Number of founded businesses	2
Founders age	58
Company age	2006

Table 3 Peepoople summary table

Background of Anders Wilhelmson

Anders Willhelmson is the inventor of the Peepoo toilet, founder of Architects Wilhelmson and Peepoople AB where he is both a partner and works directly under the board.

Figure 7 Anders Wilhelmson, Founder and board of director at Peepoople AB

Growing up Anders loved high school and believes that this was the basis for his creativity and ability to go beyond all disciplinary boundaries, and his ability to see how different pieces of a puzzle could fit into a bigger solution.

1979 Anders took a degree in architecture from the University of Gothenburg and has been active in various configurations since 1984. He has also been responsible for the Royal Art Academy in Stockholm of architectural education for 10 years.

Through his employment in the Royal Art Academy Anders has been supervising students in a number of different projects that could be seen as crisis projects or difficult projects, and in

that sense he explains one could say he has an ability to lead people to achieve results. Anders has been running a consulting business since two years after his graduation. The business has been taking different forms, changing ownership from time to time, but today Anders is the sole owner.

Wilhelmson architect is an architectural firm that has worked many years with the auto industry, including car companies like GM, Opel and Cadillac. They have also worked with LKAB, in the relocation of the new city of Kiruna where their primary work was with housing. They have a renowned reputation in the architect industry, and are to some extent regarded as provocative. So in business terms he did not start from scratch with Peepoople. Of course there is a big difference between a consulting firm which Wilhelmson architects is and operating a large industrial company as Peepoople. But the bases are the same, and the experience he has been through has had a huge influence he explains.

5.2.1 Discovery

The idea for Peepoo started in early 2002 when the Royal Art Academy began a three year project which confronted design-oriented architects, and conventional methods of architectural speculation and projection, as well as to look at the state development in extreme urban slum conditions. This was done for several study trips to among others Mumbai, Cairo and Mexico City. It was the notion that one billion people lives in slums around the world that sparked his interest in the subject. He studied slums during some years and the idea was born during a meeting with a number of women who lived on the pavements of Mumbai in India.

Approximately 40% of people in the world have no toilet, and it was one of the issues that Anders explains the woman for Mumbai India could not manage on their own. Their problem was that they could build their own housing and they could do a lot, but they could not handle the issue of going to the toilet.

"At this time there was no indication that I would start a company, but I got a vision, I have a very special approach to architecture, I am more problem-oriented, which means that when this problem appeared, I saw this as a problem that needed to be solved"

(Anders Wilhelmson, Founder of Peepoople, 2013).

He began working on the problem in May 2002 and the idea in its principles, consisting of five points surrounded by a main point, was clear on September 19th the same year. There after he set up a project team which was started by a group of three people, among them Camilla Wirseen who later also co-founded the company and who is still active in the company. Anders and his team started by looking online after useful solutions that could be applied in their case and together with the team constructed a list of six pieces that they thought would be an interesting field of research to develop a solution. They found a number of interesting companies but finally settled with one professor, Håkan Jönsson and a group of researchers at Uppsala University. Their research proved to be what they could build the product around in the case of sanitation. When it comes to the material of the product it would be based on chemical research, and it was quickly understood that they had to work with some of the largest companies in the world who engage in biodegradable biomaterials. Their decision came finally to BASF, the German large chemical group.

In September 2005, Anders and his team had the concept formulated. Five points which were enclosed by a larger main point; 1) It should be private or personal, 2) It should be mobile, 3) Infection should not be spread through toilet, shall be required to be self-cleaning and easy to be washed, 4) Not wasting resources, not creating any waste, all waste will be made into

something useful, 5) Product itself would not be a waste in the end, but should disappear through decay or something similar. The final point, which was the sixth overall point, was that it would have to be easily accessible and so cheap that even the poorest can buy it. It was formulated on 19th September. During this period, we worked with the five points in parallel to get all issues.

At this stage, Peepoople was well in time, there was only one biopolymer in the market of plastic, so Peepoo was in the forefront of what could be possible with plastic.

"In a sense, the knowledge me and my team had was crucial, it would perhaps not have been possible to imagine this type of product two years earlier"

(Anders Wilhelmson, Founder of Peepoople, 2013).

During 2005-2007 Anders formed a project management and a multidisciplinary team of researchers from KTH Stockholm, Professor Michael Hedenqvist and from the Swedish University of Agricultural Sciences, Uppsala, Dr. Annika Nordin and Dr. Björn Vinnerås, like Peter Thuvander, a cluster of researchers and companies that produced the whole concept.

Peepoo became a personal, single-use, self-cleaning, fully biodegradable toilet which also prevents feces to contaminate the immediate area and surrounding ecosystem. After use, the product Peepoo and the human feces could be used as fertilizer to improve the livelihoods and increase food security. Anders explains that it is huge risks to put one's own money in a startup company, more so if one is not exceptionally wealthy. But he also stresses that one must not be too scared. He also points out that a 25 year old might have more chances to start a business than when a 50 year old so the risk could be seen as higher for him.

Anders continues

"I have been running a business so long now and worked in fairly large project, so it is important to build a team and have the right people develop properly in their job. I have an ability to see what people can and cannot do which also is incredibly helpful"

(Anders Wilhelmson, Founder of Peepoople, 2013).

2006 Anders and Camilla Wirseen officially founded Peepoople in Stockholm, Sweden, to develop, produce and distribute the product Peepoo. Peepoople was formed with the mission that all people who so wish should have access to a dignified and hygienic sanitation, the long-term goal of peepoople is to provide 150 million people with daily sanitation. Peepoople was at this point an initially wholly owned subsidiary, which was 94 per cent owned by Wilhelmson architects which is Anders own consultancy company.

5.2.2 Exploitation

They applied for a patent in March 2007, which was a quick process and already in December it was granted. Anders explains that having a Swedish patent is considered very strong in the world. Having Wilhelmson architect as owner where Anders owns 100% was an easy decision simply because of the economical aspects since Wilhelmson generates good profit and has therefore good capital bases. Though 18 month after the patent approval the costs would become quite large which mean that money would be diverted from Wilhelmson architect to Peepoople. Therefore the company was taken out of Wilhelmson architects and formed as a joint-stock-company.

It is Anders first patent which he is very proud of considering that this is a radical idea, and unique in the world. He has further got the patent accepted in many places around the world and has been selected as one of 100 inventions in the royal technology museum.

In 2008, Anders decided to go out and try their products in a larger scale, 2008 was also the world sanitation year, so he decided to make a number of major pilot project which were self-financed and at the same time market their product. Peepoople have put a lot of energy to communicate the name of the company and has therefore become one of the mostly acknowledged Swedish companies within design in the world.

At first it was about how to make Peepoople known, and at that time they were aware of which strategic decision they had to choose.

In early 2009, Anders and his team decided to seek funding to hire a CEO, he was able to get his first funding by the summer of 2009. A CEO was short there after hired in October of 2009. At that time, they set a goal that they would ensure the necessary funding to build a production system, they accomplished it two years later, in 2011, and thus they were ready to start developing their production which is supposed to start by the end of March 2013.

Anders at the start thought that Peepoople would be a little less capital-demanding than it was, he explains that he was probably alone in that beliefe. The lesson he learned was that one should include the Pi factor in all costs, that is, everything becomes 3,14 times more expensive. Since 2010, Peepoo has been sold, used and collected in several locations, including Silanga, a village in Kibera, Kenya, Africa's second largest slum. The product Peepoo has also been successfully tested in Boxwood slum, Durban, South Africa with Oxfam Novib, slums in Mymensingh, Bangladesh along with GIZ, and Bihar, India. Peepoo currently is used by 5000 people and in more than 30 schools. Anders never had the aspirations of being president of Peepoople since he was president in his other companies. And that is also why they recruited a CEO early. He see it more as a excitement to build a company that is stable and long term rather than being bought by a multinational giant companies.

”Is it possible to do this through individuals today… We hope so. We did not really understand the extent of it when it was started, but maybe it was a positive thing that we did not grasp the whole picture from day one”.

(Anders Wilhelmson, Founder of Peepoople, 2013).

5.3 Graphensic AB

Background of Graphensic AB

Graphensic AB which is a spin-off from Linköping University research is a business to business company and run by 3 employees Mikael Syväjärvi, Rositsa Yakimova and Tihomir Iakimov. The company was founded by Mikael Syväjärvi 45 years old in 2011, a technical PhD, associate professor of materials physics who started his career studying Applied Physics and Electrical Engineering in Linköping, Sweden. The company produces and supplies epitaxial graphene on silicon carbide which is manufactured using the high temperature graphene process. The material graphene which was Awarded with a Nobel prize, has created

an astonishing range of new possible applications originating from its versatile properties, among the applications are next generation of electrics, allowing faster technology changes in development of new devices for environmental and energy systems.

Corporate form	Joint-stock company
Main owners	Founders
Discovered through	University and research
Number of founders	3
Number of employees	3
Turnover	354 000 SEK
Number of founded businesses	2
Founders age	45
Company age	2011

Table 4 Graphensic AB summary table

Background of Mikael Syväjärvi

Mikael Syväjärvi is one of three founders of Graphensic AB and has worked with the business concept since 2010.

Figure 9 Mikael Syväjärvi, Founder of Graphensic AB

Growing up Mikael went the science program in high school and then chose to study at Linköping University, a masters degree in Applied Physics and Electrical Engineering. After his studies at Linköping University, he decided to continue his career within the university and research on materials. Today material science is his specialty and he has also become a technology doctorate, associate professor of materials physics. His earlier work experience consists of working as a journalist, a sole proprietorship and holding presentations in popular science. He has worked in research for almost 20 years, since he started with his thesis.

When Mikael had to choose a program in high school, he did not know what he wanted to work with later and therefore chose the science program since it was an open program with many possibilities. He saw it as a way to postpone the choice till after he graduated. So when he was suppose to choose a university program he chose the masters degree in Applied Physics and Electrical Engineering in Linköping, because he felt applied physics was best suited for him. Mikael explains that this is often the way he make his decisions, he chooses what he enjoys doing and belives is fun and ensures that he is working in that direction. It is the same with the company, he thinks it is fun to build a business and get it rolling, however when the date comes that they need to focus on large volumes and optimizing the production, subjects which do not really appeal to him, he will let someone else take over.

Today there are three people working on Graphensic AB and they have complementary skills, Mikael early on got the role of becoming the entrepreneurial driver in the team and describes himself as the initiator of the group, doing things a little faster while his colleagues are a little more thoughtful which makes the dynamics of the group very good.

Mikael has published many articles and from his previous experience he is used to documenting results and plans his research. This way if something unexpected happens it will

not become as much of a panic. He explains that he has always had that sort of a planning routine.

Rozitza Jakimova is behind the research, she is the one who has the most scientific experience and expertise on the subject. Rozitza has also been Mikael's supervisor during his own research so they have been working together for 17 years. They usually sit down to discuss ideas they have which in turn leads to a lot of more ideas.

"As a person, I often get many ideas and I'm pretty creative when it comes to different things".

(Mikael Syväjärvi, Founder of Graphensic AB, 2013).

5.3.1 Discovery

The background to the business of Graphensic AB is that in 2005 Mikael and his team had developed a method for making films of silicon carbide. This led to an inquiry from a company that thought the method which had been developed seemed very interesting from a commercial standpoint, they then proposed the idea to help Mikael and his team to commercialize the method. This ended up in an agreement where Graphensic AB would assist them with materials, and the company would commercialize the method.

Through this experience Mikael learned the benefits of a network, specifically a good business network that was focused on research. He describe that the company is developing materials, but in order to study the properties they need cooperation. It was important to have cooperation's with others and have exchanges with others to be able to move on with the development. For Mikael as an entrepreneur it is something that is very basic, having a network, talking to people, bounce ideas, get input and ask around while providing them whit information in an exchange.

The cooperation with the firm worked well, the team got both experience and lessons learned. During this time Mikael also got the chance to work closely with a businessman, and this was the first time where he got a taste of the possibilities surrounding commercialization of research. That experience also helped him when they started their next project, because he got a basic understanding of developing businesses. He further explains that off course he will never avoid all mistakes but he may be able to avoid more mistakes than necessary.

After a few years, Mikael and his team was able to develop a new method. He got the hunch that there could be a great idea behind the material the new method was able to produce, so he chose to examine the material more comprehensive.

"You do not know right from the start if it is a good idea or not, and you definitely do not know if there is a commercial interest for the materials, we are researching the basics of materials, fundamental properties, and from that point of view it is a pretty far distance to a commercial use"

(Mikael Syväjärvi, Founder of Graphensic AB, 2013).

The material which later would come to be epitaxial graphene on silicon carbide was made in the research lab long before there was a great deal of interest in the material graphene. They were able to make the material and had research collaborations, supplying the materials to research groups for free to study the properties. Mikael describes that it was important to be critical and searching for more information before one believes a breakthrough has been

made. Often it turns out that the result is good but not as good as one had hoped for and therefore one has to do a little more research in some way to make up for it. By doing so one becomes more realistic when presenting the results.

The materials they supplied quickly became an issue, as the interest grew and took too much of their time. This was the time when Mikael first got the thoughts of starting a business. Requests for their materials appeared continuously for about a year. So when Mikael and his team could not handle the situation anymore they decided to stop the free sampling and start charging instead. It was soon clear that customers were willing to pay for the material they produced. Mikael describe himself at that time as being unfamiliar with the whole process of entrepreneurial startups. So during this time, he got in contact with the innovation office, and a business coach there who gave him advice and support and pushed him to take more moves. Also, at the same time, Mikael was involved in a mentoring program, where he got a mentor that he could discuss with concerning starting a business which helped him developed as an entrepreneur. Soon he had enough support to take the step and start the company.

5.3.2 Exploitation

Mikael got the responsibility to provide the initial data and specify the business case, how to set up a business and what to sell, as the material they would sell differed greatly from the material they usually hand out to scientists in research. Since there is a wide range of applications for the material he also had to specify the market and which customer was most relevant to their type of Graphene.

Because he was the instigator to a lot of the business himself, when it came time for the idea Graphensic is based on, Michael got in touch with customers and operators so that he could develop the ideas. He visited the innovation office to ask questions, the Swedish innovation agency which was easily accessible and whose role it is to support researchers who want to commercialize. He took courses in order to understand more about entrepreneurship and patents, in order to gain a better understanding, and to make a decision and start a business. Since everything was new, he search for the necessary information, googling on the internet, asked people “how did you do, I have this idea” and then he bounced ideas. He explains that the experience is the same when learning anything new, one day one has enough information to make decisions whether he or she should start or not.

They began selling materials to other research groups that they did not have any relationships with, and for each sample they also rented out the equipment in the lab, this gave them a safe scene in which they could start a business, get revenues, and never having to search for venture capital. The aim was to build the company gradually, to sell in a few volumes, but have the first customers secured. Mikael explains that it was not much risk given that they did not take any loan to start the business, and also when they started they already had a bunch of orders so the financial risks was very low. Mikael does not like the kind of risk where someone has to mortgage the house to be able to concentrate on their business idea. He has a wife and four children that he does not want to risk putting on the street. Further, since they were researching from the University it came with the advantages that they could have flexible working hours.

“If you have to risk too much like for instance, take a loan on your house, then you are not good enough as a businessman, or found the right solution yet, or the idea in itself is not interesting enough”.

(Mikael Syväjärvi, Founder of Graphensic AB, 2013).

The sort of risk he feels comfortable with is spending his time on the research which he cannot get back, but is necessary to avoid the financial risk.

Michael continues to explain that the reason he continued in this direction was because it was interesting to him. He did not do it to make money, it was not the basic justification. At the age of 40, he needed to find something new and in entrepreneurship he found it, it gives him new kicks, new ideas, and is today one of his biggest motivations. But also, Mikael tells us that pride also plays a big role, they have developed the technology themselves which has a commercial interest, and Graphene has big potential.

There is a big hype and a great faith in the material Graphene today and the general belief is that there will be a variety of applications in the future. This has resulted in a great need for materials today to be able to develop these applications, this means that Mikael and his colleagues can deliver material that is still very close to the research.

Graphen on silicon carbide can be done in different methods, and Mikael explains that a big difference between Graphensic and its competitors is what temperature to use. Other research groups may use temperatures between 1100 degrees and 1700 degrees Celsius while Graphensic has a method that uses 2000 degrees Celsius, apart from this, there are other technical and physical advantages, it is a difficult process to implement technically, thus there are not many who can do it. But Graphensic has the background experience necessary to produce the material and with good quality of material, in fact Graphensic had world leading quality of Graphene on silicon carbide.

"It is a key point to innovate, especially in my case where I am a young researcher, yet established professor".

(Mikael Syväjärvi, Founder of Graphensic AB, 2013).

So because of this, Graphensic not only supply materials but also knowledge, so that customers can take on and develop their applications. For example, when customers got their results from the material, the team at Graphensic participates and discusses the results, provide input and help them interpret their results. This is a strength in Graphensics which is often highlighted. For Mikael it is a balance, both to innovate and find new areas that are interesting but within the company one needs to adapt to what the customer is interested in. He explains that it is pointless developing graphene towards something nobody needs or is interested in, this means there is a limit to how innovative one can be if no one is prepared to buy the developed material even if it is superior to any other.

It is Graphensics understanding of the material and how to develop and use techniques to make the material which also distinguishes them from others. But they are also very aware that in the case of materials such developments always take a long time. Mikael explains that other companies that attempted to commercialize similar research in materials, had a standard time of development of about 8 years from the launch of the company to them being in full production. Research does not go fast, which Mikael and his team know from earlier research projects. Further he explains that it is not possible to accelerate even if one is efficient, which means one have to find the balance. But also find solution to problems that appears.

”Nothing goes fast, and things take time, so the expectations have to be put on that level”.

(Mikael Syväjärvi, Founder of Graphensic AB, 2013).

5.4 SensAbues

Background of SensAbues

SensAbues is a business to business company and a spin-off from the Karolinska institute of medical science. The company was founded by Bo Hammarlund and Olof Beck in 2009 and has a turnover of 50 000 SEK, the company develops a product that is able to sense drugs from exhaled air. The product DrugTrap consists of a filter holder, mouthpiece, plastic bag with volume indicators and seals for both ends. After the drug test has been done the filter holder is sealed and labeled and then posted to the laboratory where it is analyzed. The target customer consist of addiction care and prisons, as well as traffic controls made by the law force. SensAbeus has several key partnerships in the Europe and the U.S. The company’s objective is to sell 10 000 tests per day by the end of 2013.

Corporate form	Joint-stock company
Main owners	Founders
Discovered through	University and research
Number of founders	2
Number of employees	2
Turnover	50 000 SEK
Number of founded businesses	12
Founders age	48
Company age	2009

Table 5 SensAbuse summary table

Background of Bo Hammarlund

SensAbues was founded by Bo Hammarlund and Olof Beck. Bo Hammarlund started his career in Linköping where he studied for an MSc in Engineering Physics, and belongs to the class 82nd. After his studies he worked as a researcher for 8 years, both in Sweden and in the U.S. He has been part of the Academy Board of Education and worked with sales and marketing for 10 years in larger corporations. From 2001-2005 he worked primarily with startups, two in the U.S. and two in Sweden. Thereafter, since 2005, he chose to focus on starting his own companies, and today he is involved in about 10 companies.

Figure 10 Bo Hammarlund, Founder and CEO of SensAbues

Olof Beck in turn is head of the laboratory at the Karolinska Institute where he spends 80% of his time working at the Karolinska Hospital analyzes drugs and doping, and the remaining 20 percent of his time inventing at the Karolinska Institute. Olof is the technical director at

Karolinska Institute, and is not at all interested in marketing, which Bo does not mind as he prefers him manage the development of analyzes on his own. After two years, Bo has been working with marketing, sales and ensures that they hire people so they can get started and intensify customer relationship.

5.4.1 Discovery

The background to the discovery of SensAbues is based on a conversation that Olof had with a former contact. The contact was also from the same field within the medical industry but who had a different analysis method to drugs. The contact asked Olof if it was possible to analyze drugs from a person's exhaled air, something that Olof at the time said would be impossible. After some time however Olof thought to himself that perhaps it was worth trying anyway.

It was in the fall of 2009 and Olof had an addict on the Maria policlinic who had taken amphetamines. Olof decided to contact the Defense Research Establishment and get hold of a filter which might be able to capture traces of small particles in the air exhales. He then asked the addicted man to blow through the filter, Olof then took care of the sample and started working with it in his lab. In the first test result, Olof managed to find amphetamine, a much unexpected discovery for Olof. Thereafter he obtained ethical permission to test for all other drugs. Soon he got a positive result for all the drugs he sought for. This was much unexpected and he decided to write a scientific publication. Not before long he got a call from the U.S, a man who told him that he had tried this idea for five to ten years without any result, and that was the point when they realized that he had made a large but totally unexpected discovery. It was during this time that Bo came into the picture in May of 2010, explaining:

"It takes almost a year to know if something works, weather it is the project or the personal chemistry, but we started anyway. I'm not worried about starting a kickoff, the worst that can happen is that you have to close it down".

(Bo Hammarlund, Founder of SensAbuse, 2013).

Bo was at Karolinska Institute with a mutual friend of theirs, investigating a technique of a completely different sort, namely if they could develop a new system for measuring anesthetic gases from a person's exhaled breath using a laser diode technology. When at the institute Olof presented his idea to Bo, seeing this as his only chance to commercialize the idea, and explained that he needed money to start the project, and he could not do it by himself. This was something that Bo had a better experience of than Olof, so he decided to invest in the project.

Bo and Olof are working mostly at separate locations where Bo is in the north of Stockholm and Olof is in the south of Stockholm. Bo is sitting in an incubator at Karolinska Institute periodically called Karolinska Institute Science Park, The reason for this was to get information and documents about where to start and what to think about. He felt that he lacked the administrative experience the most, but also how to write a business plan. After gathering some information from the incubator he then proceeded with registering the company. Bo's job was to do everything and anything, he was the president, managed sales, managed the financing. However he did not do the analyzing in the lab that was Olof's job. So Olof and Bo meet once a week or once every two weeks and beyond that they are in constant communication through phone.

They also try to meet customers together, and they have done so at exhibitions in particular, but Bo also has been at exhibitions many times on his own. Bo explains himself as being very

independent, he is not so good at working with other people in a group and sitting in meeting whole days discussing. He is very eager to grab things, love to travel by himself and establish customer contacts and sales.

"Entrepreneurship is a pretty hard job, I usually say that you have to be an idiot to try this job. For someone who does not have good experience or a great product it means a lot of risk".

(Bo Hammarlund, Founder of SensAbuse, 2013).

Because Bo has a family, wife and two boys, it could have meant a lot of financial risk because one do not get a salary for a few years, no pension and if the business goes bad one has no security. He continues and explains that even if one has a good idea, it is not known until two to three years later.

Bo continues to explain that he was focused when they started setting up the company mostly because he was very curious. He fully engaged in the subject of drug testing and learned a lot. He went to the U.S looking at how the equipment worked but also learned as much as he could from Olof. Bo reflects on the situation explaining that in the beginning he did not know where to start so he asked anyone for tips and advice. People gave the impression that they know exactly what to do, but many of them had only heard or read about what to do, but few of them had actually done it.

Bo explains that some projects at the Karolinska Institute were focused on for example enzymes and proteins, a subject which he did not know much about so he often declined those projects. However, drug tests did not seem so complicated and it felt like something he could manage.

Bo later tells us that his focus was towards the market, and internal administration, a role which he felt did not change over time. The only thing that changed over time was him being able to complete his job at a much faster paste and with better quality.

I myself have started companies before but not in this industry, so my decisions were made, more or less based on trial and error, with the belief that we really had a good product"

(Bo Hammarlund, Founder of SensAbuse, 2013).

Bo now needed funds in order to develop his business. By October 2010 Bo managed to convince Vinnova, the Swedish innovation agency to invest one million Swedish crowns in contribution so that he could develop the company. This allowed his partner Olof to continue his research while Bo could file for a patent and begin the commercialization process, which he did the following month. Within six months Bo was able to get an additional 2,7 million SEK to develop the idea further. When they started to make the first number of products they needed a quite small sum of money which they got from Vinnova, so in that sense the risk for Bo was quite low. The only risk Bo has invested is his time. But his view on the situation is as he explains that, he has many companies so even if one of them goes down the drain, he might gain back the loss from another company.

5.4.2 Exploitation

Bo explains that when he started the company and when he starts a company in general, his thoughts are that in two years he must have good board members, In about three or four years,

he must have a good CEO who comes from an industry background that can take the company and assure the quality of it and build a great company out of it. He does not see himself as an industrialist who can take this to the next level, he rather see himself as someone who can start it, get money and customers and get some guidelines on how to collaborate with other companies to create better products for the customers.

Bo and Olof established the company in 2010. SensAbuse did a lot of creative solutions themselves at the start. Aside from developing the product which is able to pick up traces of drugs, they also did the design of the sampler together with Munkplast which they came into contact with in November of 2010.

"You have to be creative enough so that you get a good patent for example. All innovations come from some kind of invention and the invention must be creatively processed to fit the market. So creativity comes directly after the invention".

(Bo Hammarlund, Founder of SensAbuse, 2013).

Bo explains that his prior experience taught him how to find money in Sweden, Europe and even from investors around the world. The first company which he sold, he received a number of millions thus he acquired himself people who could help him manage the money, the same people also has acted as financial advisor throughout the years. Apart from this, he decided to put all the money in the same bank, using the same accounting firm, and auditor. Thus, he has managed to create a good network which he can rely on for advice and ask when he needs financial advice. When it came to SensAbues Bo also found a competent administrator who used to have a job in which he reconstruct companies which were about to go bankrupt, reconstructing them to run effectively again. This individual also turned out to be a good source of information regarding the financial aspects of running a business.

Bo explains that he is glad that he has a technical educational background because it is a quite complicated analytical process in SensAbues. When a company this small has to do the marketing themselves, the job also involves a lot of traveling and meeting major clients, and one has a lot of use of networks and contacts. Bo had to rely on his knowledge to get money, find customers, production, prototypes and collaborations and by June of 2011 he started the international marketing of his product. Everything else was new to him, considering that he did not have any network within drug test at all. He got a lot of input from Olof, he was also at exhibitions every six weeks throughout the world where he could met interesting people, pick up brochures and information which made everything less complicated in the end. Bo is always expanding the network and is also a part of several network groups. His internet network has played a major role in reconnecting with people that he has met at shows and exhibits above all. Through the internet and social media he can also see which ones are good at the subject and which are not, it is reflected in their blogs, and how well they respond to questions and topics and from the answers one asks them.

By June the same month he had the first test product produced in a manufacturing facility which went well, this also meant that by September they could manufacture 5000 units per day. In July Bo also filed for an international patent. In December the same year SensAbues had their pilot test in Västervik and Färingsö prison which was successfully completed.

Today SenAbues has its production facilities in Uppsala with a subcontractor, and can produce a few thousand samplers a day. They have just started with the commercialization in Sweden. The Karolinska Institute makes the analyses whilst the businesses are doing the drug tests on their own. They also focus a lot on the U.S. market, doing road shows to visit the big labs. Bo has been at around 15 exhibitions worldwide, over the past 1.5 years, including 8 in the U.S, so he is not completely unknown, he also has established good relations with the biggest global drug testing companies. Bo has been aware that things take longer time than expected and costs a little more, explaining that one cannot promise investors too much gold and green forest.

"An entrepreneur is often enthusiastic and expects to be able to take shortcuts everywhere, and it is not always possible. So one has to critically examine things and it may take six month before you can move on in a project".

(Bo Hammarlund, Founder of SensAbuse, 2013).

6. Analysis

In this chapter we will compare the empirical data which we have collected with the theoretical framework. We will focus on the entrepreneurial knowledge used during the entrepreneurial process. We will then, based on the within-case analysis compare the single cases with each other to find similarities and differences.

6.1 Rolling Optics

Axel Lundvall, the founder of rolling optics studied at Uppsala University, as a student in engineering physics. His final three years he was working on a paper factory where he got his first glance on large-format mass production. This early employment experience can be seen as knowledge tied close to the entrepreneur and the concept of unfulfilled needs, thus knowledge that can be used by the entrepreneur during the discovery and development of the opportunity (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000).

Through his university network he pursued to contact Fredrik Nikolajeff who had an assignment he was very interested in, this in turn lead to the project assignment of reflective materials, this was based on a initiative taken by Axel which can be tied to the knowledge concerning the company of leadership and decision making, namely the concept of managerial knowledge (Chandler & Jensen, 1992; Chia, 1996; Delmar & Shane, 2006; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a).

6.1.1 Discovery

Axels ability to recognize an opportunity seems to be strong as he during his work with the project stumbled on a reflective effect, an effect that was very diffuse but enough to make the decision that it was worth examining further and later even exploit.

In order to pursue this idea he needed an instigator, he found this in two occasions, as the IT crash forced the company which he made the project through to cut the project after its finish, it made it possible for him to take initiative and get the rights for commercialization, which shows that he had fundamental knowledge of how to start a business (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003) which can be connected to knowledge concerning the company and the concept of functional knowledge. Secondly, the IT crash also resulted in less jobs for educated people in his sector, thus as Axel (2013) self explains:

"I saw starting a business as the most reasonable way of getting myself a job"

*(*Axel Lundvall, Founder of Rolling Optics, 2013)

proving a good self leadership skill and ability to make personal decisions (Chandler & Jensen, 1992; Chia, 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Stuart & Abetti, 1990; Ucbasaran et al., 2003a) which can be connected to knowledge concerning the company as in managerial knowledge.

Axel then proceeded with seeking money from various organizations and institutes such as Almi, Innovationsbron and VINNOVA to be able to pursue the idea further. Later also

managed to get special access to the university lab where he could make prototypes and search for additional funds another sign of a good ability to plan ahead (Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Stuart & Abetti, 1990) which is connected to knowledge concerning the company and the concept of managerial knowledge such as finance and acquire resources (Chandler and Jensen, 1992; Delmar & Shane, 2007; Jones and English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane and Venkataraman, 2000).

In time, they came in contact with the Göteborg company Geveko which wanted to start collaboration with Axel and Fredrik. Right from the start Axel knew that the product they were asking for would not match what they had, thus Axel developed a new product specifically to fulfill their demand. This action of identifying unfulfilled needs (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000) and being creative (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which can be connected to knowledge tied close to the entrepreneur and the concept of unfulfilled needs. But also problem solving (Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Stuart & Abetti, 1990) which is consistent with the knowledge tied close to the entrepreneur as of creative knowledge.

By 2004 Axel and Fredrik had been running the idea for 2 years, they stumbled upon two university students who wanted to make a business analysis for them, by the name of Anders Ullstrand and Fredrik Blomquist. Having done a great job with the market research Axel and Fredrik decided to offer them the possibility of starting the business together. This can be linked to the knowledge used concerning the company, namely management (Bates, 1990; Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Reuber & Fischer, 1994; Shane & Venkataraman, 2000; Ucbasaran et al., 2008) and handling personnel (Chia 1996; Chandler & Jensen, 1992; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a)

During this year Axel also got a job at Micronoc Laser systems where he got the chance to work with microstructures from an industrial perspective, this can be related to knowledge concerning the company where his knowledge of how to measure small differences in structures gave him an understanding of his products and how to develop them (Omerzel & Antoncic, 2008; Rerup, 2005; Shane, 2003) which can be connected to knowledge concerning the company and the concept of functional knowledge. But eventually he needed more time to focus on Rolling Optics, so he decided to get a job as an consultant within the firms so that he could manage his time as he wanted, a decision made which indicates on a strong entrepreneurial leadership (Chandler & Jensen, 1992; Chia, 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a), in which he takes control over his own actions to pursue the idea further. This can be connected to knowledge concerning the company and the concept of managerial knowledge.

Axel now as he explains it went out of his comfort zone to find people, customers and build a good network, he also very efficiently used Fredik Nikolajeffs network, this shows that he had good organizational knowledge (Colombo & Grilli, 2005; Delmar & Shane, 2007; Kourilsky, 1995; Omerzel & Antoncic, 2008; Shane, 2003) which can be connected to knowledge concerning the company and the concept of functional knowledge but also communication knowledge (Honig & Davidsson, 2000; Jones & English, 2004; Omerzel & Antoncic, 2008) when developing the idea which can be connected to knowledge concerning the company and the concept of managerial knowledge.

To pursue the idea even further he needed the financing, which he eventually managed to get through Uppsala University and HH-Foundation, a fact that can be linked to the knowledge concerning the company, namely knowledge of finance and the concept of managerial knowledge (Delmar & Shane, 2007; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000).

6.1.2 Exploitation

To achieve this he had through the years searched for companies in Sweden which had the type of machinery and production facilities that he was in need of. He was searching for processes that involved materials which were close to what they were developing, to get more ideas. He was very imaginative and creative which did him well in the development phase (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which can be connected to knowledge tied close to the entrepreneur and the concept of creative knowledge. The reason for this being that he early on realized that for the project to be successful in achieve the necessary goals, they needed an idea in how to mass produce micro-structures in a rolling process. They searched through a number of companies and finally found a company in Finland who had the technology necessary to produce the materials. This in turn made it possible for them to get an additional funding from Vinnova of 3.6 million in 2006. These different events can be seen as knowledge concerning the company, that is the entrepreneurs ability to formulate a strategy (Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) which can be connected to knowledge concerning the company and the concept of managerial knowledge. But also commercialize a concept (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003) that can be connected to the concept of functional knowledge.

When Axel resigned from Micronic Lasersystems, Axel brought with him two employees which were to become the first two employees of Rolling optics, this shows that the entrepreneur had organizing capabilities but also how to handle personnel which is tied to the knowledge concerning the company and the concept of managerial knowledge (Colombo & Grilli, 2005; Delmar & Shane, 2007; Kourilsky, 1995; Omerzel & Antoncic, 2008; Shane, 2003; Ucbasaran et al., 2003a).

However as he mentions, the decision to quit his job and work full time on Rolling Optics was taken only 3 weeks after his first child was born, which can be seen as an indication of the entrepreneurs willingness to take risk in uncertain circumstances (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which can be connected to knowledge tied close to the entrepreneur and the concept of creative knowledge. In addition to his new employment he also got the opportunity to take courses in innovation and entrepreneurship of 10 credits (7.5 credits in today's value), which can be seen as entrepreneurial knowledge concerning the company, in how to start and operate a business (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003) and the concept of functional knowledge.

By 2007 Axel together with Anders Ullstrand visited a lot of companies in the north to gain a better understanding of how to develop the Rolling Optics production system. Axels ability to pitch their ideas was probably of most importance this year as they managed to get a financing of 14 million Sek. Axel describes himself as never being afraid of standing in front of a crowd to present his ideas, which shows an entrepreneurial ability of how to communicate (Honig & Davidsson, 2000; Jones & English, 2004; Omerzel & Antoncic, 2008) which can be connected to knowledge concerning the company and the concept of functional

knowledge. He also views his ability to motivate others as very good, explaining that his positive outlook on things often becomes contagious to others, which can be seen as a great sign of leadership (Chandler & Jensen, 1992; Chia 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a), and entrepreneurial knowledge concerning the company and the concept of managerial knowledge.

After some time they found out that the technology found in Finland was not suited for their needs, but Axel soon found a new technology better suited than the first, a sign of entrepreneurial adaptability to changes in the environment and unpredictable events, that is a great knowledge of suppliers (Chandler 1996; Delmar & Shane, 2007; Rerup, 2005; Ucbasaran et al., 2003a; Unger et al., 2011) and connected to knowledge concerning the external environment of the company and the concept of general external knowledge. Further, when a roadblock occurred which forced them to change strategy, Axel found the new customer segment which would prove to be better suited for them, this shows a entrepreneurial understanding of the market (Jones & English, 2004; Omerzel & Antoncic, 2008; Shane 2003), customer (Chandler 1996; Delmar & Shane, 2007; Rerup, 2005; Unger et al., 2011) and ability to scan the environment (Chandler & Jensen, 1992; Colombo & Grilli, 2005; Oosterbeek et al., 2010;Rerup, 2005; Shane & Venkataraman, 2000), which is entrepreneurial knowledge concerning the external environment and both concept of general external knowledge and marketing knowledge.

By 2008 a number of employees were hired, from now on Axel had to start delegating responsibilities to his employees, which can be connected to knowledge concerning the company more specific, the concept of managerial knowledge such as leadership skills and handling personnel (Bates, 1990; Chandler & Jensen, 1992; Chia 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Jones & English, 2004; Omerzel & Antoncic, 2008; Reuber & Fischer, 1994; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a).

During their exploitation phase, they stumbled upon a company called Iggesund who were very interested in their products. The company later came to play a very significant role in the development of the company, however it was no easy process. Not being capable to produce the products in a continuous band they needed a solution to solve this problem. Axel being the head of R&D proved to have a good knowledge of suppliers (Chandler 1996; Delmar & Shane, 2007; Rerup, 2005; Ucbasaran et al., 2003a; Unger et al., 2011) and of the industry (Bates, 1990; Chandler & Jensen, 1992; Colombo & Grilli, 2005; Delmar & Shane, 2006; Oosterbeek et al., 2010; Otani, 1996; Reuber & Fischer, 1994; Shane & Venkataraman, 2000), as he yet again found a company in Åtvidaberg which had these capabilities. This can be connected to knowledge concerning the external environment of the company and the concept of general external knowledge.

During the later year Axel continued developing products which he saw were close to what the market wanted. As when they needed to find their competitive edge, he saw the opportunity of making their products recyclable and biodegradable, an idea which they soon after skipped as the industry was price pressured and he believed the customers were not interested in paying for the product. This shows knowledge of the external environment of the company and the concept of marketing knowledge through market knowledge (Jones & English, 2004; Omerzel & Antoncic, 2008; Shane 2003) and customer (Chandler 1996; Delmar & Shane, 2007; Rerup, 2005; Unger et al., 2011) is put into focus when developing the new products.

6.2 Peepoople

Anders Wilhelmson has an architectural education from the University of Gothenburg, class of 1979. And has since then run a consulting firm all his life. For 10 years he has also been responsible for the Royal Art Academy in Stockholm of architectural education. During his year in the university he has also supervised a number of projects with the focus of distressed areas. All this early life experience can be seen as entrepreneurial knowledge which is tied close to the entrepreneur which in turn has helped him with the opportunity recognition and the exploitation of the opportunity (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000).

Anders is today the sole owner of the consulting firm Wilhelmson Architect which has been involved in a number of projects from the automotive industry to urban development. Anders explains that there's a big differences between consulting and trying to operate a large industry, however he explains that the basics are similar and the experience he got from Wilhelmson architect helped him a lot in the start of Peepoople. This shows that Anders had previous knowledge of how to start and operate a business (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003) which can be connected to knowledge tied close to the entrepreneur and the concept of knowledge of unfulfilled needs.

6.2.1 Discovery

The idea for Peepoople grew when Anders was on his study trips in among others Mumbai, Cairo and Mexico City. During a meeting with a number of women who lived on the pavement in Mumbai India, the women explained that they could build their own housing and do a lot of other things, however they could not handle the issue of going to the toilet, and the idea was born. This could be connected to knowledge concerning the external environment to the company and the concept of marketing when understanding the customers need. The reason for the discovery was mainly due to Anders being very problem oriented and as the problem arose he saw it as a problem that needed to be solved, this shows that he had a very good ability of solving problems (Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Stuart & Abetti, 1990) and identifying unfulfilled needs (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000). This is consistent with the knowledge tied close to the entrepreneur and both the concept of knowledge of unfulfilled needs but also creative knowledge.

Anders began working on the idea soon after, and within six months the principles for the idea was formulated. There after he set up a project team which was started by a group of three people, among them Camilla Wirseen who later also co-founded the company and still active in the company. This shows that he had a great management ability (Bates, 1990; Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Reuber & Fischer, 1994; Shane & Venkataraman, 2000; Ucbasaran et al., 2008) as well as organizing (Colombo & Grilli, 2005; Delmar & Shane, 2007; Kourilsky, 1995; Omerzel & Antoncic, 2008; Shane, 2003) and strategy formulation (Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a), which can be connected to knowledge concerning the company and the concepts of managerial knowledge.

Further axel explains that he and his team made a list of six different pieces that they thought would be an interesting field of research in the development of the solution, and then proceeded with finding companies that had the necessary competence to develop it. They weighted the different solutions and decided for a company in Uppsala. Then they decide

which chemical company to go for, using the same method of weighting companies based on different factors, and finally chose BASF. Anders explains that Peepoople at the start is well in time, saying that if it wasn't for the knowledge they possessed it would probably not have been possible to imagine that kind of product. This shows that Anders had a great sense of how to operate a business and how to commercialize the concept (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003), as well as formulate a strategy (Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) which can be connected to knowledge concerning the company and the concept of managerial knowledge.

Between 2005 and 2007 Anders was able to form a project management- and multidisciplinary team of researchers from KTH Stockholm, and from Swedish University of agricultural Science in Uppsala, and a cluster of other researchers and companies that produced the whole concept. And thus the personal, single-use, self-cleaning, fully biodegradable toilet "Peepoo" was made. This shows that Anders had a great ability to manage (Bates, 1990; Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Reuber & Fischer, 1994; Shane & Venkataraman, 2000; Ucbasaran et al., 2008), lead (Chandler & Jensen, 1992; Chia 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) and organize (Colombo & Grilli, 2005; Delmar & Shane, 2007; Kourilsky, 1995; Omerzel & Antoncic, 2008; Shane, 2003) his team, as well as product development and understanding of products (Omerzel & Antoncic, 2008 Rerup, 2005; Shane, 2003), consistent with the knowledge concerning the company and the concept of both functional and managerial knowledge.

Anders explains that it's a risky business to put once own money in a startup, and describes himself as not being an exceptionally wealthy person. This shows that he is aware of the fact that the risk is high, thereby making him willing to take risks (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which is knowledge tied close to the entrepreneur and the concept of creative knowledge.

Anders then explains that because of financial aspects he chose to register the company Peepoople as a subsidiary to Wilhelmson architect, as he owned Wilhelmson himself it was a good decision financially, since Wilhlemson at that time had good capital bases. This shows that he had great knowledge of finance (Delmar & Shane, 2007; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000) which is knowledge concerning the company and the concept of managerial knowledge.

6.2.2 Exploitation

He further explains that as they filed for the patent they know that after 18 months the costs would increase very much and because of this he then chose to take Peepoople out of Wilhelmson architect and form it as a joint-stock-venture, which shows that he was great at formulating strategies for the company (Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a), which is consistent with the knowledge concerning the company and the concept of managerial knowledge but also knowledge of finance (Delmar & Shane, 2007; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000) which can be connected to knowledge concerning the company and the concept of managerial knowledge.

By 2008 it was the world sanitation year so Anders decided to try their product in a larger scale by making a number of major pilot projects, and at the same time market their products, he than explains that they have a good strategy in marketing their products. This shows a ambition to try out new project and be creative and imaginative (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which can be connected to knowledge tied to the entrepreneur and concept concerning creative knowledge.

"*For example our product is called the same as the company, so when we write information about Peepoople we do not write about Peepoople the company but Peepoople the product, this makes it easier for anyone to find the most necessary information about us on the internet"*

*(*Anders Wilhelmson, Founder of Peepoople, 2013).

This chows that the entrepreneur had a great deal of knowledge about marketing (Jones & English, 2004; Omerzel & Antoncic, 2008; Shane 2003) which is knowledge concerning the external environment and the concept of marketing knowledge.

By 2009 Anders and his team decided to set a goal of ensuring enough funding to hire a CEO to build a production system and ensure the quality of the company, which they also did in 2011. Anders than explains that he had never seen himself in the role of being president of this company but rather the person who gets it going, however he always had a desire of building a company that would be stable and long term, this can be linked to the entrepreneurial knowledge of formulating a strategy (Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) as well as leadership (Chandler & Jensen, 1992; Chia 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a), consistent with the knowledge concerning the company and the concept of managerial knowledge.

6.3 Graphensic AB

Mikael has an education from Linköping University, a masters degree in applied Physics and Electrical engineering. During the past 20 years he has worked within the university and research on materials. He now has a technology doctorate and is an associate professor in material physics. Besides this he has also had a sole proprietorship and has been holding presentations in popular science for some time. All this earlier life experience can be seen as entrepreneurial knowledge tied close to the entrepreneur. Knowledge that will have a significant role in the discovery of the opportunity which in turn will leads to the development of the company (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000) which can be connected to knowledge tied close to the entrepreneur and the concept of knowledge of unfulfilled needs.

Mikael explains that they very early in the development submitted the patent for their method, further he explains himself as having a great experience of planning his research and documenting his results. Something that can be tied to the entrepreneurial knowledge of planning (Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Stuart & Abetti, 1990), which can be connected to knowledge concerning the company and the concept of managerial knowledge.

6.3.1 Discovery

In 2005, Mikael and his team had developed a method for making films of silicon carbide, which lead to a collaboration with a company that were very interested in commercialize that method. This development can be seen as a creative process (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) that can be connected to knowledge tied close to the entrepreneur and the concept of creative knowledge.

Through this experience Mikael got the basic understanding of how to develop a business, for instance having been in contact with the IRS, doing his own declaration and bookkeeping, and also learning the benefits of having a good network. He realized that they can develop materials but they are in need of cooperation in order to move on with the development and study the properties, these factors shows that he had a good understanding of how to commercialize the concept and how to start a business (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003) which is part of the knowledge concerning the company and the concept of functional knowledge.

A few years after the initial cooperation Mikael and his team developed a new method in which they would eventually be able to develop epitaxial grapheme on silicon carbide. In its early stages Mikael got the hunch that there could be a great potential for the material which they could produce with the method, thus this shows that he had a great ability to recognize the opportunity (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000) consistent with the knowledge tied close to the entrepreneur and the concept of knowledge of unfulfilled needs. As well as product development and understanding products (Omerzel & Antoncic, 2008; Rerup, 2005; Shane, 2003), that is knowledge concerning the company and the concept of functional knowledge.

Eventually Mikael and his team started supplying these materials to different research groups for free so that the companies could study their properties, however the demand form materials quickly grew out of hand so until it became too much for them to handle, and they chose to stop the free sampling and start charging instead. In order to do this they had to register a business, Mikael took it on himself to gather the necessary information, contacting the information office, a business coach and getting involved in a mentoring program, these different facts can be linked to the entrepreneurial knowledge of decision making (Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Stuart & Abetti, 1990) as well as leadership (Chandler & Jensen, 1992; Chia 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) which is knowledge concerning the company and the concept of managerial knowledge.

6.3.2 Exploitation

Mikael got the responsibility of providing the initial data and specify the business case, how to set up a business and what to sell, as the material they would sell differed greatly from the material they usually handed out to scientists in research before they went into business. This shows that he also had a great deal of knowledge of how to start and operate a business (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003) consistent with the knowledge concerning the company and the concept of functional knowledge.

As the company grew into becoming Graphensic, Mikael had to get in touch with customers and different companies so that he could develop their ideas. This can be connected to knowledge of customer (Chandler 1996; Delmar & Shane, 2007; Rerup, 2005; Unger et al., 2011) within the category of knowledge concerning the company and the concept of

marketing, but also knowledge of unfulfilled needs (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000) concerning knowledge tied close to the entrepreneur and the concept of knowledge of unfulfilled needs. They started by selling the materials to research groups and for each sample they also rented out the equipment in the lab giving them a safe start, a revenue flow without having to search for ventures. With the aim of building the company gradually, securing the customers and selling in few volumes. This shows that they had a good knowledge of how to formulate a strategy (Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) as well as organizing (Shane Colombo & Grilli, 2005; Delmar & Shane, 2007; Kourilsky, 1995; Omerzel & Antoncic, 2008; Shane, 2003) which is knowledge concerning the company and the concept of managerial knowledge. But also in order to be able to reduce the risks (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003), which is knowledge tied close to the entrepreneur and the concept of creative knowledge.

Mikael explains that customer focus is an essential part of his job, he explains that he constantly has to be aware of what the customer wants and need, so Graphensic does not only supply materials but also knowledge, the team in Graphensic helps the companies and research groups develop their application by participating through meeting and discussing the results, providing input and helping them interpret their results. This can all be linked to knowledge concerning the external environment, namely service (Unger et al., 2011). Graphensic also develops the materials towards what the customers are interested in which also indicates knowledge of customers (Chandler 1996; Delmar & Shane, 2007; Rerup, 2005; Unger et al., 2011) which can be connected to knowledge concerning the external environment and the concept of marketing knowledge.

Mikael explains that what distinguishes Graphensic from others is their understanding of materials and how to develop and use techniques to make the materials. However he also knows that this process is time consuming, explaining that it has taken up to 8 years for other companies to fully commercialize similar concepts explaining that "*we knew that it would take a long time and it is not possible to accelerate even if you yourself are efficient" (*Anders Wilhelmson, Founder of Peepoople, 2013). This indicates that Mikael already has a basic knowledge about the industry (Bates, 1990; Chandler & Jensen, 1992; Colombo & Grilli, 2005; Delmar & Shane, 2006; Oosterbeek et al., 2010; Otani, 1996; Reuber & Fischer, 1994; Shane & Venkataraman, 2000), knowing what to expect from having scanned the companies doing similar research. This is in line with the knowledge concerning the external environment of the company and the concept of general external knowledge.

6.4 SensAbuse

Bo Hammarlund started his career with an education from Linköping University, where he studied MSc in engineering physics. His early employment experience consist out of an 8 year research job for several different companies both in Sweden and the U.S and within sales and marketing for approximately 10 years with larger corporations. Between the years 2001-2005 Bo worked primarily with startup companies which later lead him to start his own businesses, and today is involved in approximately 10 companies, where Sensabues is his latest creation. All this early experience from his technical education, his work experience within marketing and his involvement with startups, moreover starting companies himself can be seen as knowledge tied close to the entrepreneur, assisting him in development and exploitation of future ventures such as Sensabues (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000).

6.4.1 Discovery

Bo's independence and capability of travel by himself, establishing customer contacts and sales, can be seen as both the ability of self leadership (Chia, 1996) which can be connected to knowledge concerning the company and the concept of managerial knowledge, as well as knowledge concerning the external environment and the concept of marketing knowledge (Jones & English, 2004; Omerzel & Antoncic, 2008; Shane 2003) this is foremost because the notion of the opportunity came from the need in the market and therefore can be seen as an identification of a unfulfilled need.

Bo also explains that he practically threw himself over the drug testing project after it was presented by Olof, investigating the possibilities and tried to learn as much as he could, which indicated that he had a good ability of identifying an unfulfilled need (Chandler & Jensen, 1992; Kourilsky, 1995; Rerup, 2005; Shane & Venkataraman, 2000) already believing that this was worth exploring further which can be connected to knowledge tied close to the entrepreneur and the concept of knowledge of unfulfilled needs. Further, as Bo planned to collaborate with Olof, he explains that he was aware of the fact that it would take about a year to know if a project, or for that matter, the partnership would work, an aspect he wasn't so worried about. His explanation was that; the worst that can happen is that you have to close it down. The situation indicates an entrepreneurial ability of taking risks (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which can be connected to knowledge tied close to the entrepreneur and the concept of creative knowledge.

When the decision was made to develop the opportunity Bo went to an incubator to get information and documents about how to start and what to have in mind when starting a business. When he had gathered enough information he then registered the company, he explains that his job at first was to do everything from being president, managing sales and finances, with a focus towards the market and internal administration a role which did not change over time. However letting his partner Olof does all the analysis of the drugs. This clearly indicates that Bo had a very good sense of management (Bates, 1990; Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Reuber & Fischer, 1994; Shane & Venkataraman, 2000; Ucbasaran et al., 2008) as well as finance (Delmar & Shane, 2007; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000) as he took it on himself to provide with the necessary resources to develop the idea. This also reflects leadership (Chandler & Jensen, 1992; Chia 1996; Delmar & Shane, 2007; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) which can be connected to knowledge concerning the company and the concept of managerial knowledge. But this also shows knowledge of how to start and operate a business (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003) something that's consistent with the knowledge concerning the company and the concept of functional knowledge.

To proceed, Bo than needed the finance, and was able to get this through Vinnova, the Swedish innovation agency where he received 1 million SEK, within six months he was able to get an additional 2,7 million SEK in funds to develop the idea further which as mentioned earlier proves the fact that he had a great ability of acquiring resources (Delmar & Shane, 2007; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000), also consistent with the knowledge concerning the company and the concept managerial knowledge.

6.4.2 Exploitation

When starting the company Bo had a 5 year vision, explaining that he always plans ahead what type of competence the company would need In the different stages of the development, explaining that two years after registering the company his goal was to have good board members, and after three years he wanted a great CEO who could assure the quality of the products and make the company even greater that it was. This behavior is seen as a great ability to formulate strategies and visions (Chandler & Jensen, 1992; Jones & English, 2004; Omerzel & Antoncic, 2008; Rerup, 2005; Shane & Venkataraman, 2000; Ucbasaran et al., 2003a) which is a part of knowledge concerning the company and the concept of managerial knowledge. Further, he explains that he do not see himself as an industrialist, rather as the person who starts the company and gets it going, this shows an ability of self planning (Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Stuart & Abetti, 1990) which is the entrepreneurial knowledge concerning the company and the concept of managerial knowledge, as he already has a vision of his own role in the development and the company.

Bo explains that they did a lot of creative solutions themselves, such as developing the product, the design of the sampler, the plastic casing in which the user exhales the breath, and which picks up the traces of drugs. This can be linked to the entrepreneurial knowledge of creativity (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which can be connected to knowledge tied close to the entrepreneur and the concept of creative knowledge as well as product development and understanding of products (Omerzel & Antoncic, 2008 Rerup, 2005; Shane, 2003) which can be connected to knowledge concerning the company and the concept of functional knowledge.

Bo's next step was to create a good patent, he explains that this demands a good creativity as the patent is the primary competitive advantage they will have in the market so an insufficient patent could be very damaging if the technologies would be copied in some sort, thus this can be linked to entrepreneurial creativity (Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003) which is knowledge tied close to the entrepreneur and the concept of creative knowledge.

By 2011 Bo started international marketing of SensAbuse, having no experience in the drug industry he took a strong initiative to find new contacts, he went to different exhibitions concerning drugs, every six weeks all over the world to meet with new people and create new contacts. He explains that he was out hunting contacts to increase his network, using social networking sights such as LinkedIn to reconnect with people that he had met, joining several networking groups with focus on blood testing for drugs. And over the past 1,5 years he had been at around 15 exhibits worldwide which focused on drugs. Bo considers himself today to be well known in the drug testing industry. Further he has developed a lot of contacts with the biggest global drug testing companies. This shows that he is most definitely familiar with marketing (Jones & English, 2004; Omerzel & Antoncic, 2008; Shane 2003), as well as the industry as a whole (Bates, 1990; Chandler & Jensen, 1992; Colombo & Grilli, 2005; Delmar & Shane, 2006; Oosterbeek et al., 2010; Otani, 1996; Reuber & Fischer, 1994; Shane & Venkataraman, 2000), and that he had a skill for scanning the environment (Chandler & Jensen, 1992; Colombo & Grilli, 2005; Oosterbeek et al., 2010. Rerup, 2005; Shane & Venkataraman, 2000) a skill very likely developed from his prior experience with his other ventures. This can be connected to knowledge concerning the external environment of the company and both the concept of general external knowledge and marketing knowledge. But this can also be seen as an understanding of the product (Omerzel & Antoncic, 2008 Rerup, 2005; Shane, 2003) which is needed if promoting the concept and can be connected to knowledge concerning the company and the concept of functional knowledge.

Further, Bo explains that by September 2012 they were able to manufacture 5000 units per day, filed an international patent and by December had their pilot testing in Västervik and Färingsö prison which was successfully completed, knowing that Bo is the person in the team managing this sort of activity, it shows a great deal of knowledge in how to commercialize a concept (Bates, 1990; Colombo & Grilli, 2005; Delmar & Shane, 2006; Kourilsky, 1995; Otani, 1996; Rerup, 2005; Shane, 2003), knowledge concerning the company and the concept of functional knowledge.

6.5 Cross-Case Analysis

We will now do a cross-case analysis where we compare the individual cases with each other within the entrepreneurial process. Firstly we present a summary table of the cases regarding the different categories of entrepreneurial knowledge and the connected concepts that's been used during the entrepreneurial process. In this cross-case analysis we are using the summarized table of the cases that will be presented next which is a summary of the previous within-case analyzes. Therefore there will be no references in this section because it is implied from the previous within-case analyzes.

Table 6 Cross-case analysis summarizing table

	Category	Concept	Rolling Optics	Peepoople AB	Graphensic AB	SensAbues
Discovery	**Entrepreneur**	Knowledge of unfulfilled needs	a) Opportunity recognition.	a) Opportunity recognition.	a) Identification of unfulfilled needs.	a) Identification of unfulfilled needs.
		Creative knowledge	b) Problem solving.	b) Problem solving, Risk taking.	b) Creativity	b) Risk taking.
	Company	Managerial knowledge	a)Leadership, Decision making, Planning, Finance and acquire resources, Management, organizing,	a) Leadership, Management, organizing, Formulate a strategy, Finance and acquire resources.	a) Leadership, Decision making.	a) Leadership, Management, Finance and acquire resources.
		Functional Knowledge	b) Commercialize a concept and how to start a business, Product development and understanding products, Communication.	b) Commercialize a concept and how to start a business, Product development and understanding products.	b) Commercialize a concept and how to start a business, understanding products and product development	b) Commercialize a concept and how to start a business.

	Category	Concept	Rolling Optics	Peepoople AB	Graphensic AB	SensAbues
	External environment	General external knowledge	No result	a) Industry knowledge and environmental scanning	No result	No result
		Marketing Knowledge	No result	b) Customer	No result	b) Customer
Exploitation	**Entrepreneur**	Knowledge of unfulfilled needs	No result	No result	a) Unfulfilled needs	No result
		Creative knowledge	b) Imagination, creativity, Risk taking	b) Creativity	b) Risk taking	b) Creativity
	Company	Managerial knowledge	a) Formulate a strategy, Organize, Leadership and handling personnel, Managing. business, communication.	a) Formulate a strategy, Leadership, Finance	a) Formulate a strategy, Organizing.	a) Formulate a strategy, Planning.

Category	Concept	Rolling Optics	Peepoople AB	Graphensic AB	SensAbues
	Functional Knowledge	b) Commercialize a concept and how to start a business.	No result	b) Commercialize a concept and how to start a business.	b) Commercialize a concept and how to start a business, Product development and understanding products.
External environment	General external knowledge	a) Industry knowledge, Environmental scanning.	No result	a) Industry knowledge & Environmental scanning.	a) Industry knowledge, Environmental scanning.
	Marketing knowledge	b) Marketing, Customer.	b) Marketing.	b) Customers, Service.	b) Marketing.

6.5.1 Discovery

Knowledge tied close to the entrepreneur

The biggest similarities found in the first level of the discovery phase are the entrepreneur's abilities to identify an opportunity, found in the concept of knowledge of unfulfilled needs, which is a part of the knowledge concerning the entrepreneur. This is in a way given as their ability to identify an opportunity leads to the development of the entrepreneurial firm.

However they do use the creative knowledge concept differently in their knowledge use of problem solving and their knowledge of risks, where Rolling Optics and Peepoople use more problem solving knowledge while SensAbues and Peepoople are more aware of knowledge concerning risks. While Graphensic AB use creative knowledge rather than knowledge of risks and problem solving. These differences could be because of difference between respondent's for instance in experience and age, where an entrepreneur's judgment of risk may not be the same as the others. Not only do these differences have to be tied to the entrepreneur but can also be a characteristic of the industry and environment where the capital structure of the industry for an example might need more initial investment and therefore bear more perceived risk, for an example Graphensic AB manage to solve their capital need by cooperation with customers and usage of the university facilities while Peepoople needed more money to secure the patent and preparation for mass production. Rolling Optics also realized that they needed to industrialize the production which will include more money requirements and therefore be perceived more risky. Also, a company that have had it comparable less problematic than another in the discovery phase, might not think of problem solving as prominent as an entrepreneur who clearly reminds a problem he or she had to tackle. Problem solving can off course also depend on the attitudes the person has and therefore might not see problem as problems, rather challenges or not at al. Still all the companies have university research as a base, they are innovative and have invented new materials and products which make it a qualified guess that all of them needed knowledge concerning problem solving in one or another form when developing new things that hasn't been developed before.

Knowledge concerning the company

At level two, still in discovery phase, we find the entrepreneurs ability to start a business as the knowledge which all entrepreneurs have in common. This is also very self explanatory as their knowledge of how to start a business as well as how to commercialize a concept directly influences whether or not they start a company. In all cases, even though they didn't have all the information about a startup, they went to incubators and had business mentors helping them discuss different aspects of entrepreneurship, gaining enough knowledge to decided and exploit the opportunity and start the company.

Further, what all four cases have in common is the entrepreneur's ability to lead. We believe this can be connected to the entrepreneurs' knowledge of how to start a business, and not only the concept of managerial knowledge. This because the entrepreneur is the person who instigates the development of the idea, searching for information and eventually, with enough knowledge registers the company. This shows leadership from an individual point of view, where the entrepreneurs need to lead themselves in the first place and when later they hire employees need to be able to lead them. Rolling Optics is the only company who stresses the role of communication, but we do reason that communication is a building stone in both in leadership which all the companies uses knowledge in, because how can one lead without communicate but also communication can also concern how one choose to communicate with customers and external environment and therefore can be a part of marketing knowledge.

What also is interesting is the entrepreneur's ability to acquire resources in order to reach their goals. This is also in a way self explanatory as the entrepreneurs knowledge of how to start a business and ability to lead motivates the entrepreneur's actions in acquiring the necessary resources. However Mikael did not have finance as knowledge during his discovery process, stated from the empirical data reason may be that he did not have the need for acquiring resources to commercialize on his idea. This because the whole operation was run through the university where he and his team worked, and the material which they supplied to their customers was not something new, it had already been produced by the team some time before the initial start. Which lead to that there was no need to acquire additional resources as there was no new machinery that needed to be acquired.

Worthy to note is that the ability to make decisions is much clearer in the case of Rolling optics as well as Graphensic AB. Also here we can speculate that this is due to the amount of experience and age the entrepreneur has, as the entrepreneurs of Rolling Optics and Graphensic AB may be more aware of their decisions makings while the decision process of those with more experience becomes more routine and something they doesn't consciously reflect about.

Another important expressed knowledge that is shared by Rolling Optics, Peepoople and Graphensic AB, however not SensAbuse is the knowledge of how to develop products and the understanding of products in the discovery phase. This can be seen as self evident as the entrepreneurs in the three cases also were involved in the development of the first products, however in the case of SensAbuse, the entrepreneur was the initiator in commercializing the concept and came into the project soon after the product was discovered, thus the knowledge of how to develop the product did not apparent in the development stage. So dependent on which role the entrepreneur takes on, they will need the use of different knowledge, as in the case of SensAbuse where Bo rather took the role of initiator of commercializing the concept rather than product developer, while Axel and Rolling Optics is very close to the product development function in the company and therefore will use this knowledge more.

Knowledge concerning the external environment of the company

An interesting fact worthy to note is that two of the four cases used knowledge which concerns the external environment of the company, namely Peepoople and SensAbuse. We see a clear connection with that their products were born out of a market need, while Rolling Optics and Graphensic AB was born out of an invention and needed to find an applicable market for the products. Peepoople also seem to be more aware of the general external knowledge because of Anders years of prior studies within the research field of slum, while SensAbuse and Bo was fairly new to the field of drugs.

One can also discuss that in the case of Peepoople and SensAbuse they identified unfulfilled needs while Rolling Optics and Graphensic AB discovered an opportunity where the identification of unfulfilled needs rather concerns the external environment of the company and opportunity recognition is more concerning the knowledge tied close to the entrepreneur and his or hers ability to invent.

6.5.2 Exploitation

Knowledge tied close to the entrepreneur

Examining the exploitation phase we see that knowledge tied close to the entrepreneur and the concept of unfulfilled needs is not so populated by any of the four cases with the exception of Rolling Optics. The creative ability is however present in Rolling Optics, Peepoople and

SensAbues, showing a need for finding creative solutions weather it is in the case of patenting or product development.

What is interesting is that Graphensic AB and Rolling Optics did not show any need of risk taking knowledge in the discovery phase, but instead in the exploitation phase. And Peepoople and SensAbuse did not show any need of creativity in the discovery phase but instead in exploitation phase. This can show that when the entrepreneur finally takes the decision to exploit an opportunity one needs to think of risks because it becomes more prominent when you invest more into the idea for instance time and money. While both Peepoople and SensAbuse had prior experience of starting companies and might therefore perceive the risk more in the discovery phase because that doesn't have to be similar for every opportunity as the formal activities in exploiting an opportunity. It is also in this phase that Graphensic AB starts to identifies and come in contact with new customers when trying to find an applicable market.

But also, Peepoople and SensAbuse products originated from a market need and they needed to develop the technique which could be perceived as risky while Rolling Optics and Graphensic AB products come from inventions and they needed to find a customer which didn't appear until in the exploitation phase which might be perceived as an uncertainty and increasing the risk.

Knowledge concerning the company

In the category of knowledge concerning the company it shows that the most used knowledge for each entrepreneur is the ability to formulate a strategy, the entrepreneurs abilities to formulate strategies have had a direct influence in the company's development and can be seen as a natural progression after having established the company and pushing the development of the company towards a bigger market. One can also assume that it is the results of the entrepreneurs previously mentioned abilities of identify an opportunity, knowledge of how to commercialize a concept as well as their leadership skills that motivates them to seek a strategy and keep moving forward. If we connect this with the previous phase, Peepoople was the only company that shows a usage of strategy formulation knowledge in the discovery phase which could be linked with Anders early understanding and knowledge of the external environment in the discovery phase and the need to conclude his own way among other competitors.

In all cases except of Peepoople, how to commercialize a concept and how to start a business is present yet again, this shows that the knowledge of how to operate a business is used throughout the development process. One can guess that in the case of Peepoople, the knowledge of how to operate a business is embodied in the strategy formulation or a rather a routine knowledge not really reflected upon.

Also here, the entrepreneurs ability to lead himself as well as lead others shines through in both the cases of Rolling Optics and Peepoople. Further the entrepreneur's ability to organize is present in both Rolling Optics as well as Graphensic, yet again one can only speculate that this is due to the lack of experience in having dealt with ventures before and therefore a more conscious use of knowledge.

Worth mentioning in the category of knowledge concerning the company is that product development and understanding of products becomes strongly apparent in the case of SensAbues in the exploitation phase, a reason may be that as mentioned earlier, the entrepreneur came in to the project soon after the product was discovered and thus the entrepreneur in time began researching the topic, accumulate information and participated in

the development of the sampler, as it was necessary if he was to be able to market and commercialize the concept. But also that is was in relation with the customer that the product was further developed and therefore more prominent in the exploitation phase.

Knowledge concerning the external environment to the company

During the exploitation phase all the four entrepreneurs used knowledge that concerns the external environment of the company. In the third level the most apparent knowledge's used by the entrepreneurs was their ability to market their products as well as their knowledge of their industry. The knowledge of the market is most significant in all cases except Graphensic AB, which can be explained from the empirical data of Graphensic AB as they started selling their materials only to research groups with the aim of only build the company gradually so they could secure customers and sell in few volumes. This meant that the entrepreneurs' ability to market their products did not appear clearly in their case.

Industry knowledge can be tied to the knowledge of product development and understanding products, as well as the ability of formulating strategies, the entrepreneurs seem to naturally progress from one knowledge to another.

In addition to this, both Rolling optics and SensAbues have been scanning their environment for knowledge, which can be tied to their ability of marketing their concepts. Further, the knowledge of customers also stands out as an important part in the development of Rolling optics as well as Graphensic AB which could be connected to that they didn't have a clear picture of what or to whom the product aimed at in the beginning during the discovery phase.

Overall a pattern appear in the use of knowledge where one type of knowledge, in for instance the ability of recognizing opportunity as well as commercializing a concept can progress into another type of knowledge such as strategy formulation, and later also industry knowledge and marketing, which could suggest those knowledge's are more tightly connected. Further, as mentioned earlier, in some parts of the development process, some abilities or knowledge are more strongly used in the two cases of Rolling Optics and Graphensic AB than they are in SensAbues and Peepoople. Something that maybe explained by the differences in entrepreneurial experience and market entry either by invention or market need.

7. Conclusions and Discussion

In this chapter we will present our conclusion and by that answer the research question; which role the entrepreneur's prior knowledge of entrepreneurship play in the entrepreneurial process. We will then present the theoretical and practical implications of this study

7.1 Conclusion

Based on the problem discussion and background presented in the introduction, the purpose of this master thesis is to describe which role the entrepreneur's knowledge of entrepreneurship has played in the entrepreneurial process to show how the entrepreneur's knowledge of entrepreneurship contributes in the process from opportunity discovery to opportunity exploitation. We started this research with the question; *which role does the entrepreneur's prior knowledge of entrepreneurship play in the entrepreneurial process?* Which we will answer next.

During the discovery phase the knowledge of entrepreneurship that is mostly used are the entrepreneurs´ knowledge of;

- Identify an opportunity
- Lead
- How to start a business and commercialize a concept.

When possessing these knowledge´s the entrepreneurs find it easier to take the step and start the entrepreneurial venture. These knowledge´s are connected to the first category of knowledge tied close to the entrepreneur and the concept of knowledge of unfulfilled needs but also the category of knowledge concerning the company and the concept of managerial knowledge.

During the exploitation phase however the most commonly used knowledge's of our four entrepreneurs are;

- Formulate strategies
- Commercialize a concept
- Industry and marketing knowledge

These can be connected to the category of knowledge concerning the company and the concept of managerial knowledge and functional knowledge but also the category of knowledge concerning the external environment of the company and both the concept of marketing knowledge and general external knowledge.

The knowledge of how to formulate a strategy leads the entrepreneurs to find solutions, create competitive companies, and solve problems in order to get investment, build confidence and attract investors or customers, eventually making it possible to develop their ideas and goals. Further the entrepreneur's ability to develop products and their understanding of products is also a significant part of the development that arises primarily in the discovery phase, but also in some cases in the development phase. The knowledge of how to develop products plays a big role in how the entrepreneur formulates their strategies, are able to commercialize the

concept, satisfy their customers and their ability to market their products. This is shown in all four cases.

Concerning the whole entrepreneurial process, one can see a shift in the entrepreneurial knowledge that has been used. In the beginning of the process the weight were more prominent in the categories of knowledge tied close to the entrepreneur and knowledge concerning the company. In the exploitation phase, the weight is more in the category of knowledge concerning the company and knowledge concerning the external environment of the company. This off course is not a surprise that the further along the entrepreneurial process one comes the more people get involved and more factors are influencing than only the entrepreneur himself. This can be illustrated as in figure 10.

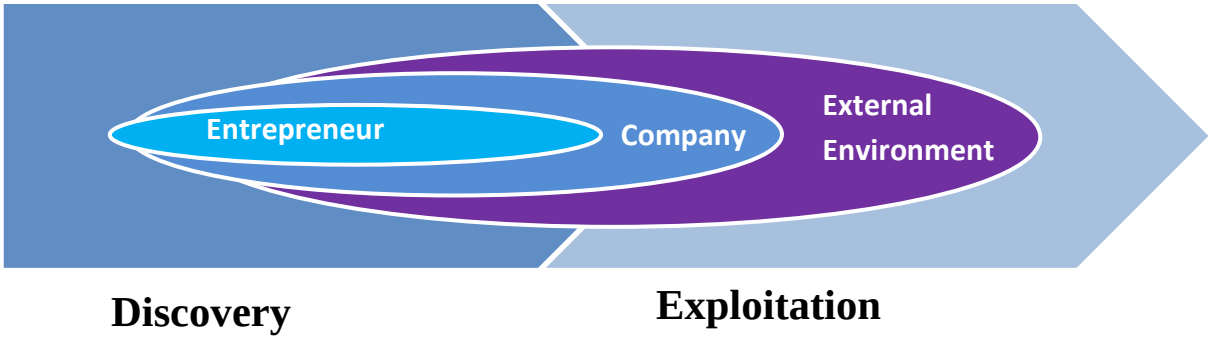

Figure 11 Shift in Entrepreneurial Knowledge

This was the general overall conclusion that could be drawn but if we take this one step further one can distinguish a difference between the direction the shift is taking between the categories and concepts when taking into consideration from where the opportunity is born; as an invention needing to find a market or by a market demand that needs to find the technique.

Both Peepoople and SensAbues was born from a market need and as we discussed in the cross-case analysis we found a difference between Peepoople and SensAbues and the identification of unfulfilled needs while Rolling Optics and Graphensic AB recognized an opportunity through their inventions. This shows a dynamic between the knowledge tied close to the entrepreneur and knowledge concerning the external environment of the company. Namely, the companies that developed inventions from identified unfulfilled needs also used knowledge concerning the customer in the discovery phase and creative knowledge in the exploitation phase.

While the process was opposite for the companies that first developed their invention and then proceeded to find a market. Namely they did not involve the customer until the exploitation phase where they also used knowledge of risk, and we consider that in these cases the knowledge used when involving the customer is somehow connected to the perception of risk. This can be illustrated in table 7.

Companies	Rolling Optics	Graphensic AB	Peepoople AB	SensAbues
Market entry	From invention	From invention	From market	From market
Discovery phase	Opportunity recognition	Opportunity recognition	Identification of unfulfilled needs	Identification of unfulfilled needs
	Creativity	Creativity	Risk taking	Risk taking
	-	-	Customer	Customer
Exploitation phase	Risk taking	Risk taking	Creativity	Creativity

Table 7 Similarities by division of market entry

7.2 Implications and Contributions

Our research shows that the entrepreneurial knowledge which has been mostly prominent in the different phases within the entrepreneurial process are opportunity identification, leadership, how to organize and start a business, formulate strategies, commercialize a concept and industry knowledge. These factors can be considered key factors, and the practical implications can thus be for institutions and entrepreneurial education to focus on these categories of entrepreneurial knowledge to increase the entrepreneurial growth in their region (Regeringskansliet, 2012).

Furthermore depending on the nature of the opportunity, if it is derived from a new invention or from a market need, the entrepreneur will benefit more from specific sorts of knowledge in a different order and at different times. This makes it possible to customize the entrepreneurial education depending on the nature of the opportunity.

The theoretical implication this study contributes with is an increased knowledge of which role the entrepreneurial knowledge play in the entrepreneurial process. We now have a more detailed view of what knowledge is used and its changes in significance from knowledge tied close to the entrepreneur towards knowledge concerning the external environment of the company. Yet again depending on the nature of the opportunity this switch will look differently. We also would like to theoretically contribute with our deductively developed frame of reference regarding knowledge of entrepreneurship to increase the body of research within entrepreneurship. With this model we also catch the importance of the external environment as entrepreneurial knowledge that for instance European Commission (2012) lack in their divisions.

7.3 Further Research

In this research we did a qualitative study of the entrepreneurial knowledge by conducting interviews. We suggest to increase the knowledge of this subject even further, to conduct an observation or a deeper time series study where the respondents write a dairy to really capture the whole process and not only the big milestones we did by our interviews.

In this study we deliberately chose to study only one of the founders in respective company, in future research it would be interesting to study the each member of the founding team, their respective roles, how they interact, and how this affected their use of knowledge during the discovery and exploitation of the opportunity. Another factor that could be interesting to study is how the network and the entrepreneurs networking capabilities affect the entrepreneurs' use of knowledge during the entrepreneurial process.

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Appendix 1

Summarizing table over frame of reference with developed concept and their associated references from education chapter and experience chapter.

Concept	Knowledge	Education	Experience
Knowledge tied close to the entrepreneur	Opportunity recognition, identifying unfulfilled needs	Kourilsky, 1995; Shane & Venkataraman, 2000.	Chandler & Jensen, 1992; Rerup, 2005.
	Risk taking	Chia, 1996; Johannison, 1991; Oosterbeek et al., 2010; Porter, 1994; Shane, 2003.	
	Imagination		
	Creativity		
	Problem solver	Honig & Davidsson, 2000; Omerzel & Antoncic, 2008.	Omerzel & Antoncic, 2008; Stuart & Abetti, 1990.
Knowledge concerning the company	Management	Jones & English, 2004; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000.	Bates, 1990; Chandler & Jensen, 1992; Reuber & Fischer, 1994; Ucbasaran et al., 2008.
	Strategy formulation, tactics, vision		Chandler & Jensen, 1992; Omerzel & Antoncic, 2008; Rerup, 2005; Ucbasaran et al., 2003a.
	Finance, acquire resources		Delmar & Shane, 2007; Rerup, 2005.
	Leadership, handle personnel,	Chia 1996; Honig & Davidsson, 2000; Omerzel & Antoncic, 2008; Shane & Venkataraman, 2000.	Chandler & Jensen, 1992; Delmar & Shane, 2007; Ucbasaran et al., 2003a.
	Decision making and Planning	Honig & Davidsson, 2000; Omerzel & Antoncic, 2008	Stuart & Abetti, 1990; Omerzel & Antoncic, 2008.
	How to start and operate a business and commercialize a concept	Colombo & Grilli, 2005; Kourilsky, 1995; Shane, 2003.	Bates, 1990; Delmar & Shane, 2006; Otani, 1996; Rerup, 2005.
	Organizing		Delmar & Shane, 2007; Omerzel & Antoncic, 2008.

	Communication & information system	Honig & Davidsson, 2000; Jones & English, 2004; Omerzel & Antoncic, 2008.	
	Product development & understanding products	Shane, 2003; Omerzel & Antoncic, 2008	Rerup, 2005.
Knowledge concerning the external environment of the company	Marketing, market	Jones & English, 2004; Shane 2003.	Omerzel & Antoncic, 2008.
	Services	Unger et al., 2011.	
	Customers		Chandler 1996; Delmar & Shane, 2007; Rerup, 2005.
	Suppliers, distribution channels		Chandler 1996; Delmar & Shane, 2007; Rerup, 2005; Ucbasaran et al., 2003a.
	Bargaining	Honig & Davidsson, 2000; Omerzel & Antoncic, 2008.	
	Sell		
	Industry Knowledge	Colombo & Grilli, 2005; Shane & Venkataraman, 2000; Oosterbeek et al., 2010.	Bates, 1990; Chandler & Jensen, 1992; Delmar & Shane, 2006; Otani, 1996; Reuber & Fischer, 1994.
	Environmental scanning		Chandler & Jensen, 1992; Rerup, 2005.

Appendix 2

Interview Guide

Category	Knowledge concepts
1. Knowledge tied close to the entrepreneur	**a) Knowledge of unfulfilled needs** such as identifying opportunities.
	b) Creative knowledge that emphasize boundary free tendencies rather than strictly knowledge within limits such as; imagination, creativity, problem solving and risk taking.
2. Knowledge concerning the company	**a) Managerial knowledge** such as; leadership, organizing, strategy formulation, tactics and vision, employees, finance and acquire resources, planning and decision making.
	b) Functional knowledge such as; how to start and operate a business, commercialize a concept, communication and information systems, product development and understanding products.
3. Knowledge concerning the external environment of the company	**a) General external knowledge** such as; environmental scanning and industry knowledge concerning competitors, suppliers and distribution channels.
	b) Marketing knowledge such as; customers, bargaining, sell and service.

(These knowledge's was always in the back of our minds when we asked the questions)

A. Background question

Name: Company:
Age:
Gender:
Position in the company:

B. Entrepreneurial process

Can you tell us how you went about when you discovered the opportunity?

- (*What knowledge did you use? which knowledge was important?*)
- What happened,
- What needed to be done
- Which role did you have
- Was there a knowledge you were missing?

Can you tell us how you went about when you exploited the opportunity?

- (*What knowledge did you use? which knowledge was important?*)
- What happen,
- What needed to be done
- Which role did you have
- Was there a knowledge you were missing?

How long have you been working with the opportunity?

C. End questions
What previous education do you have?

Do you have any earlier experiences concerning company startup?

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