Independent Inventors' Invention Processes

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MASTER THESIS

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Abstract

Title: Independent inventors' invention processes- and how it differs from organizational and entrepreneurial design processes

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Issue of study: In the pre-study for the project Innovation for regional growth (IRT) managed by the Swedish Inventors' association (SUF), which aims to help more independent inventors reach commercialisation, a long list of areas within which independent inventors needed to be educated to increase their commercial success rate was presented. However, little attention was given to their invention processes. When conducting a literature study, no previous research dedicated to provide a holistic description of independent inventors' invention process was found. It was further noticed that front end activities are rarely even mentioned among research on independent inventors.

This master' thesis aims to cover the gap in the existing literature, by first providing a richer description of independent inventors' invention processes, and next comparing that process to models used by organizations and by entrepreneurs to find similarities as well as differences in the approaches. Key insights based on these gaps will be presented, as well as recommendations to SUF based on these observations.

Purpose: The purpose of this master' thesis is to develop a holistic understanding of independent inventors' invention process. The result will provide support for a conceptual model, describing independent inventors' invention process. Also, key insights based on the gap between IIs' process and organizational or entrepreneurial approaches presented in literature will be provided.

Method: To answer the research questions, a qualitative abductive approach was undertaken. The interplay of empirics and literature has provided a holistic description of independent inventors' invention process. The empiric is based on studies of ten independent inventors. Each inventor was first observed twice at pitching occasions. Next, in-depth interviews were conducted, and finally follow-up questions were asked. All inventors were in their invention process. Literature describing independent inventors was conducted, as well as a theoretical framework consisting of models describing organizational and entrepreneurial processes. By applying the theoretical framework on the refined conceptualized invention process, gaps between IIs' approach and literature were disclosed, and presented as key insights. These insights led to suggestions for future studies, and highlights areas in need for attention by SUF if they are to reach the goal of increasing the commercial success rate for inventions by independent inventors.

Conclusions: Independent inventors typically start to develop a solution to a problem they have personally experienced. They quickly move from realization of a problem to an iterative process of sketching, building and testing. During these activities, little interaction with customers and other stakeholders was found. The main reason for this at an early stage was that they did not want to risk patentability. Once a patent application was submitted, external interaction was still low, which was now explained by the fact that few wanted to accept a sunk cost, and making large changes at this stage would make the patent obsolete.

When benchmarking with organizational and entrepreneurial approaches, six main key insights derived from the gap analysis. Independent inventors perform few front end activities, they do not go through divergent phases, little focus is directed towards business related issues, they involve few customers and external stakeholders in their process, they make no formal assessments. Finally, the Lean start-up approach could be a good alternative for some inventors to increase chances to reach commercialisation.

Key words: Invention, Independent Inventor, Innovation process, Invention Process, NCD, Design Thinking

Acknowledgments

This master thesis has been performed with support from Svenska Uppfinnareföreningen (SUF), an organization with 130 years of experience of inventors and inventions. During this project, I have met with many members of the association, as well as other individuals within SUF's network, from which I have learned a lot. Although they are not used as sources in this thesis, they have helped me develop a richer understanding of the inventive world and culture, which I believe was necessary to fully understand and interpret the data.

Furthermore, it was through SUF I came in contact with relevant inventors to study. I would like to express my sincerest gratitude to all ten inventors who have patiently answered all my questions, and shared more stories and details than I could ever have hoped for. Also, this thesis could not have been written without the support from the president of SUF, Mats Olsson, who initiated this project and has shared infinitely of his experiences and contacts to make it possible. I would also like to thank my colleague at SUF, Rasmus Kling, who volunteered as a sounding board which was much needed as I was a single author.

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Helen Mattsson

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Acronyms

SUF	Svenska Uppfinnareföreningen
II	Independent inventor
NCD	New Concept design
DT	Design Thinking
TF	Theoretical Framework
Invention Process	The innovation process without focus on commercial related activities

1 Introduction

1.1 Background

1.1.1 Inventors importance for Innovation

Today, innovation is a political and corporate buzzword (O'Bryan, 2016), not very surprisingly, as innovation is considered crucial for long-term economic growth. Already in 1911, Joseph Schumpeter pointed out that small company innovation plays a crucial role in the success and dynamism of capitalist economies (Schumpeter J. , 1911). It has been further argued that the function of innovation is to introduce novelty into the economic sphere. Should the stream of innovation dry up, the economy will settle into a stationary state with little or no growth (Metcalfe, 1998). Moreover, issues such as climate change, water stress, biodiversity loss, land system change and altered biochemical cycles are issues humanity need to address and solve (Steffen, et al., 2015). To do, we may rely on innovation.

Sweden has a long tradition of inventing; many of the large companies such as TetraPak and SKF, which have played fundamental roles in the development of the Swedish economy, are based on inventions (Norrman & Frankelius, 2013). So, innovation is clearly important also on a national level; but where does it come from? Recent statistics from Patent- och registreringsverket (2016) shows that 22% of all national patent applications submitted in 2015 derived from independent inventors (IIs), that is inventors who invent outside a company's boarder and without connection to universities (Lettl, Rost, & Von Wartberg, 2009). However, sometimes as part of patent strategies, companies hand in multiple applications without planning to commercial all of them; 22% of the company applications were submitted by the same ten companies (Arvidsson, 2015), and similarly, not all inventions by independent inventors are commercialized. If instead studying where Sweden's 100 most important innovations derive from, a study shows that 47% of the inventions were developed within already established companies, 33% were developed by independent innovators, while the academia represented the remaining 20% (Sandström, 2014). Although this study considered innovations over time, meaning the distribution might be different if only considering innovations from the last year, it shows that independent inventors have played an important role to the innovativeness of Sweden, and hopefully they will continue to contribute to a sustainable development and economic growth.

However, studies show that many inventors struggle to successfully commercialize their ideas. Only five to eight percent of inventions from independent inventors reach the market (Åstebro & Dahlin, 2005), meaning a lot of time and money that is spent on development of these inventions is never regained.

1.1.2 Svenska Uppfinnareföreningen

Svenska Uppfinnareföreningen (SUF) is, as the name discloses, an association for Swedish inventors. It was founded in 1886, and is thereby the world's oldest inventor association (Norrman & Frankelius, 2013). SUF owns the corporation Svenska Uppfinnareföreningen Service AB, which among other services provides patent fee coverage, support and acknowledge inventors through innovation scholarships, and manage innovation projects, often on behalf of Vinnova, The Swedish Governmental Agency for Innovation Systems. The association SUF consists of 30 member associations, all non-for profit organizations. The number of members within each association varies, as well as activities and services that are offered. However, all associations provide advice and support to their members through a network of experienced inventors (Olsson, 2016).

Figure 1: Organization SUF

A national support system for innovation exist, but it is not always available to independent inventors, due to reasons such as lack of fit with accepting criteria to incubators and science parks, or because of geographic location. Furthermore, the support that is offered does not always meet the inventors' needs (Norrman & Frankelius, 2013).

1.1.3 Innovation for Regional Growth

Innovation for regional growth (IRT) is a project financed by Vinnova and managed by SUF. The aim with the project is to increase the number of new products based on inventions from independent inventors to the market, and thus promote innovation. The background to IRT is the report Innovations Importance for Sweden (Norrman & Frankelius, 2013) which indicates that Sweden would profit from helping more inventors to commercialize their inventions.

1.2 Issue of Study

In the report Uppfinningars betydelse för Sverige, Norrman & Frankelius (2013) analyse the main obstacles independent inventors face while trying to reach commercialisation. They highlight idea development, conceptualization, identification of customer needs, design, channels, financing, intellectual property rights, regulations and sales as areas in which inventors need to be educated. Furthermore, Norrman and Frankelius (2014) propose that education should include both self-study courses on the web, and study circles or workshops where people on local, regional and national level meet to develop their ideas with support from a workshop leader or supervisor.

However, while suggesting that inventors should be educated, and even within which areas, the authors never discuss the problem through a more holistic point of view. While reading the report, many questions came to mind, of which one were of specific interest. Are independent inventors working through a process that leads them to develop desirable and commercially viable products? Studies researching the underlying incentive for inventors to apply for patents shows that patentability is a more common incentive than market related opportunities (Åstebro & Dahlin, 2005). This indicates that inventors prioritize the technological solution over the customers' needs for the solution. This is also described in Uppfinnares betydelse för Sverige (Norrman & Frankelius, 2013), which claims that many inventors have a strong focus on developing a great technology or solution rather than including customers and anchoring the idea in market needs. Especially the early phase of the innovation process was found interesting to study, as that sets the direction for the entire project, and problems that occur later may spring from early decisions.

Furthermore, commercial success rate for new products developed within already established companies is higher than the success rate for independent inventors (Mansfield, et al., 1971). Similarly, the chance for a start-up to succeed that is not based on an invention is higher than those that are (Katz, 1989, Reynolds & White, 1992). Hence, it was considered interesting to study the gap by benchmarking independent inventors' innovation processes with corporate and entrepreneurial innovation processes to see how it differs, and analyse the insights of those gaps.

1.3 Purpose

The purpose of this master thesis is to develop a deeper understanding of independent inventors' innovation process, with focus on the early phase. As little attention is given to commercialisation, the process in scope will be referred to as invention processes. The result will provide support for a conceptual model, describing independent inventors' invention process. Also, key insights based on the gap between IIs' process and organizational and entrepreneurial design processes presented in literature will be provided.

1.3.1 Research Questions

This master thesis is based on two research questions (RQs). The purpose of the thesis will be attained by answering these questions.

RQ 1: *How can independent inventors' invention process be described?*

RQ 2: *What is the gap between inventors' invention process and organizational and entrepreneurial design processes suggested by literature?*

1.4 Definitions

1.4.1 Inventor

To *invent* was defined by Schumpeter (1939) as the act of intellectual creativity. Many definitions have followed, such as Fagerberg's suggestion that "Invention is the first occurrence of an idea for a new product or process" (Fagerberg, 2004, p. 3). An inventor is a person who is inventing, thus, the title could be carried by anyone who has invented something, for instance a scientist, a student with a new idea for an application or someone working as a product developer at a company. There was hence a need to further specify the type of inventor relevant for this thesis.

1.4.2 Independent inventor

Weick & Marin (2006) defines an independent inventor as an individual who creates outside the context of a company, university or government institutions. Lettl, Rost, & Von Wartberg (2009) adds to this definition, that independent inventors have no formal obligation to invent. In this thesis, independent inventors are similarly defined as inventors without connection to universities, who do not have access to incubators or science parks, who's inventive activity is conducted separately from an established firm, and who does not have an obligation to invent. Almost all SUF's members fall into the category of independent inventors (Olsson, 2016).

1.4.3 Entrepreneur

An entrepreneur is an individual who recognizes and actively exploits opportunities on the market (Johannsson, 1988). Evidently, the definition does not pint to any demands of novelty in the offerings, but rather focuses on the exploitation of the market opportunity. A notation should be made that a person naturally can be both an entrepreneur and an inventor at the same time, although some claim that is rare (Smeilus, 2015).

1.4.4 Invention Process

The invention process is in this thesis defined as the process of developing an invention, from the initial trigger point to a final concept. However, the definition excludes activities aiming to introduce the invention to the market, meaning turning the invention into an innovation (Fagerberg, 2005).

1.5 Delimitations

The scope of this thesis only includes independent inventors, hence, that was the only type of inventors studied. However, although making this distinction, there is not necessarily a difference in which activities are sufficient for an incubated student versus an independent inventor to innovate. Everyone who is developing an idea must go through a process, and a product must be desirable and feasible no matter who developed it.

Little attention will be given to issues and activities concerning commercialisation, as doing so would imply that the project would not fit within the master' thesis 20 weeks' scope. The early phase was chosen to study, as it was considered important to understand the primary phase before analysing activities and issues that may derive from those early activities and decisions. However, further studies focusing instead on the IIs' commercialisation process is suggested for further research, which could extend the conceptual model and insights developed in this thesis.

1.6 Disposition

Chapter 1 Introduction

This chapter introduces the reader to the research subject, gives the background to the master thesis and explain the issue of study. Also, the purpose of the thesis is presented along with two research questions. Delimitations of the study are discussed, and finally the disposition of the report is presented.

Chapter 2 Method

Chapter two explains the research strategy and process, as well as the method used for data collection. Moreover, it presents the analytical approach, as well as the work process. Finally, a discussion of the credibility of the study is conducted.

Chapter 3 Theoretical Framework

In chapter three the reader is introduced to previous literature that will be used in the analysis to find answers to the research questions. First, literature describing independent inventors is presented, followed by an introduction to various organizational and entrepreneurial design process models, mainly focused on the early phases of innovation processes. A compilation of the models is presented as a theoretical framework. The research areas relevant for this study were; fuzzy front end, new product development, design thinking, lean start-up and innovation process. Furthermore, an introduction to patents is presented.

Keywords used while searching for relevant theory were: Independent inventor, Innovation process, New product development, Lean, HCD, Intellectual Property.

Chapter 4 Empirics

Chapter four describes the insights gathered from the empirical study. First a compilation of data and insights derived from the pitching activities is presented. Next, all inventors' processes are described in a compilation. Generalized insights about their process, based on the data, is then presented. Finally, some additional material derived from interviews with incubator managers is provided.

Chapter 5 Analysis

In chapter five the results presented in the empirics are compared to previous research results found through the literature study, and a conceptual model describing independent inventors' invention process is developed and introduced. Furthermore, the theoretical framework is applied on the IIs' process, and activities are compared and discussed. Gaps are identified from which key insights are presented.

Chapter 7 Conclusion and final remarks

In the last chapter, conclusions from the study are presented which answers the research questions, as well as a discussion of the result and some recommendations to SUF, who initiated this project. Finally, some final remarks are provided.

2 Methodology

2.1 Research Strategy

For this thesis, a qualitative research strategy with an abductive reasoning approach was undertaken. The qualitative method is appropriate to use in an explorative manner to find out how something works and why it works that way (Hennink, Hutter, & Bailey, 2011). Furthermore, the method allows open research questions which means the study does not need to be limited at an early stage (Bryman, 2011), and leads to more affluent data which helps understanding the phenomena explored in the study (Edmonson & McManus, 2007). Hence, the qualitative strategy is particularly useful within research areas that are relatively young (Starrin & Svensson, 1994). Independent inventors’ invention processes are yet unexplored (Smeilus, 2015), and the aim was to develop a deeper understanding of the process, meaning that “how” and “why” where important elements. Thus, the qualitative approach was considered appropriate for this study.

The approach was inspired by the abductive reasoning approach, implying that theory building is done through the interaction of theory and empirics (Wallén, 1993). Thus, after the problem is identified, an iterative process follows in which theory is matched with real life observations, which allows the researcher to return to literature to find explanation to phenomena exposed by the data (Starrin & Svensson, 1994). The abductive approach is appropriate and commonly used for qualitative research. In contrast, inductive reasoning implies that theory should be derived from data alone. Finally, deductive reasoning means testing of hypothesis derived from existing theories (Bryman, 2011). As the aim was not to confirm but to explore and understand, and no previous theories in this thesis’s topic was found, this method was considered inapplicable.

2.2 Work Process

The work process for master thesis is often described as a funnel. For this thesis, the process can be better described by a double diamond process as presented in Figure 1. After the research questions were formulated, an explorative phase followed to discover and understand the inventors’ invention processes and to find organizational and entrepreneurial design models to benchmark against. A broad literature search was conducted. Then, a convergent phase followed, during which four models were chosen, and the data gathered through pitching activities and interviews was compiled and interpreted with support from previous literature describing independent inventors. Once a theoretical framework was developed, and a better understanding of the independent inventors’ invention process was reached, another explorative phase followed. In this phase, the aim was to explore opportunities and insights based on the gap that became visible through comparing IIs’ process with the theoretical framework. Finally, the insights were categorized and compiled, and the contribution to the academia and recommendations to SUF derived.

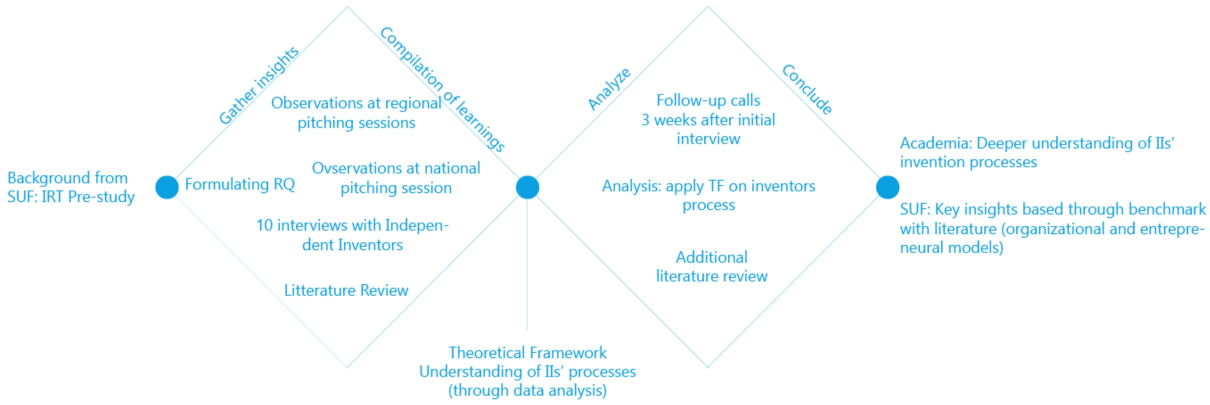

Figure 1: Master' thesis work process

The trigger point was a meeting with SUF, at which the IRT pre-study Uppinningars betydelse för Sverige (Norrman & Frankelius, 2013) was discussed. The study indicated that there is a long list of issues that IIs face and need to overcome to reach commercialisation. SUF wanted to better understand their members so they would be able to provide better support in the future to increase the commercial success rate.

The author's previous knowledge of innovation processes led to the notation that theory on innovation processes taught at universities differs greatly from inventors' processes as described at SUF, where the problem always seems to start with an idea of a solution rather than looking for an opportunity. Thus, it was considered interesting to further study the early phase of the innovation process. The starting point and purpose for this thesis was chosen to better understand II's innovation processes and identify explanations to why some paths are chosen, with focus on the early phase.

A thorough literature review was required, both to find support and explanation for IIs behaviour disclosed by the empirics from previous research, but also to understand different innovation processes better. Some behaviour could be supported and explained, while some are still unanswered and proposed subject for further research. No existing models to specifically describe IIs' invention process was found. Literature on organizational and entrepreneurial design models was compiled into a theoretical framework. As the empirics pointed towards that intellectual property affected IIs' processes heavily, a brief literature study on patents was added. Finally, the theoretical framework was applied to the process, and key insights derived from the gap is presented.

2.3 Data Collection

The research questions are of descriptive and explanatory character, thus qualitative methods for data collection was chosen as it provides a more detailed and nuanced data (Holme & Solvang, 1997). The data has been collected through observations and in-depth interviews.

2.3.1 Observations

Observations can be used to identify what goes on, how it happens, and from a participants standpoint why it happens (Jorgensen, 1989). Furthermore, observations are claimed to be exceptional for studying processes and patterns (Jorgensen, 1989). For this thesis, it was desired to study independent inventors' processes. It was not possible to observe each inventor throughout their entire process, as the work performed by inventors is typically spread out over years. Hence, they were instead observed during pitching activities. The aim was to gain a basic understanding of the independent inventors' invention projects and process, as well as their main areas of focus.

2.3.2 In-depth interviews

Collecting data through in-depth interviews means collecting individual's personal stories and experiences regarding a certain topic or issue (Hennink, Hutter, & Bailey, 2011). Interviews are beneficial when exploring new areas (Edmonson & McManus, 2007) which was the case for this thesis. For all interviews, semi-structured interview guides with open questions were used as a framework, which allowed follow up questions to further build to the interviewees replies, but kept the interview open to unpredictable input (Hennink, Hutter, & Bailey, 2011). It was considered important to obtain a flexibility to the interviews as inventors' have different experiences and stories which may be relevant but difficult to predict. Potential follow-up questions were prepared in advance as well as topical probes, which aimed to remind the interviewer to clarify areas that the interviewee did not mention, to ensure that no relevant information was missed (Hennink, Hutter, & Bailey, 2011).

2.3.3 Independent Inventors

2.3.3.1 Selection of inventors to study

As part of the project IRT, regional pitching activities were planned and executed at six of SUF's 30 associations. At each pitching, five or six inventors were invited by the president of each association to pitch their ideas. At each pitching, two inventors were announced winners by a panel of four judges with rich experience of innovation. The winners were invited to a national pitching event. These were the inventors chosen to study. Two inventors fell out due to personal reasons, thus in total 10 inventors were studied.

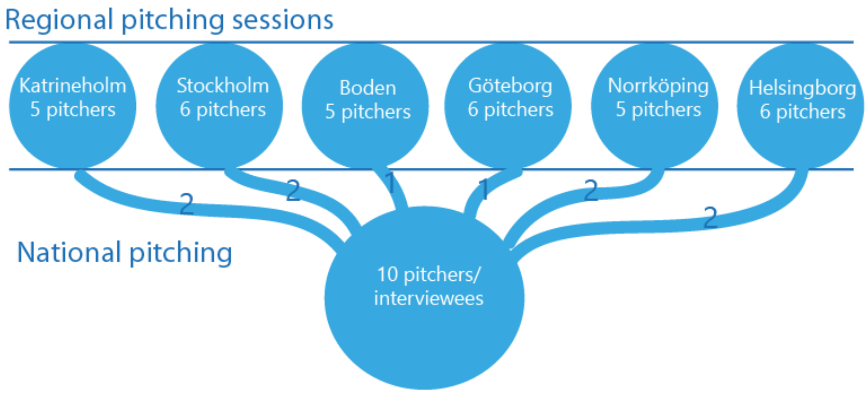

Figure 2: Selection of inventors to study

2.3.3.2 Evaluation Criteria

Two weeks before the first pitching activity, a document including 34 evaluation criteria, inspired by the evaluation criteria in the Canadian Inventor Association Program (Åstebro & Michela, 2005) which can be found in appendix C, was e-mailed to all pitching facilitators. As IRT at the time was very focused on helping the inventions to market, rather than the inventors, the criteria were focused on the potential of the invention without considering the person behind the invention. The four areas were technology, production, market and risk. However, while observing the panel discussion to select two winners, it was clear that all criteria in the evaluation document was not considered. One reason was that the criteria was very extensive, and thus it was too time demanding to consider all aspects. Also, the pitches did not include all necessary information to judge the inventions based on all criteria.

2.3.3.3 Observation of independent inventors at pitching activities

All 10 inventors were observed at two pitching occasions each, during which notes were taken. Furthermore, notes from the pitching panel and one colleague was received at both occasions. This provided a fundamental understanding of the inventors' processes, such as which activities they had performed, and what they focused on. Questions were asked by the panel at the end of the pitches which helped to clarify uncertainties and disclose gaps in their process.

The inventors were instructed to pitch by first presenting need for the product, then describe their approach to solve it, next to describe the benefit over cost and finally to present existing and expected competitors. Not all inventors stuck to these guidelines. The time limit for each pitch was five minutes, after which questions from each jury member followed. The panel had been pre-directed roles to make sure many perspectives would be considered. One focused on positive aspects, one on areas for improvements, a third on financial aspects and finally, one held the customer's perspective.

2.3.3.4 In-depth phone interviews with inventors in an active process

All inventors were interviewed over the phone. The reason for this was large geographical distances between the interviewer and the interviewees. However, the interviewer had previously met with all inventors twice at pitching occasions, during which non-disclosure agreements were signed. Thus, the interviewees were comfortable discussing their ideas with the interviewer. The reason why the interviews were not conducted in conjunction with the pitching activities was that it was still at an early stage of the project. The confidential trust was further established through the cooperation with SUF which has 130 years' tradition of handling inventions. The duration of the interviews varied between one and two hours. Due to the confidentiality agreement, only data that inventors felt comfortable sharing is presented in this thesis, and all inventors are anonymous, meaning their names and identities are not disclosed. However, most data that was relevant for the analysis of the inventors' invention processes could be shared as it often does not disclose the inventions but rather their approach.

Interviews with inventors were not recorded, as some were worried that their inventions could be disclosed, and hence risk the patentability. Also, some were uncomfortable with being recorded, thus there was a risk that they would not talk as freely. Instead, notes were taken during the interviews, and their replies were repeated back to them after each question was answered. This was done to make sure the notes were correct.

A written compilation of the interviews was sent to the inventors to read through and approve before the data was analysed. This was done to confirm that the content had been correctly captured and interpreted. The interview guide was updated throughout the interviewing process as the interviewer realized additional questions could provide valuable input. Also, all inventors were contacted again three weeks after the initial interview for follow-up questions to clarify uncertainties and get a richer description of their processes. This was also done over the phone. The insights presented became clear after about eight interviews, but to avoid selection bias, and to reach a better validity, all ten inventors were interviewed.

2.3.4 Additional interviews

2.3.4.1 Incubator managers

Incubator managers were contacted to receive their perspective on the invention or start-up process in the early phase. All SISP members received an e-mail inquiry. Three of them agreed on a phone interview and were hence contacted. Interviews were conducted over the phone. The duration of the interviews lasted between 30 minutes and one hour. The calls were recorded on approval, and the interviews were then complied in a written document.

2.4 Data Analysis

To analyse the data in this thesis, an abductive approach has been undertaken, meaning existing research was used to explain the results derived from the data (Wallén, 1993). A theoretical framework presenting innovation models used by corporations and within entrepreneurial contexts have been developed and applied to the conceptual model describing the IIs invention process. The interplay between interpreting qualitative data gathered from interviews and observations and literature is well in line with an abductive approach.

All interviews were not recorded and consequently not transcribed, due to reasons previously discussed. This means some formulations and nuances from the interviews were potentially missed. However, through multiple conversations, first at the two pitching activities, next during the phone interviews and finally through follow up calls, a rich understanding of all inventors' processes evolved, including soft aspects and subconscious choices which were noted. Also, the probes and follow up questions during the conversations helped to truly understand the inventors. All notes were compiled and approved by the interviewees. The data was coded, and based on that categorized (Hennink, Hutter, & Bailey, 2011).

2.5 Discussion of chosen methodology

2.5.1 Overview

The aim with the thesis was to better understand and describe II's invention processes. The choice of method well captured the essence of inventors' processes, and provided explanations to many choices in IIs' processes. The open in-depth interviews provided a rich description of the processes and even gave insights outside the initial scope of the interviews. Also, the complementary questions that were added during the analytic phase helped to handle uncertainties. As little literature was found on II's invention processes from a holistic perspective, not much support could be received from previous studies. This was especially challenging as the thesis only is a 20-week project, thus there was a limit to the amount of data that could be collected. More interviewees would have been desirable. However, interviews were performed until trends in the data could be identified, meaning the data did show clear patterns, which is what is presented in the results. Naturally, it is possible and even likely that there is more to understand about independent inventor's invention processes, and hence that more interviews and further analysis could lead to a refined view of their process.

2.5.2 Selection of inventors to study

By selecting the winning inventors from the pitching activities, a geographical spread was reached, as well as a broad variation in type of inventions; the inventors came from Stockholm, Gothenburg, Boden, Linköping, Helsingborg and Katrineholm, and the type of inventions ranged from mechanical solutions to smart-phone applications and electronical components. What they all had in common was a strong ambition to commercialize their inventions, meaning they did not "just" invent for fun. This was considered important as the aim with IRT is to increase the commercial success rate for independent inventors. Furthermore, they had all passed the earliest stage, yet were still in the development process. One could argue that it would have been more beneficial to study inventors after a process had been completed, that is after they have reached commercialisation or given up, as it would mean the outcome could be added to the analysis. However, the presence-perspective was considered beneficial as the chances of describing why certain decisions are made at certain stages are closer in time. This implies the replies were not as affected by the brains processing of memories which can change them overtime (Kahneman, 2012).

The data was gathered through observations and interviews, hence the sampling of inventors to study affected the outcome. If other inventors had been chosen, there is a possibility that the data would have pointed to other conclusions. Thus, the sampling was important for the reliability of the study, as was providing a thorough description of how selection was done (Höst, Regnell, & Rundeson, 2006). The 10 inventors that were selected to study were chosen through a pitching competition, meaning an external panel selected interview objects rather than the author herself. This was considered beneficial, as it eliminates the risk that the author selected inventors that would confirm some subconsciously pre-formulated hypothesis about the result. Lastly, the choice of key words in the initial literature review might have affected the result. The author has gone through a wide phase of literature search, and has received some recommendations from the supervisor. However, there are many different models that could have been used for the benchmark, which could have led to other insights.

2.5.3 Data capturing

The fact that all interviews were not recorded and transcribed implies a risk that some important nuances or underlying needs or explanations were missed. This was done due to the wishes of the inventors, and to make them open up more. However, the natural breaks that occurred when the author finished writing notes, gave space and time for the interviewee to think. A few times, this led to additions to the initial reply which was richer and deeper in content. Furthermore, it is beneficial to be at least two people facilitating the interviews, so that one can focus on taking notes and the other to listen and come up with relevant follow-up questions based on how the conversation evolves (Stanford, 2016). This was not done as the thesis was conducted by one single author. However, the fact that the author interacted with the inventors at four times enhanced the chance to capture more nuances and underlying aspects, and gave many opportunities to prepare and ask follow-up questions to fill out blanks that might have been missed while interviewing as a consequence of being only one interviewer. It is also noticeable hat although the compilations of the interviews were sent to the inventors for a review, the final conceptual model that provides a gathered view of IIs' process was not confirmed with them. Doing so could have provided more legitimacy to the model.

2.5.4 Potentially biased

The author was located at, and held a half-time position at, SUF during the writing of this thesis. There is a risk that the environment affected the author to a biased view. When interpreting the data, it is possible that the opinions and perspectives from other employees and stakeholders pointed the author to conclusions that was not visible in the data, but rather an expression of confirmation bias. However, that could also be an advantage, as perspectives from experienced and competent individuals at SUF, who possesses major experience of inventors' processes, could help identify insights that otherwise would have been missed, and helped to interpret and confirm or question some conclusions.

2.5.5 Transferability

For qualitative studies, transferability can be used to measure how well the context is described. High transferability means providing enough information about the context for the reader to be able to determine if the result can be applied to other studies as well (Bryman, 2011). In this thesis, the selection process and context was well described. Although the inventors were not selected with all pre-determined evaluation criteria in mind, there are clear indications of the basis on which inventors were selected. This improves the transferability of the study. However, due to confidentiality preventing the author to disclose information about the technical solutions, the transferability is at risk. The author tried to overcome this by describing the type of invention and the relevant context of the inventors interviewed in as much detail as possible without risking to break the confidentiality.

3 Theoretical framework

No literature was found to provide a holistic view of IIs' invention process, and little literature discussing independent inventors in the early phase was found. However, IIs have been studied with other focus. As has innovation processes, although mainly from an organizational perspective (Weick & Eakin, 2005). *First, an introduction to independent inventors will be given, followed by a description of innovation processes and elements in those with focus on the early phase. Finally, an introduction to patents will be provided.*

3.1 Independent Inventors

3.1.1 Success

As described in the introduction to this thesis, inventors are an important source of innovation, but many have problems to succeed. The probability of commercialisation for inventions developed by independent inventors is on average 6.5%. This can be compared to the successful start-up of any business, which is 10-50% (Katz, 1989, Reynolds & White, 1992), or to the success rate of commercializing inventions developed within already established firms which is 26-52% (Mansfield et al., 1971).

Anticipated stable demand, price required for profitability, and technical product maturity were the three variables found to significantly affect survival of IIs' inventions (Åstebro & Michela, 2005). Klofsten (2005) further found that a high degree of market anchorage enhances the chance for commercial success, and states that it is specifically important for actors with small resources. Norrman & Frankelius (2013) conclude that although it is difficult to "pick the winners" among a group of inventions on beforehand, it is possible to, with high probability, know which projects will fail. Åstebro & Dahlin (2005) argue that an early analysis of the potential of inventions is important so that time and money is not wasted on projects that are doomed to fail.

3.1.2 Independent Inventors Inventing

The result from an analysis of 66 inventor biographies, presented as part of the Lemelson-MIT programme, concluded that inventors who successfully reach a licensing agreement spend a lot of time researching the market before developing the solution (Smeilus, 2015). Typical activities are primary and secondary market research studies to confirm the need and to develop design specification for the invention. They also seem to conduct many experiments to prove a concept or test different materials, and many file for patent a protection. However, their relations to their patents are not discussed in the study. At a later stage, they typically develop prototypes which can demonstrate fit, functional and aesthetic appeal (Smeilus, 2015).

Although that is what inventors who have successfully reached a licensing deal do, it is not what all IIs do. In general, independent inventors are technology- and solution driven rather than market oriented (Macdonald, 1986), and persue a solution to a problem they have personally experienced (Smeilus, 2015). They typically have many ideas, and the choice of in which to invest is not always well analysed, but rather depends on an unqualified perception of the market situation and on influences from friends, family or other close associates (Klofsten, 2005). The heavy focus on technique often lead innovators to an underestimation of the more soft, outgoing sides of entrepreneurship, such as marketing and customer development, which is critical if the idea is to take the next step forward in the process (Klofsten, 2005). In an ex-ante perspective on innovation development received from the case-companies in Klofsten's (2005) study, the founders stated that they strongly underestimated the work of defining a market segment, developing sales material and involving clients in the development. The fact that inventors focus more on the technical solution than the need and demand of the solution to a problem is further supported by a study showing that inventors tend to apply for patents based on the patentability rather than market related opportunities (Åstebro & Dahlin, Opportunity knocks, 2005).

Typically, inventors produce drawings to explain how their invention might function; many start sketching directly after having the initial idea, such as on the bus (Smeilus, 2015). Although many wants the invention to reach the market, few independent inventors aspire to be an entrepreneur (Parker, Udell, & Blades, 1996). Moreover, few individuals possess all necessary knowledge and competence that is sufficient to develop and commercially sustainable invention, and to bring it to the market. To find the right contacts and partners is considered difficult by many inventors (Norrman & Frankelius, 2013).

3.1.3 Independent Inventors' personal characteristics

Smelius (2015) made a compilation of previous research describing independent inventors' personal characteristics. The result can be seen in Table 1: Independent inventors' characteristics (Source: Smelius 2015).

Table 1: Independent inventors' characteristics (Source: Smelius 2015)

Autodidact (self-taught)
Autonomous/individualistic
Over-confident
Optimistic
Risk-seeking
Opportunity seeker
Relatively high level of self-efficacy
Attracted to complexity
Energetic
Intuitive
Perceive themselves as creative
Favour bredth over expertise
Specialise in problem solving
Curious
Self-motivated

Combine practical and theoretical knowledge	
View knowledge as coherent	

It is notable that no extrovert or empathic characteristics are listed. Instead, characteristics such as autodidact and individualistic are common. Curious could imply some external engagement, but mainly refers to technology curiosity (Smeilus, 2015).

3.1.4 Confirmation Bias

Udell (2004) argue that inventors are overly committed to commercially and technically flawed inventions due to cognitive bias, implying they are too in love with ideas or solutions with poor potential. Åstebro (2003) further claims that inventors are guilty of blind optimism. This argument is based on the discovery that 50% of independent Canadian inventors who were evaluated by a third party (The Canadian Innovation Centre) and advised not to precede with their inventions because of its poor quality, ignored the advice. They did so although it was explained to them that the chances to reach commercialisation statistically were at best 0.04 based on the grade they received, and the fact that even if they were to commercialize their ideas, the return on investment most likely would be negative (Åstebro T. , 2003). Later, Åstebro, Jeffery, & Adomdza (2007) found further support for the theory of the role of cognitive bias while showing that inventors are more overconfident and optimistic than the general population.

3.2 Innovation Processes

3.2.1 Overview

The innovation process has been described in various ways by different researchers (Veryzer, 1998). However, Veryzer (1998) claims that the basic phases are similar in most definitions. In the first phase, there is strategic planning and concept generation, which is followed by a pre-technological evaluation and technical development and finally commercialisation. Similarly, (Koen, et al., 2001) describes an innovation process as a three-stage process, illustrated in Figure 3. In the first phase, the front end, the main activities include defining an opportunity, get inspiration and develop concepts. This phase is followed by the new product development process (NPD process), and finally, the product is brought to market in the commercialisation phase.

Figure 3: Innovation Process (Source Koen et al., 2001)

Recently, other more iterative innovation models have been suggested, in which the commercialisation is integrated early in the process to develop a sustainable business around a product. This is often referred to as the Lean start-up methodology (Blank, 2013) which will be described later in further detail. As this thesis does not include the commercialisation phase, when possible to separate, only the front end and NPD phase will be discussed further.

3.2.2 Fuzzy Front End

The term Fuzzy Front End (FFE) was first popularized by Smith & Reinertsen (1991). It refers to the initial phase of a product engineering development process, starting at the innovation opportunity identification or inspiration, and ends when an idea is ready for a formal development process with committed resources for that purpose (Smith & Reinertsen, 1991). The term fuzzy comes from the characteristics of the process which is hard to grasp, control and understand (Smith & Reinertsen, 1991), as well as the uncertainty and experimenting associated with the process (Koen, et al., 2001).

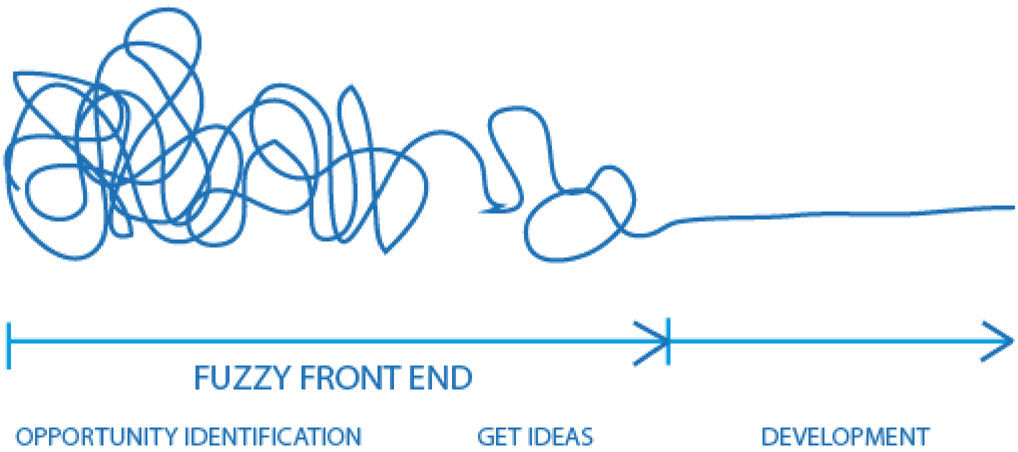

Figure 4: The Fuzzy Front End (Source: Gijs van Wulfen, 2016)

As this part of the innovation process determines which problem to solve, and sets the concept for further development, it also affects the outcome of the final product, and is thus an important part of the process. By improving the upfront efforts in the FFE, the market success rate will improve (Cooper R. , 2014). This is further supported by (Page & Stovall, 1994), who claims that those companies that spend more time on the FFE activities generally are more successful in their allocation of research and development (R&D) resources, as they manage to support projects with higher success rate, higher profits and increased revenue from new products, as well as and shorter time to market.

To provide clarity to the mysterious and what seems like an unmanageable FFE process (Gassmann & Schweitzer, 2014), Koen et al (2001) developed the New Concept Development Model (NCD) which is regularly referred to in further research on FFE (Reid & de Brentani, 2004).

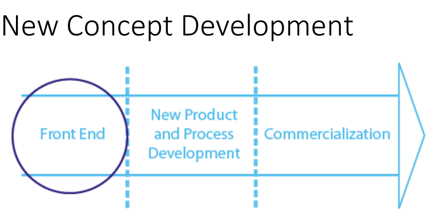

Figure 5: New concept development front end activities

Koen et al. (2001) defines five elements that are included in the FFE process, and stresses that it is not a linear process, but rather a highly interactive iterative process. The model is illustrated in Figure 6.

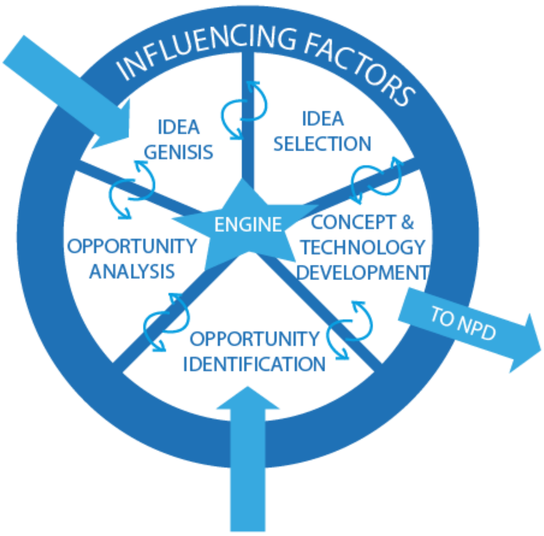

Figure 6: NCD (Source: Koen et al., 2001)

Opportunity identification is about recognizing opportunities through identification of gaps between current situation and a possible future situation. It can refer to identification of new markets or new technologies, and can occur through structured processes or random appearances (Koen, et al., 2001).

Opportunity Analysis involve efforts to align ideas to target customer groups as well as making market research and some technological tests. It aims to clarify trends through early and often insecure estimates of market and technology possibilities. The methods used might be formal or informal, but should derive in a description of the identified opportunities' attractiveness and appropriateness (Koen, et al., 2001).

Ideas Genesis implies generation of tangible ideas based on the opportunities identified, as well as development and maturity to a concrete idea. It aims to find user needs and new solutions to the problems that meets the needs. It also includes finding methods to include users and customers, and to create a creative culture (Koen, et al., 2001).

Idea selection involves evaluation of ideas based on business potential, and selection of which ideas to proceed with. As information at this stage is often insufficient, complex evaluation processes are often required. Methods might include multiple quantitative metrics, quick feedback or risk assessments (Koen, et al., 2001).

Concept and technology development is the last phase in the NCD-process. A business case is developed with consideration to estimates of market size and share, customer needs, investment requirements, competition and uncertainty. It results in a concept which is ready for a formal process for further development (Koen, et al., 2001).

The engine in the middle symbolizes the driving force of the five elements, and derives from the leadership or culture of the organization. The influencing factors refer to organizational capabilities, business strategy and the outside world, including distribution channels, customers and competitors, and finally enabling science (Koen, et al., 2001).

3.2.3 The new product development process

There are many models describing the NPD-process (Smeilus, 2015). The Stage Gate model was chosen as a previous study describing independent inventors who successfully reach licence deals argue that the stage gate is closest to describe their process. However, as that paper only study IIs who have successfully reached a licence agreement., it probably differs from how all IIs work. An introduction of the stage gate model is provided.

The Stage Gate model

Figure 7: The stage gate model: mainly within the new product & process development

The Stage-Gate model is a conceptual map for bringing ideas to market, see Figure 7. It is based on research on what winning companies do (Cooper 2004), to lead the way for others to manage their NPD processes more efficiently. The Stage Gate Model was initially introduced by Cooper in 1990, but has since then been developed by many, including himself (Cooper 2008). The model includes active developing stages, followed by evaluative gates to decide on whether to continue the development or not. The gate keepers are often senior managers with diverse roles and experiences. The criteria are often execution and action plan quality as well as business rationale. Hence, the projects are continuously evaluated by people who are less attached to the ideas, and those projects that do not meet the objectives are cancelled or redefined. The Stage-Gate is considered a planned-based approach due to many upfront activates devoted estimations, analysis and plans (Cooper 2015).

Coopers Stage-Gate model from 2008 is illustrated in Figure 8. The model ends with post-launch review. However, only the activities within the scope of this thesis will be further described.

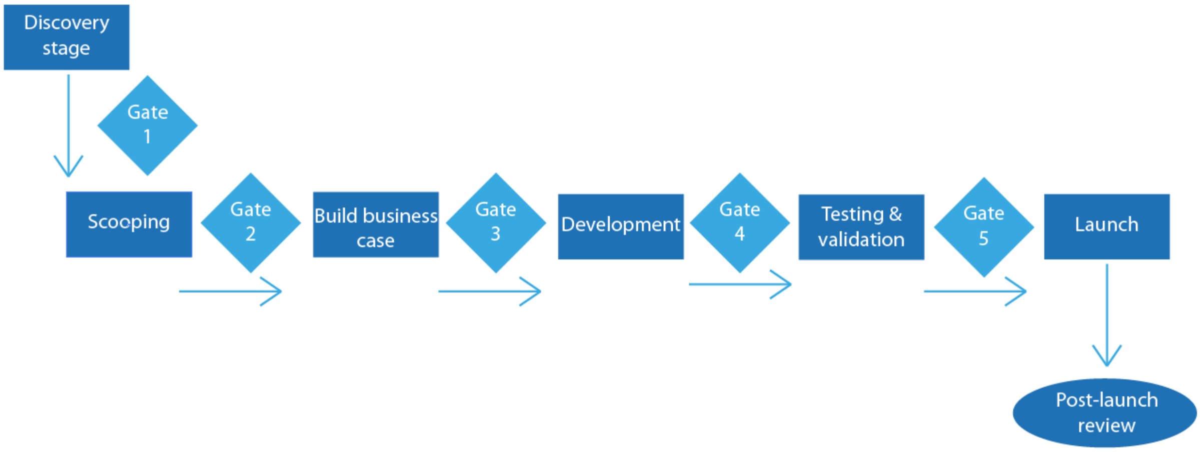

Figure 8: The Stage Gate model (Source: Cooper, 2008)

The discovery stage is sometimes also referred to as idea generation. Ideas could derive from scientists or technicians strategic planning exercises, technology forecasting & technology road mapping, brainstorming or group creativity sessions, scenario generation, customer visitation programs and voice-of customer initiatives, or active solicitation campaigns within the organization (Cooper R. , Managing Technology Development Projects, 2006). Activities in this stage overlaps with the those in the NCD.

Scoping is a phase at which the foundation for the project is built, by defining the scope and evaluating the idea's market- and technical potential. Activities include determining market size and potential, as well as estimating the market acceptance and assess developing and manufacturing and costs and times. This is done through library search, contact with key users, focus groups, and sometimes concept test with potential users (Cooper R. , 2006).

Build business case is the last phase of analysing before beginning to develop the product. Market research studies, in which customer needs are discovered to understand what benefits the product will provide are done, and which features it should have to meet the needs of the customers is explored (Cooper R. , 2006).

The business case also involves legal and regulatory requirements, considerations of safety, health and environment. Detailed intellectual property (IP)- landscaping is done, and a through financial analysis is conducted. A project plan that lists the tasks that needs to be performed during the development process, and estimations of financial and human resources that are needed to perform each activity should be done. An expected launch date is often set (Cooper R. , 2008).

Development refers to development of the product. The plans are executed, and a professional prototype is developed. The IP is revised and finished, and an updated financial analysis as well as marketing and operation-plans (Cooper R. , 2008).

Testing and validation can refer to in-house testing, field testing or market testing, of which the last is considered optional (Cooper R. , 2008).

Launch includes deciding quantities as well as marketing the product. As it is outside the scope of this thesis it will not be further described.

The SGM model has been criticised, and a summary of the weaknesses is presented by Cooper himself. It has been argued that the linear model fails to capture the iterative and cyclic nature of product development, that it is too inflexible and planned, and thus does not consider the requirements of individual development programs. Also, it provides little scope for experimentation and the review gates are too focused upon financial measurements. Finally, the process has been accused of being too bureaucratic (Cooper 2014). Thus, a new version of the model, inspired by the agile approach has been developed in which the iterative, testing approach has been adopted in favour to that strictly panning approach found in the early Stage-gate models (Cooper 2016). As there are other models that better capture the agile approach, Cooper's agile version will not be presented here.

3.2.4 The Design Thinking Model

This section presents a product development method called design thinking. It is a process that starts at the inspiration phase, before knowing which problem to solve, and ends with a final solution which meets the needs of the users and is ready to be introduced to the market, see Figure 9. Thus, it could be argued that design thinking model covers the entire invention process.

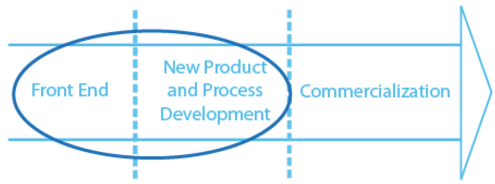

Figure 9: Design thinking: front end and new product and process development

An iterative & human centred approach

Design thinking is a dynamic, human centred design approach, meaning new products are developed with the end user in the centre, resulting in solutions that are tailored to meet their needs (Brown, 2009). The method recognizes the importance of starting by finding the right problem solve. Martin (2010) points out that projects often start with objectives which really are solutions. By applying design thinking, all outcome assumptions are eliminated at an early stage, in favour to activities aimed to uncover the real problems, their root causes as well as how people currently deal with those problems. Another key essential of the design thinking methodology is that the process consists of both divergent and convergent phases. The divergent phases lead to exploration of new opportunities, whereas the convergence phases evaluate these options and selects which to precede with. The final solution might be a combination of several alternatives (Martin, 2010).

The design thinking method is characterized by non-linearity and experimentation. It prevents the designer or inventor from sticking to one solution, which might not be the optimal one, at an early stage of the process, and encourages the exploration of several solutions (Glen, Suciu, Baughn, & Anson, 2015; Brown, 2009; Young, 2010). Moreover, it suggests that one should think with the hands, hence many prototypes are encouraged (Gravina and Saunders, 2010). The approach is collaborative and multidisciplinary, meaning a team including stakeholders, in particular end users, are required throughout the design process (Brown, 2009). Research to understand human needs, drivers and barriers is required (Young, 2010). Moreover, a design thinking process is iterative. Through prototyping and testing, issues and gaps between the current solution and the users' needs or wants are identified, which leads to new versions and more iterations. Sometimes, throughout this process, as a deeper understanding of the customers are developed, which leads to a redefinition of the problem.

The Institute of Design at Stanford made a model to describe design thinking through five elements, as showed in Figure 10.

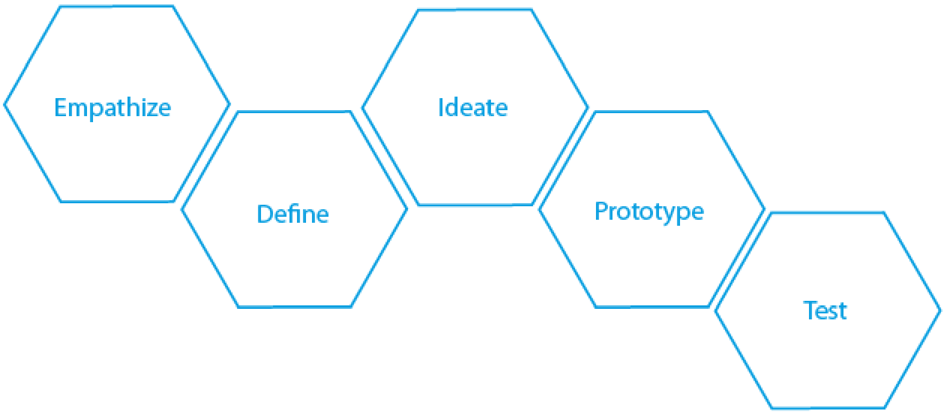

Figure 10: Design Thinking Model (Source: Stanford, 2016)

The following descriptions of each step are based on the Bootcamp Bootleg manual from the Institute of Design at Stanford (2016).

Empathize aims to develop a deep understanding of the challenge through:

- Observation; by viewing the users' behaviour in the context of their lives
- Engagement; by interacting with users and interview them
- Immersing; by putting yourself in the end users' shoes to share their experiences.

There are many methods that can be used to help reaching empathy. Examples of methods are the What? How? Why? method, meaning one observes what people are doing, specify how they do it and finally analyse why they are doing it in that particular way, or to observe extreme users as their needs might be more obvious. Another method is to interview users to understand their thoughts, emotions and motivations. It is important to prepare the interviews, and to make room for unexpected turns or stories, as well as asking why, even when one think the answer is obvious. Furthermore, it is important not to affect the answers by giving the interviewee suggestions or asking non-neutral questions. Never say usually, be specific. Look for inconsistencies, which is when they say one thing but do something else. Ask questions naturally and don't suggest answers to your questions. Keep the questions open, and avoid binary questions. Rather encourage stories to get deeper insights (Stanford, 2016).

Define: Produce a coherent vision, and clearly articulate the problem you want to solve, through processing and synthesizing the findings from the empathy work. Understanding the meaningful challenge to address is the basis to any successful solution (Stanford, 2016).

Ideate: The ideation process aims to discover solutions to the problems previously defined. Methods used in this phase, such as brainstorming and analogous empathy, are leveraged to bring out many, diverse ideas, beyond the obvious solutions, by uncovering unexpected areas of exploration. The ideation phase is encouraged to do collectively in a team of designers, experts and stakeholders. The aim with methods such as brainstorming is to evolve creative potential from the entire group, thus, it is important that the participants build upon the ideas of other, and that the energy is kept high and positive (Stanford, 2016).

Assessment

There are also methods suggesting how to evaluate the ideas derived from the ideation phase. Stanford (2016) stress the importance of not immediately putting much focus on feasibility criteria, as there may be important insights or aspects captured within those ideas which are still meaningful and useful. Hence, some evaluation methods are designed to allow also for more wild ides. Also, more than just one idea should be selected to be brought forward to prototyping. Two methods are:

- Post-it voting, in which each member gets three votes to mark their favourite ideas. Hence, everyone who is participating get a voice.
- Four-categories method, which means one or two ideas from each of the four categories; the rational choice, most likely to delight, the darling & the long shot, are selected.

It is important to be aware of when ideas are generated and when they are evaluated, and separate the two processes as assessments during an ideation phase could be restricting to the creative outcome of the process (Brown, 2009).

Prototype: A prototype is a physical illustration of the product, but it is not necessarily a real size model with full functionality. It could just as well be a wall of post-it notes, an interface, a storyboard or a paper model. Design thinking encourages that many prototypes are constructed at many levels, and that stakeholders and users get to interact with them. The resolution of the prototype should match where in the process the designer is. In the early phase, simple and quick prototypes are beneficial as it is enough to gather insights and learn, while still not costing much time or money, meaning many possibilities can be explored and rejected (Stanford, 2016).

Test: Engage in a continuous short cycle innovation process to continually improve the design. Try out high-resolution products and use observations and feedback to refine prototypes. It is also another opportunity to learn more about the user. Sometimes, during the testing phase, it becomes clear that the problem was not stated correctly. It is then necessary to go back to the very beginning of the process, and thus accept a sunk cost (Stanford, 2016).

Although the model in Figure 10 appears linear, the process is not. It is rather an inconvenient visualization of an iterative process. A summary of all important aspects of the design thinking approach is visualized in Figure 11.

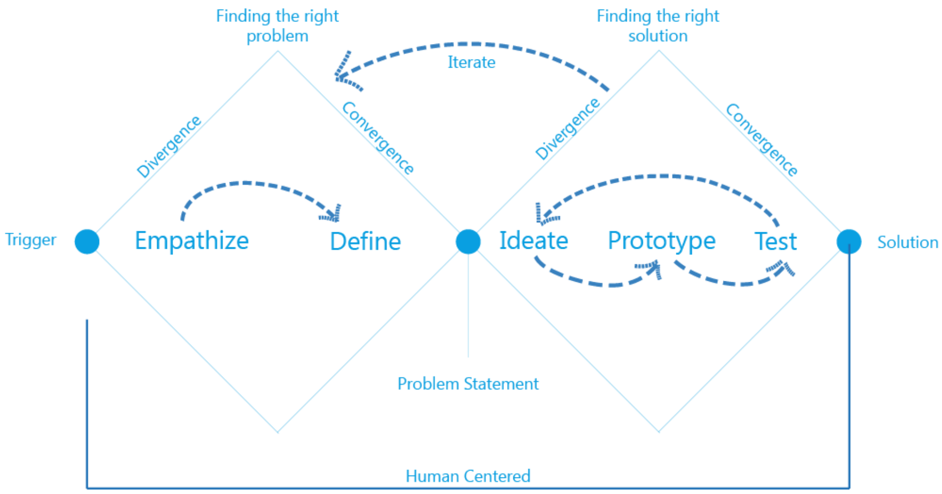

Figure 11: Double Diamond, Design Thinking (Source: Jasper Liu)

3.2.5 The Lean Start-up

Although design thinking involves customers and keeps their experience in focus throughout the entire process, it never suggests that the products should actually be sold during the development process. Commercial potential may be evaluation criteria, but the process of developing customers and a business is not included in the model. Thus, even if a great product is developed, which perfectly fits the customers' needs, it is not certain that they are willing to pay for it, or that the business model holds.

The lean start-up approach does not fit in to the three-step innovation process suggested by Koen et al. (2001). The Lean start-up supporters questions the necessity of the innovation process to be linear, in which commercialisation is not included until a perfect product is developed. Instead, they suggest a more iterative approach (Blank, 2003; Osterwalder, 2012). Using linear innovation process models imply a high risk of developing a non-sustainable business around a product that perhaps no one wants or will pay for (Blank, 2013). Blank (2013) states that no business plan survives the first contact with customers. This implies that developing a business case, such as Cooper's Stage gate model suggests, without truly involving customers in all elements at an early stage likely will lead to failure, as the reality will not match the expectations. Ries (2011) does not just mean including customers in the product development for ideas and feedback, but rather places them as a central part of the entire process of starting a business. By start selling a simple version of a product to at least one customer as soon as possible , all aspects of the value proposition towards the customer is tested. That is the concept of the lean start-up. In a world with fast pace change and high uncertainty about the future, it is unlikely that even the best forecaster will be able to predict the future. Furthermore, this approach has been accepted also by Cooper (2014) as more suitable for more innovative and bolder projects directed at less defined but growing markets, hence his decision to develop the agile version of the Stage Gate model.

Eric Ries (2011) developed the lean start-up concept as a process of innovating with the customer in focus, with a holistic approach to the business model, and with the mindset that learning through iterations is essential. At an early stage, he thinks all efforts that are not necessary for learning what customers want should be eliminated. Focus on the learning what customers wants can be done by building a minimum viable product (MVP). A MVP is a basic version of a product, which presents the core functions that meets the users' underlying needs on which the idea is based. The goal of the MVP is to test the fundamental business hypothesis, rather than answering design or technical questions, often related to prototype or concept tests by testing the value proposition. It provides a solid empirical foundation on which to build, and helps figuring out what customers care about (Ries, 2011).

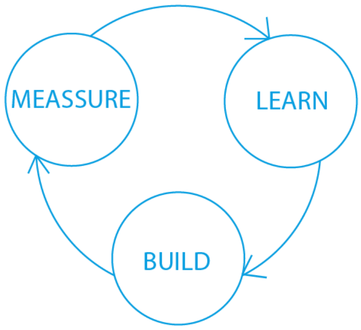

Figure 12: Build, measure and learn (Source: Eric Ries, 2011)

The lean start-up means a process of building, measuring and learning (see Figure 12). However, Ries argues that in the process of planning the loop, the activities occur in a reversed order. The starting point must be to understand what should be learned, which means risks and uncertainties and critical assumptions must be identified and prioritized. Next, what to measure to get that knowledge must be specified, and finally what product must be built to run the experiment and get the measurement should be figured out (Ries, 2011).

Using the Lean method rather than traditional methods is no guarantee that a new venture will succeed, as success is determined by many factors. However, people with massive experience of start-ups, such as Blank, claims that using lean methods across a portfolio of start-ups will result in fewer failiuors than using traditional methods (Blank, 2003). Also, the Lean Startup method builds capital-efficient companies because it allows start-ups to recognize that it's time to change direction before large resources in terms of money and time has been spend on product development (Ries, 2011).

3.3 Intellectual Property

Due to the nature of inventing, the topic intellectual property is a central notion for many inventors which also affects their development processes. After all, intellectual property right is constituted to protect idea owners' exclusive right to their discoveries or inventions, to motivate companies and individuals to spend resources on innovation with supernormal profits. Without IP-rights many argue, it would be too risky or just not economically justified to spend a lot of money on developing new inventions (Graham & Sichelman, 2008).

There are many types of IP-protection, such as patent, trademark, design, and copyright. For this thesis, mainly patent related issues are relevant, as those imply largest costs in terms of both money and time for inventors (Patent- och registreringsverket, 2016). Also, rules concerning the newness of the invention effects how it can be disposed in public before a patent application is submitted, thus it effects the flexibility of the product development process to many inventors.

3.3.1. Patent

A patent is an exclusive right to an invention, meaning no one else in any of the countries which the patent covers can produce and sell the invention without permission from the patent owner. A patent can be valid for a maximum of 20 years (Patent- och registreringsverket, 2016). As the patent system not only aims to promote innovation by providing inventors and companies incentives to invent, market and sell innovative products, but also to disclose the knowledge on which the inventions are based, all patents are published, official documents (Graham & Sichelman, 2008). However, from the day a patent application is submitted to PRV, the content is secret for 18 months (Patent- och registreringsverket, 2016).

For an invention to be patentable, it must have a certain degree of novelty, be utilizable by an industry, i.e. have a technical character, and be new to the world. The novelty-criteria implies that the invention must differentiate essentially from previous inventions. New ways to combine known methods or objects are not necessarily patentable. Being utilizable to an industry, means that the invention must be able to be produced or performed in any industry. Thus, an invention that conflict with the law of nature, such as an eternity machine, is not patentable. The criteria *new* mean the invention cannot be known by the time the application is submitted. It is not of relevance how, by whom or where in the world it is known, not even if it is the inventor him-or herself who used or published it (Patent- och registreringsverket, 2016). Examples of situations when the invention might be considered non-patentable as it is no longer new:

- It has been made public through a magazine, brochure, lecture, interview, radio, movie, video
- It has been commercialized (sold somewhere)
- The invention has been discussed among friends and family
- It has been tested on a place where anyone could see it

Non-disclosure agreements can be signed to ensure that the idea is handled confidentially (Patent- och registreringsverket, 2016).

The right to the patent can be bought, sold or licensed. PRV holds out that a patent can lead to better market opportunities, as it means price competition can be avoided. Furthermore, they claim that a business partner might be willing to pay more for an invention that is patented. It is notable that inventors tend to apply for patent based on patentability rather than market related opportunities (Åstebro & Dahlin, Opportunity knocks, 2005). To understand why, some incentives for independent inventors to patent and to avoid patents are presented.

Reasons to patent

Other than the fact that a patent gives the patent owner exclusivity to the patent, there are other reasons why inventors find it appealing. Patents could be used as part of a marketing strategy. Stating that a product is patent pending can make it more attractive. Others do it to avoid NDA's as it may be difficult to prove that someone have broken the confidentiality. Also, some third parties are not willing to sign a NDA as it may risk some of their current projects (Graham & Sichelman, 2008).

Furthermore, some inventors believe that although the patent may not increase revenue or avoid costs, it increases the chances of securing investment or licences (Mann & Sager, 2006).

Reasons not to patent

Reasons not to patent are often connected to the high costs that the patent imply. Individuals or start-ups typically carry many ideas, and patenting all of them would be very expensive *(Patent- och registreringsverket, 2016)*. Also, if the inventor realize that they will be unable to defend the patent in case of a twist, due to high court costs, some argue there is no point or at least not worth the cost. Other reasons can be that the inventor find other protection sufficient, or that there are other potential solutions to the same problem, meaning design-around is easy *(Graham & Sichelman, 2008)*.

A rationale approach to patents

Graham and Sichelman (2008) presents a rational approach to patents. They claim that while considering a patent, a patentee should:

- Asses the likelihood of someone copying
- Asses the consequences of someone copying

If the risk is not insignificant; options to reduce risk should be weighed against the costs. For instance, there are non-legal options such as increased marketing, or legal protection such as trademark, copyright, trade secret or patent protection. A notation is made that trade secret is not a beneficial approach if it is easy to reverse engineer the invention (Graham & Sichelman, 2008).

3.4 Theoretical summary

Independent inventors typically have many ideas, and the choice of in which to invest is not always well analysed, but rather depends on an unqualified perception of the market situation and on influences from friends, family or other close associates (Klofsten, 2005). Furthermore, the early process of idea development is technique driven and focused, which often leads innovators to an underestimation of the softer, outgoing sides of entrepreneurship such as marketing and customer development which is critical if the idea is to take the next step forward in the process (Norrman & Frankelius, 2013). The fact that inventors focus more on the technical solution than the need and demand of the solution to a problem is further supported by a study showing that inventors tend to apply for patents based on the patentability rather than market related opportunities (Åstebro & Dahlin, Opportunity knocks, 2005).

There are many ways to innovate, various models have different focus and approaches. Many are organization-focused. The NCD is an organizational model describing the fuzzy front end. That process describes activities including opportunity identification, opportunity analysis, ideas genesis, ideas selection and idea and technology development.

The Stage gate model dedicate much attention to assessment of the project at different stages, with much focus on the commercial potential and the rationale to precede with the project. The assessment is done by management or other executives with a less biased relation to the ideas there are evaluated than the ones who develop it.

Design thinking suggests that the process should really start by finding the right problem to solve by stepping away from assumptions of the solution. By studying the users of the product, interviewing them and truly understanding their needs, a problem statement can be formulated. Then, many possible solutions will be considered through brainstorming and diverging, and prototypes should be built and tested. This process is followed by another convergence phase, during which many solutions are narrowed down to a few. Human centeredness and iterations are main elements.

The lean start-up also stresses the importance to find out what customers wants, but suggests a more trail-and error approach. Also, their focus is on the entire business model, not just the product development. This means everything is iteratively tested, the price, the channels, the customer segment and the solution.

What design thinking and lean start-up have in common, is a high customer involvement in their processes. NCD and Stage-gate include approaches to estimate markets and confirm customer need, as well as some customer including activities. Klofsten (2005) claims that a high degree of market anchorage is beneficial to increase the chance of commercial success, especially for small actors with small resources to spend on marketing.

The theoretical framework is summarized and presented in Table 2. The processes are broken up into eight areas of interest. The theoretical framework will be applied to independent inventors' invention process to identify gaps between IIs' approach and organizational and entrepreneurial design models.

Table 2: Compilation organizational and entrepreneurial literatures

		NCD	Stage-gate	Design Thinking	Lean start-up
Front End	Approach	Efforts to identify analyse market or technical opportunities, and to align those with the overall corporate strategy and customer needs.		Through a process of empathizing with end users and truly understanding the underlying needs. Human centred approach to make sure the right problem is solved.	Start with hypothesis about all elements of the business model. The most critical or risky hypothesis should be tested first. Be very open to change problem definition if customers show no interest.
	Customer/ stakeholder Involvement	Market research.		Yes, human centred. Desirable criteria.	Yes, the point is to present a MVP as soon as possible
	Market potential focus	The NCD gives much attention to business related issues. The opportunity identification may derive from a market opportunity realization. Furthermore, opportunity analysis should lead to an evaluation of the attractiveness of the project.		The thought is that by using design thinking, only products that customers really want and like are developed. Thus, there will be a need (a market) and an attractive solution. The creative process is thought to be at risk if to many restrictions concerning price etc. are set at an early stage. However, the ideas are evaluated with viability, feasibility and desirability in mind.	High. Lean start-up suggests to test also the market potential and business model as soon as possible.
	Assessment (of need/opportunity)	Yes, see opportunity analysis		No assessment as no decisions have been made. In DT, the early activities aim to explore rather than evaluating. A problem statement is reached by a deeper understanding rather than selection.	Through real feedback: trial and error. Pivot.
Idea genesis	Approach	Ideas Genesis implies generation of tangible ideas based on the opportunities identified, as well as development and maturity to a concrete idea. It aims to find user needs and new solutions to the problems that meets the needs. It also includes finding methods to include users and customers, and to create a creative culture (Koen, et al., 2001).	Discovery phase. Ideas could derive from scientists or technical people, strategic planning exercises, technology forecasting & technology road mapping, brainstorming or group creativity sessions, scenario generation, customer visitation programs or active solicitation campaigns within the organization (Cooper R. , 2006)	Tons of ideas should be generated. The ideation process aims to discover solutions to the problems previously defined. Methods used in this phase, such as brainstorm, extreme users, analogous empathy, are all leveraged to bring out many, diverse ideas, beyond the obvious solutions, by uncovering unexpected areas of exploration. The ideation phase is encouraged to do collectively in a team of designers, experts and stakeholders (Stanford, 2010)	
	Customer/ stakeholder involvement	Yes, see idea genesis. Although not specified which type of customer involvement activities.	Yes, see above.	Yes, suggest many methods to achieve that, such as; Brainstorm, extreme users, analogous empathy.	
	Assessment	Ideas selection stage; Idea selection involves evaluation of ideas based on business potential. As information at this stage is often insufficient, complex evaluation processes are often required. Methods might include multiple quantitative metrics, quick feedback or risk assessments (Koen, et al., 2001).	Gates. Often senior management. Cross functional group.	Post-it voting. Each member get three votes and marks favourite ideas, hence all members get a voice. Four-categories method: pitch one idea from each category: rational choice, most likely to delight, the darling & the long shot. Elect one or two ideas in each category, choose the ideas that inspire you and build a physical prototype, a digital prototype and an experience prototype. Bring many ideas into the prototype stage parallelly.	
Development	Approach		Development refers to development of the product. The plans are executed, and a professional prototype is developed. The IP is revised and finished, and an updated financial analysis as well as marketing and operation-plans.	Prototype and test: Design thinking encourages that many prototypes are constructed at many levels, and that stakeholders and users get to interact with them. The resolution of the prototype should match where in the process the designer is. Engage in a continuous short cycle innovation process to continually improve the design. Try out high-resolution products and use observations and feedback to refine prototypes. It is also another opportunity to learn more about the user. Sometimes, during the testing phase, it becomes clear that the problem was not stated correctly. It is then necessary to go back to the very beginning of the process	Keep testing hypothesis until a sustainable business model (including a solution that the customers wants). Then make a business plan to execute.
	Customer/ stakeholder involvement		Yes, e.g. in scoping phase: contact with key users, focus groups, and sometimes concept test with potential users.	Yes, human centred & see above.	Yes, always keep the customer a central element in the development process.
	Market potential focus		Yes, always. A business case is build before actually initiating the development. Otherwise it will not pass to the next gate.	Fesable criteria.	High. Lean start-up suggest to test also the marekt potential and business model as soon as possible.
	Assessment		Gate-keepers.	For instance through testing prototypes with users.	Through real feedback: trail and error. Pivot.

4 Empirics

First, an overview of the insights gathered at the two pitching activities will be presented. Next, a compilation of each inventor's process based on the interviews will be obtained. Data from both sources will be compelled and presented as general insights about their process. Finally, some insights gathered from interviews with incubator managers is presented.

4.1 Compilation of observations at pitching activities

Table 3 provides an overview of the insights gathered from the pitching activities, based on the panel's and the author's observations. Insights from the panel is presented accordingly to the perspectives they focused on during the pitches, namely positive, critical, financial and customers' perspective.

Table 3: Insights from observations at pitching activities.

Pan ervations	A	B	C	D	E	F	G	H	I	J
Con				Double-sided need		Complementary product		Extension to packages		
Pos spective	Optimistic, much energy.	Connected need to trends. An important problem relating to kids' health.	Based on customer requests. Moved quickly from idea to building and testing.	Have involved end users (one side). Great idea (thought need).	It is based on a real end-user need. Moved quickly to prototyping.	Great design and low manufacturing cost. Prototypes at different levels (& CAD-model).	Optimistic. Interacts with many customers & other stakeholders. Large market. Business model inspired from successful model.	Optimistic and detemined. Based on a confirmed need for the end user.	Smart solution to a common problem. Built many prototypes with various resolution.	Easy to understand how to use and what value it brings. Quickly made prototypes and tested. Very committed.
Crit pective	Not clear how this solution is better than existing alternatives.	No interaction with the end users; are you sure they will want this?	Individualistic, have not included more customers?	Large and complex to get all stakeholders on board. No contact with the key stakeholder.	Has no confirmation of need among targeted customer. If target end users instead it would need to be different.	Market size (how often does people buy new ones? Large secondary market), strong competitors.	Many features; should focus on the core offer and test it. For each day she gets more to develop.	Do not know who to sell to.	Need for a complementary product. No thoughts concerning that.	Confirmed the need and its position relatively other solutions.
Fina rspective	No numbers (cost, price), market size or business model. cannot evaluate the commercial potential.	No numbers (cost, price) or business model. Some estimation of market size through trend analysis. cannot evaluate the commercial potential.	No numbers (cost, price), market size. cannot evaluate the commercial potential.	No numbers (cost, price), market size or business model. cannot evaluate the commercial potential.	No numbers (cost, price), market size although some connection to trends. cannot evaluate the commercial potential.	No numbers (cost, price), market size or business model. cannot evaluate the commercial potential.	No numbers. Planning to copy a successful business model. No estimation of marketing costs which will probably be essential.	No clear business model - who will pay for it and what will they gain from doig so? In the long run, happier customers.	No numbers (cost, price), market size or business model; rental; especially important as a complementary product is needed. Rental? cannot evaluate the commercial potential.	Some financial analysis (gross margin). Highly volume-dependent.
Cus erspective	Sceptical to if the solution meets the needs, and is desirable.	Not sure it will be desirable.	Sceptical to if the solution meets the needs, and is desirable.	Great for one side of end users, but means a large cost for another stakeholder whoms need are not considered.	Is it easy to understand? Meets the needs?	It seems desirable and price competetive. Availability; where can i buy it? At the same pace as where i buy the kajak?	Great solution! But only orally feedback. Would have liked to see and interact with a virtual prototype.	How would i profit from it?	Would be better as a service than a one time cost as most people do not have the complementary product which is expensive and bulky.	Buy all equiptment throgh dealer with the club. Must be there as an option.
Author's observations	Wants to involve industrial designers after the concept is fully developd. Gives the designers little room to truly understand the needs and design to meet those.	Wants to involve industrial designers after the concept is fully developd. Gives the designers little room to truly understand the needs and design to meet those.	Very technology focused. Does not seem interested in involving customers.	Ignore the most critical aspect of the project rather than starting with it.	He wants to sell it to new production, but has not evaluated their incentives to implement his solution. Would they be able to sell the boat more expensively because of his extention? Or does it only mean another cost? It will probably not be a	Seems to enjoy construction and be a talented designer. Works independently- nothing points to interaction with end users.	She wants to deveop a perfect product with all imaginable features at once, expensive. Should focus on the core.	Does not understand the chain. The patent determined the solution befor customers were involved. Now he is trying to make it fit somewhere in the chain, but due to lack of business model, it is not clear who will	He is only interested in presenting the brilliance of the idea and solution, and argue that a business person should do all work connected to commercialization of the product. developd it himself.	Biased. No proof of need, strong enough buyers incitament. Continue to develop; not want to accept sunk cost now. Have started to develop another invention paralelly.

4.2 Compilation of interviews

A compilation of all IIs' invention process, based on data from the interviews will follow, in which the essence of each interview is captured. The content varies in detail with respect to confidentiality agreements and the inventors' wishes, as well as by where in the process they are. This was considered important to provide so that the reader would get a holistic understanding of each inventors' process. In Appendix C, the data is presented.

4.2.1 Inventor A

Inventor A (IA) has invented many inventions. The one he pitched, and hence was in focus during the interview, had been an active project for almost a year. His goal is to sell a licence to an established company, and he is planning to approach companies to which he believes his invention would be a good fit with product portfolios . His invention is a consumable product. He has no previous experience of this industry, nor of production, design, or construction. However, he has previously developed many other inventions, and notes that he constantly gets many new ideas.

The idea is based on a self-experienced problem, which he experienced when travelling on an airplane. A solution to the problem was thought of almost at the same time as he realized the problem, that is while still being on the plane. Back home he started to make some sketches of a potential product and refined the solution. He then looked for feedback to confirm the need for the product, although he did not have a thought through process or a method to do this. He has mainly been asking closed questions to people within his personal network, such as friends and family, with no strategy of how to measure, which questions to ask to get valid data, or how he defines potential. The reason why he chose to only include friends and family at this stage of the process was that he did not want to risk the patentability of the invention, and that he did not know how else to do, or how to find the right people to include.

Next, he started to look for existing solutions, mainly through googling and through research support provided by Almi. There are existing solutions to the problem he has identified in the market already, but as those solutions differ from IA:'s approach, his invention was patentable. IA hired a patent attorney to formulate a patent application which was financed by Almi.

He is now in the process of developing a prototype (designing and manufacturing). He has not considered other alternatives based on the needs he claims to have confirmed; his solution is very similar to his initial idea. The prototype is meant to be shown to potential partners rather than the end user. He has not considered making a virtual prototype for this purpose. He describes manufacturing of a proper prototype as expensive. Yet, he is willing to do that before knowing there is a buyer of the license. He has not calculated potential profits, and only very roughly estimated the market size. He has not been in contact with potential licensees or partners.

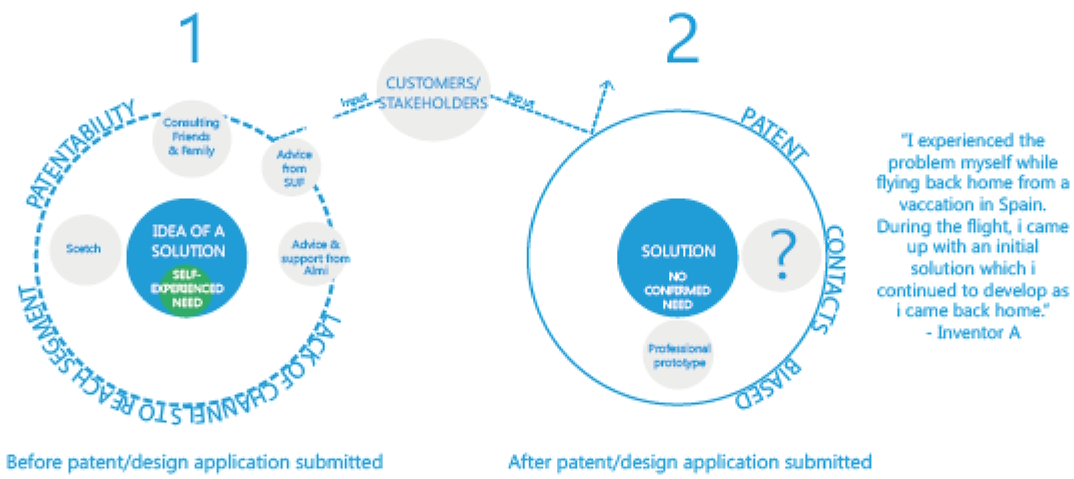

Figure 13: Invention Process Inventor A

4.2.2 Inventor B

Inventor B is currently working on an invention which is an extension of her first invention, which was designed for people with neck injuries. The first invention is launched, and she has sold a few hundred pairs. She came up with the initial idea while experiencing the need herself, as she after an accident was unable to bend her neck. While experiencing the problem, she made a mock-up for herself to use. Later, she realized more people might need the same product. Thus, she decided to apply for a patent to hinder other actors from copying her idea.

She is now looking to reach a larger market, and is hence planning to redesign the invention to suit the new market segment. She has connected the market potential to trends, but has not made more detailed estimations of market size. Her recent invention is based on the old design, so that the old patent also covers the new solution. This seems to make her less open to consider many and diverse ways to solve the problem, and she has not gone through an ideation phase where assumptions about the solution is put aside. Costs and price are estimated to be similar to those of the old model.

The new product is intended for kids. She claims to have confirmed the need; not through interaction with the end users, but through statistics of problems which kids have. She believes her solution solves these problems. The reason why she has not involved the end users or other stakeholders in the process, is because she is uncomfortable and does not know where to find them; she lacks channels to reach them. Instead, she is planning to involve industrial designers to reach an aesthetical appearance, and she argues that they will include the end users. However, that will be at a late stage, after the solution is already determined. Furthermore, she has made 3D-printed prototypes throughout the development process.

Figure 14 compiles relevant insights from the observations at pitching activities and those derived from the interview with inventor B.

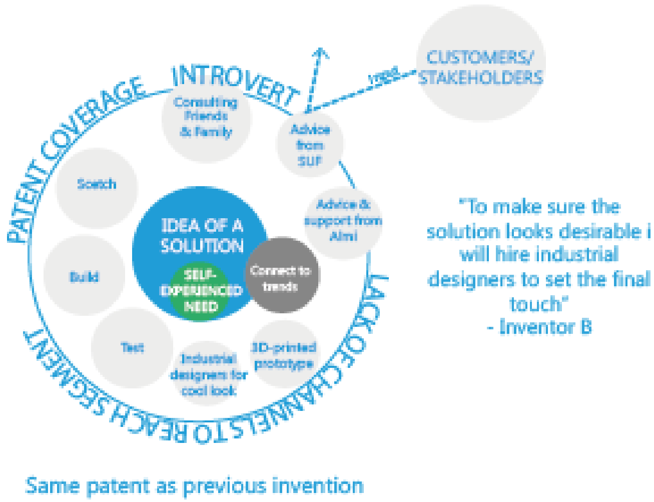

Figure 14: Invention process inventor B

4.2.3 Inventor C

Inventor C has worked on his idea about a year. He has been in the gate industry for a long time; he owns a company that sells electric gates which he buys from external suppliers. He has previously developed other inventions, such as a freewheel which is patented but has not reached commercialisation. It was developed based on technological interest, and no customer was involved in the process.

The most recent invention is based on a need he has observed among two of his existing gate-customers. He instantly had ideas of how he could solve their problem. He thought many of his current customers would need this, thus he reasons that there is a market for the invention. He has involved his family by telling them about the invention, but he does not claim to have adopted much insights concerning the solution from them. He has not made any market research activities or consulted more potential customers. However, he presented his idea at SUF, and had an initial meeting with Almi. He refers to patentability as a reason to why he is not searching external involvement, but has not estimated any cost-benefit relationship. Through Almi he received help to make a news review and have not found any other solutions to the problem. He is still at an early stage of his innovation process; he has a concept but no complete solution or business model. He defines the market as house owners and companies, and claims to know his innovators. However, throughout the interview he jumped between different customer segments. He talks about agriculture land owners in Australia, as well as villa owners in Sweden.

He is not planning to involve customers in the development process as he does not believe they can contribute due to lack of technical skills, and he has not so far included any other stakeholders in the process. He will apply for a patent, but does not have any estimation of how that will affect the market shares. He has not thought through why he wants a patent, but after a while he replies that he wants to keep competitors away.

He is mainly concerned with getting the technical solution to work. He is currently in an iterative process of sketching, building and testing. He is continuously making changes and is iteratively developing a solution based on his initial idea. Once he is done with the development he wants to make a professional prototype to show off to customers, and finally he is planning to sell his invention through his already established company. He is roughly estimating financial margins by benchmarking with those he has on the electrical gates, which he buys and sells from other manufacturers. He draws the conclusion that his construction will be cheaper, thus claims that there will be economy in the business. It should be noticed that the products are significantly different. Also, he has no idea of the market size, which will likely affect the production cost. He does not know what the critical volume to make it "worth it" is. And that volume affects the marketing efforts that he must do to reach the critical volume.

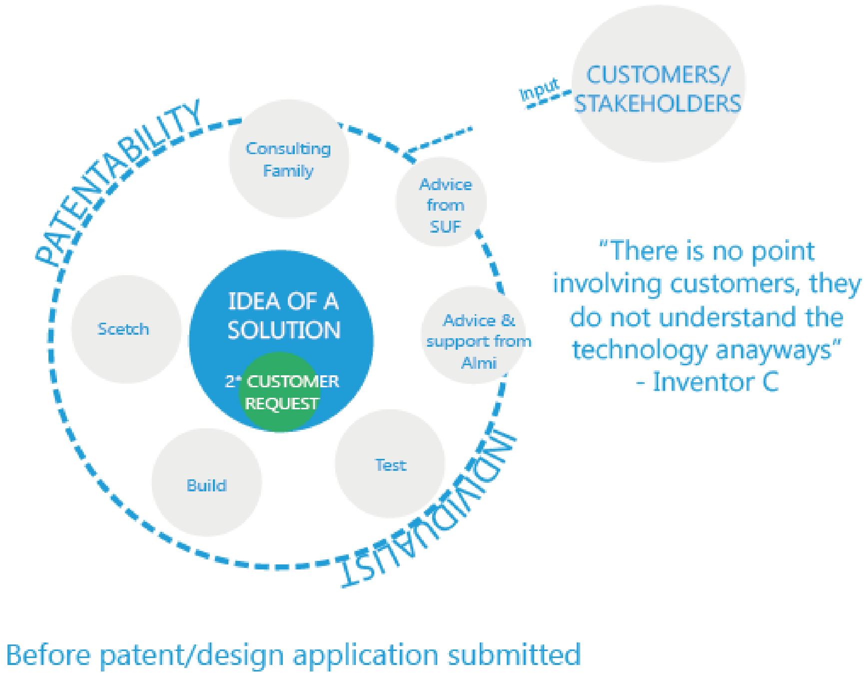

Figure 15: Invention process inventor C

4.2.4 Inventor D

Inventor D represents three girls who are still studying at the Gymnasium. The interview was done with one of the girls. The invention is a personal security product, but for it to work it is reliant on a cooperation with a governmental instance. During a year and a half, they have been developing their idea through meetings with stakeholders such as ambulance workers, police officers and some end users. They also did an online marketing research survey with 200 respondents to confirm the need for the invention, and presented some statistics on factors relevant to market size. However, they have not had a dialogue with governmental stakeholder which is critical for the implementation, and have thus not confirmed if there is any interest from them. The reason is that they have not been able to reach the right person, due to lack of contacts.

They are not planning to apply for a patent, instead they consider a design protection. They have changed the underlying technology, but not the approach. They never considered other solutions or brainstormed ideas; they had an idea of a solution and instantly tried to confirm that it would work by involving stakeholders. They made changes and added features based on these insights.

They have made no estimations of market size, nor had any financial estimations at all. Also, the technology they planned to use did not consider the cost for the critical stakeholder which they could not get in contact with. They are now in a place where they do not how to proceed.

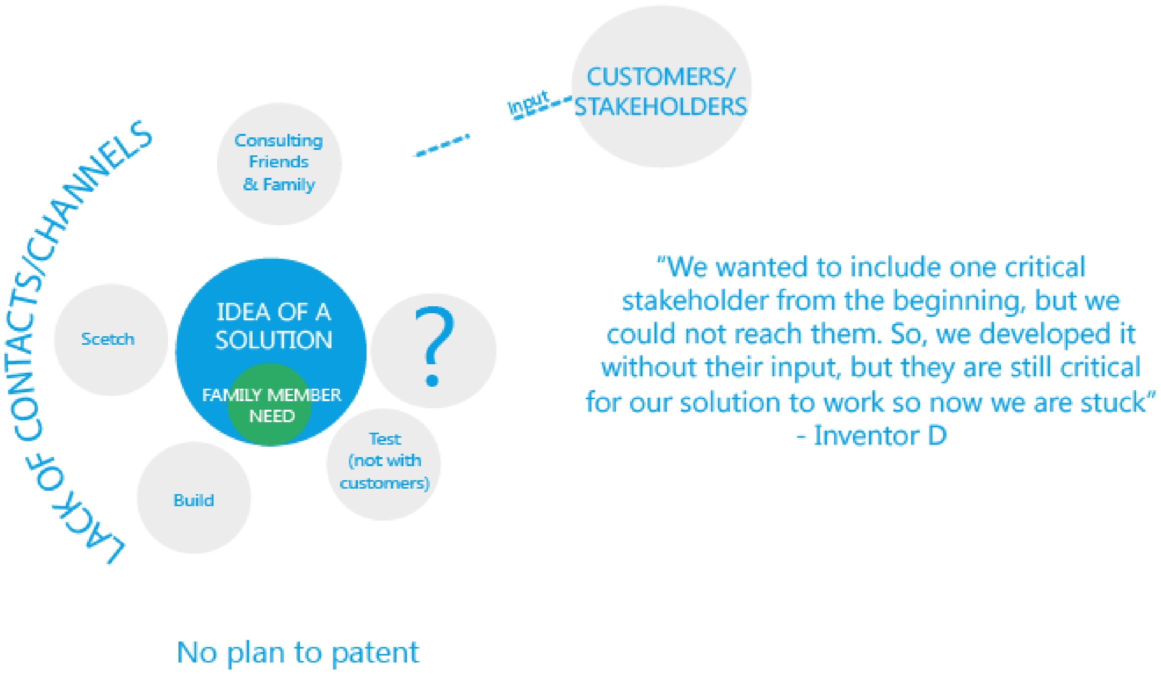

Figure 16: Invention process inventor D

4.2.5 Inventor E

IE has been working with his invention for two years. He has identified a need within the private boat sector. He did not go through an ideation process but rather continued to develop the initial idea. He has not been including customers or end users in his product development process other than asking them to confirm the need. The ones he has so far included has been friends, family, and SUF. He had no method to do this. The reasons why he has not included end users is that he believes they lack the technology skills to help, and that he does not know who to include or how to reach them. The customers, in his case meaning potential licensees, he rather wants to approach with a fully functional prototype.

Inventor E entails that he experienced the problem himself, and "suddenly" thought of a technology used in another application which could solve this problem. He searched for current solutions and found that his idea had already been patented by a Canadian inventor, however, the patent was not active and he has not found the invention available in the market.

During a meeting at Göteborgs uppfinnarförening, at which he presented his idea, another member suggested another approach to solve the same problem. He is now considering to partner up with this person to develop an offer based on that solution rather than the initial idea.

He is focusing on the technical development of the product, and aims to develop a professional prototype to have something to show to potential licences. As he does not have a patent he is planning to use NDA:s.

Figure 17: Invention process inventor E

4.2.6 Inventor F

Inventor F has been actively working with his idea for two years. It is an incremental change on an existing product, but adds value in terms of production cost, visual appearance, functionality and user experience. It belongs in the outdoors product segment. Inventor F has a long experience of mechanical construction; he has previously worked as an inventor for different companies. His solution is patented. The reason why he applied for the patent was mainly to keep competitors away, in particular the market leader, but he has not made any estimations of cost benefit for the choice of protection, meaning he lacks a patent strategy.

Inventor F experienced the need for the invention himself, and discussed the defects on previous solutions with other users. Next, he set up design criteria, developed a solution by himself. He made CAD-sketches and physical prototype to test functionality. He applied for patent and design protection. After that, he was considered done with the major development work, thus he displayed his solution to some potential end users, which were friends only. His most recent activities have been to search for manufacturers to make a prototype, as well as finding resellers.

His CAD-drawing made it easier to communicate the idea. However, he did not use sketches to include end users or other stakeholders early in the process. The reason at an early stage was that he did not want to risk the patentability. Once the application was approved, he thought his solution already met the design criteria, and was much better compared to the competitors in terms of manufacturing cost, looks and functionality. Thus, he did not think it was necessary to involve users. Also, he argued that making changes in the design at that stage could imply the design would no longer be covered by the patent on which he had spent money. The reason why he decided to apply for a patent was to prevent competitors to copy the solution, however, he has not evaluated the risk or damage if his solution would be copied, nor has he a strategy for the patent.

He has not performed any market related activities, other than guessing that the manufacturing cost would be lower than the competitors. Hence, he argues there should be a commercial potential in the invention.

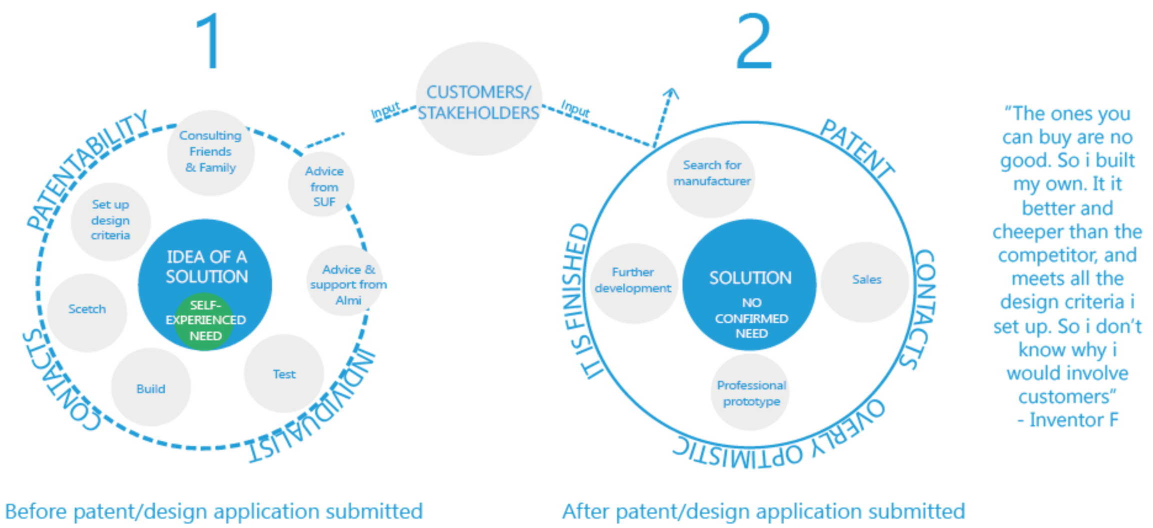

Figure 18: Invention process inventor F

4.2.7 Inventor G

Inventor G has a lifelong experience of horseback riding. She has previously invented two other products. Her latest invention is connected to her interest in horses, and it is a digital solution. She has been working with this invention for about a year. The initial idea derives from a self-experienced problem. She has confirmed the need by talking to potential end users.

Although she claims that capital and investment is the main critical factor for her potential success, she does not present any numbers explaining market size, return on investment, or marketing costs. She does, however, have a plan for how to collect revenue; she is planning to copy the business model from another, successful digital solution. She has defined a broad customer segment.

She has developed her idea to a concept with a lot of input from potential users. As she does not seem to have extracted the most important, core customer offer, her concept includes a lot of features which makes the product expensive and slow to develop. She received some support from Almi, which was spend on development of the application. However, due to the many features, it is far from ready. Now, she is looking for investors to expand the financial resources so that she can finish the application before starting to get users.

She is not planning to apply for a patent, she is rather planning to be first to market. The main reason is that it is expensive. She has not developed a prototype.

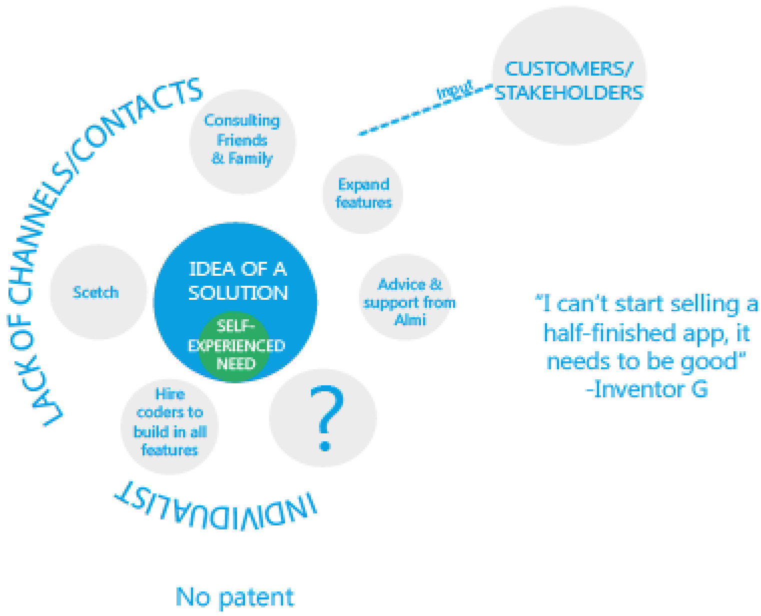

Figure 19: Invention process inventor G

4.2.8 Inventor H

Inventor H's invention belongs in the packing industry. It is based on a need for people with reduced hand function who struggle to open packages, a problem he has experienced himself. The end users' need is supported by previous research. He has developed the invention by himself, without including end users. Once he had come up with a solution, he did not see a need to involve customers or end users as he already had an idea of how to solve it.

Inventor H has been working on this invention for nine years. The solution was patented in 2009. The patented idea is the same as the initial solution and he is now trying to find a place in the chain where his solution can fit. The reason why he protected his invention was so that he would have something to sell to potential licensees, and to hinder others from stealing the idea.

He did not involve the end users nor potential licensees in the process before applying for protection, which he explains by referring to the news-demand from PRV. Once his application was submitted, he started to involve stakeholders with the goal to find a licensee. He has not made any changes to his design since the application was approved, as that would mean the protection would be lost and he would not have anything to sell.

While meeting potential licensees, he has experienced much resistance and low interest. Yet, he has made no changes to his initial design. The reason seems to be that he really likes his idea, and is convinced it is a great solution. Also, he argues the patent is what could be sold. He never considered many solutions to the problem parallelly in an ideation phase, and did not include stakeholders in the early process.

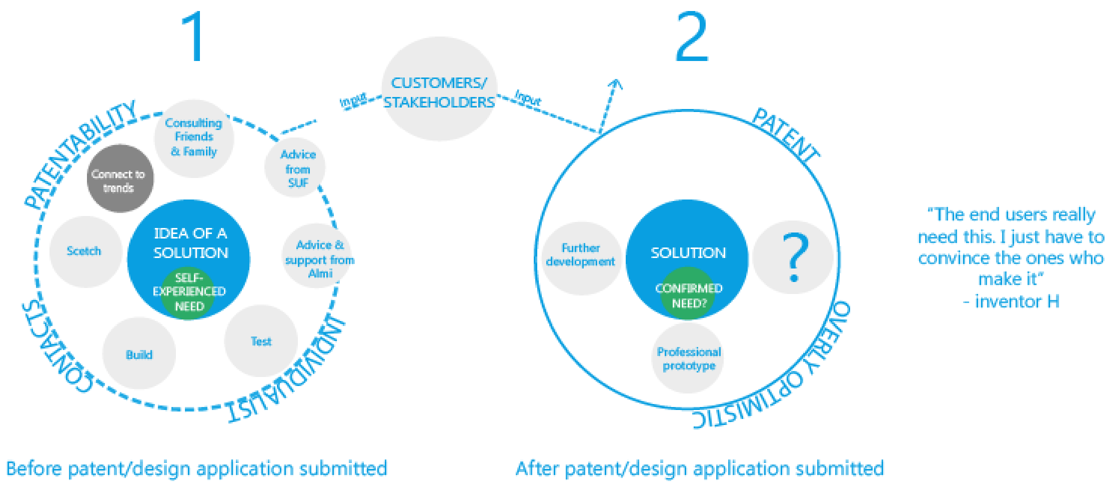

Figure 20: Invention process inventor H

4.2.9 Inventor I

Inventor I has been working on his idea for about one year. The starting point was a self-experienced problem. He suddenly came up with an idea of a solution, and instantly started to build a small and simple prototype. He has now built several prototypes, with various resolution and sizes, to test and illustrate the function and the value that the invention provides. He lacks interest in business and would rather involve someone else to bring his invention to market.

He is convinced that his invention will be desired by all house- and property owners, and have hence not specified a customer segment further. He has developed a concept completely based on his own hypothesis that there is a need for it, and that his initial idea of how to solve the problem is the best one. He has not included any customers in his process, and refers to patentability as one factor. Furthermore, he thinks the solution is complete now, and argue that what he needs now is someone who can sell it rather than involving people in the development- that is what he knows already. He is planning to patent the solution as he wants to keep competitors away, but he lacks a patent strategy and has not done a cost benefit analysis.

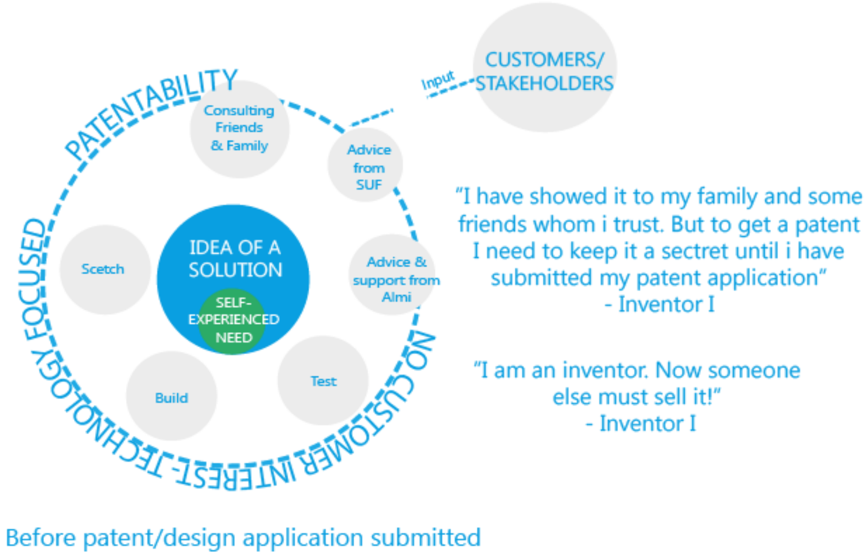

Figure 21: Invention process inventor I

4.2.10 Inventor J

Inventor J identified a problem while watching his son's soccer practice. Still, during the practice, he came up with one solution he thought would solve the problem. After the game, he talked to the coach to confirm the problem. He also asked some friends who also had kids who play sports to confirm the need, but he never considered other ways to solve the problem.

He next contacted and received help from Almi to conduct a news review, and SUF to get help to develop a prototype. As the idea was patentable, he quickly sent in a patent application to not risk the patentability of the solution. He had no strategy for his patent other than that he did it to prevent others from copying.

Once he had filed the application, he involved more externals. He asked coaches closed questions: what do you think of this solution? He considered different manufacturing options, and was very cost focused. He received help to confirm the need and commercial potential of the invention by an external party. Although the feedback was indicating low commercial potential, he still seemed determined to proceed with the project. Inventor J is currently developing two more inventions.

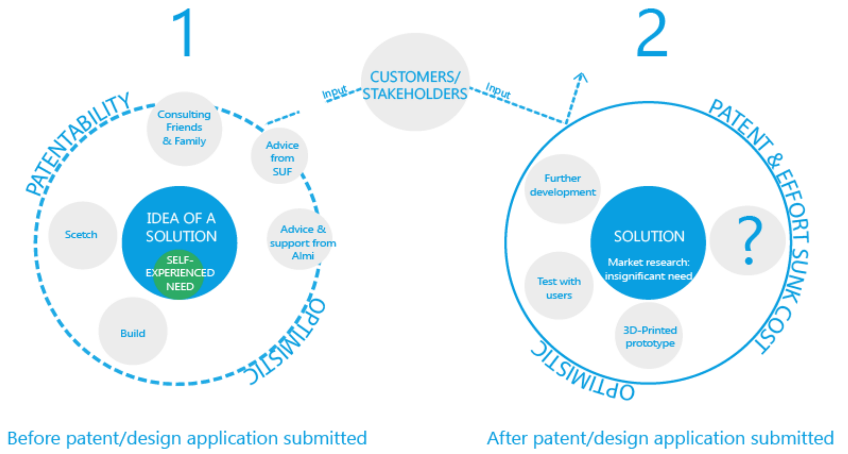

Figure 22: Invention process inventor J

4.4 General insights

This section provides a compilation of the pattern that was found during the interviews. It should be noted that not all activities or explanations are applicable to all inventors.

4.4.1 Starting point: an idea of a solution

The starting point to all inventors was an idea of a solution. Often, the idea was based on a self-experienced need, sometimes it is based on an observed need. 8 of 10 of the interviewees described that they often generate new ideas, and many develop several inventions parallelly. The reason why they choose to work with certain inventions seems to be ad hoc decisions, based on technical interests and fit in their life rather than a market opportunity assessment.

4.4.2 Sketch, build & test

After coming up with an initial idea, most inventors started by making simple sketches, and then evolved the idea by testing and building prototypes. They continuously make improvements and test various solutions. The time span between the initial idea and the first prototype is often short.

4.4.3 External interaction

Some external input on the idea is often collected. Friends and family were consulted in all cases to confirm the need for the product, however, not one inventor had a strategy for this. Instead they asked closed questions looking to confirm the need. Meetings at SUF provides some exchange of ideas under confidentiality, and advisors at Almi are often consulted to get advice and access to financial support for news reviews, patent applications or professional prototypes. The reason why many are restricted with external input is that they are worried that someone will steal their ideas, or that they will not be able to patent the solution if it is disclosed. None of the interviewees could answer questions relating to a patent strategy, but seven out of ten applied for a patent at an early stage. Other reasons why they were not involving customers were that they were uncomfortable in doing so, or that they did not how to reach the intendent customers or stakeholders that would be relevant. Furthermore, many seemed to be “in love” with their initial solution, and did not think external stakeholders would be able to contribute to a better solution. If considering to involve someone, that would be a sales person who could help them bring the invention to the market.

4.4.4 Further development

After a patent application was submitted, they further developed the solution. However, this was often done with the patent in centre. Few major changes were done. Inventor A & B plan to involve industrial designers to reach an aesthetic design, however, the specifics are relatively strict, based on the solutions they have already determined. Thus, their involvement aims to consider only visuals, meaning the problem cannot be reformulated, nor can the concept of the solution.

4.4.5 Professional prototype

Many inventors believe a professional prototype is essential, but few can explain why. The only consensus was that the ones that plan to reach a licence agreement plan to show it to potential licensees. Those who wanted to start their own business started to look for manufacturers who also could help to specify the production cost.

4.4.6 Business related issues

All inventors have waited with business related questions, such as customer segment and market size, channels, financial key metrics such as estimations of revenues and costs, and relations, until there is nothing else left to do. Many describe these activities with little confidence and interest. They are not sure who to contact or how to make estimations, or are simply not interested in business relates activities. At the pitching, some connected trends to describe the business opportunity, but when the panel asked for estimation of the market size in numbers, no one could reply. Inventor A, C and F benchmarked their production cost towards existing solutions and argued that their solutions hence would have a better gross margin.

While asking to describe the early adopters for their inventions, many gave a broad definition, and some shifted during the interview between different groups of customers, Inventor C for instance. Although some had a customer segment in mind, they had not made estimations of how large that segment was, nor had they included these users in the development process.

4.4.7 Customer & stakeholder involvement

At an early stage, before a patent application is submitted, many inventors avoided external interaction with, and thus never received input from, customers and users. The reason for this was by many inventors described as making the invention public, means the patentability is lost. Other factors that impact the decision to exclude customers from the development process was that they were not comfortable with that type of interaction and do not know where to find potential customers. Also, three inventors argued that customers could not help because they lack technical skills. They do not at all discuss observation of customers or other ways to expand the understanding of the need. Thus, not very surprisingly, not one inventor interviewed changed the problem definition based on deeper customer understanding.

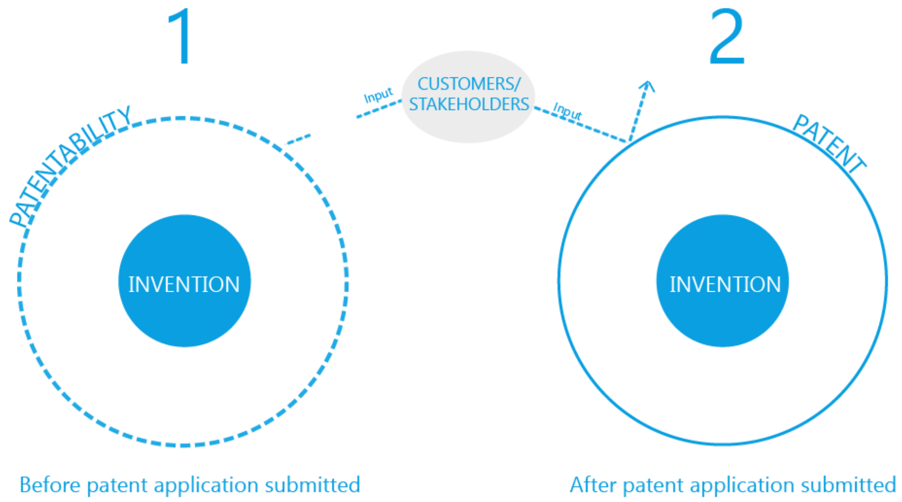

Figure 23: Independent Inventors; insights from empirics

At a later stage, once patent or design protection application had been submitted, they were more opened to the thought of talking about their inventions and show it to customer. However, still very few did so, and those who did involve some customers at that stage did not make major changes to the solution based on new insight.

Some did not want to accept a sunk cost. At this point they had already spent time and money on the patent, and making too many changes would make the patent obsolete. Inventor A & B considered hiring industrial designers to design the products as they acknowledged the importance of an aesthetic apparel and user pleasance. However, with their view on the patent as something important to keep competitors away, it was clear that they were not willing to compromise on the design to the extent that the patent would no longer be relevant for the solution. The designer was more thought of as someone doing the final touch, meaning the possibility to find the truly great solutions, or even problems, by understanding the users are strictly limited.

The three inventors that did not strictly plan to patent were more open to involving customers and users in their development. Inventor D for instance, have discussed the idea with more than 30 end users and stakeholders. They were not fixed to a specific technical solution; thus, they argue there would be no point in patenting it if it will change anyways. Instead, they have focused on the problem and embraced input on different technologies that could be used to solve that problem. Inventor E's invention was not patentable, hence he had no choice but not to patent it. As he presented his idea at an open innovation night at one of SUF's' member associations, another member came up with a completely different solution to the same problem. He is now considering to precede with that solution instead of his initial idea. Finally, IG, who decided to go for first to market instead with her application, have also involved multiple customers while developing the concept. Furthermore, she has expanded the product so that in now includes a lot of features.

4.5 Insights from Interviews with incubator managers

In this section a compilation of insights gathered from three interviews with incubator managers will follow.

While reviewing the interviews with the three incubator managers, it was noted that they all had the perception that people that leave their programs or are not accepted to the incubators mainly do so due to lack of need for the product, or because there are other solutions in the market already which they did not know of. Thus, to be accepted to an incubator, it is often required that they gather insight concerning the need, by talking to potential customers. These should be people within their intended target customer segment, not their relatives or friends which many turns to as they are easily accessible. They will probably tell you what you want to hear not to make you feel good (Klintenberg, 2016).

The ones who have not met with customers always have the largest issues, they are not even accepted to the incubator (Öbrink, 2016). They also stress the importance of providing a business coach who can identify false assumptions that may be overseen by the inventor due to cognitive bias. The coach can also provide a holistic perspective of the situation and can contribute with experience within all areas. Many are blinded by details which may be irrelevant. The coach needs to make sure they reach a more realistic understanding of the reality. Also, the coach and the incubator extends the network, which makes it easier for them to reach and engage with stakeholders (Öbrink, 2016; Wilcke, 2016).

Furthermore, they seem to agree that the willingness to learn and change the product throughout the process is critical to succeed. For some, that might mean changing the solution, to others, if there is no need for the product at all, the very core of the business idea, that is the problem definition, needs to be changed. Some simply stop when they realize their hypothesis about what the customers want was wrong, whereas some change and sometimes end up with completely different ideas than the initial one. They all had a positive attitudes towards a lean start-up approach, as it means insights from real customers are gathered and considered.

5 Analysis

The literature review leads to a conclusion that the research field covering independent inventors' invention processes is limited. No coherent theory that explains independent inventors' invention or innovation process was found. Instead, through the interplay with empirics, previous studies are used to explain why inventors make certain choices, and to find support for claims regarding their approach. This analysis leads to a holistic description of the inventors' invention process. A conceptual model that provides a visual representation of independent inventors' invention processes, and key insights based on the gaps between organizational models and IIs' process are the outcome of this analysis.

5.1 Independent Inventors' invention process

5.1.1 Front end

The trigger point for independent inventors that makes them initiate a new project is often an idea of a solution to a self-experienced need, which was also found in literature (Smelius 2015). Many inventors have several ideas, and which they choose to proceed with are ad hoc decisions. Many apply for patent to have something to sell, which is similar to the incentive that even if the patent may not increase revenue or avoid costs, it increases the chances of securing investment or licences (Mann & Sager, 2006). The meetings they do have are mainly with friends and family to confirm the need, which they do by asking closed questions rather than explorative and open questions as advocated by DT (Stanford, 2016). This could be explained by the fact that IIs are individualists; in Smelius (2015) compilation of independent inventors' personal characteristics, no extrovert personal characteristics were mentioned. Norman & Frankelius (2013) also found that IIs find it challenging to find the right contacts, which was also seen in the empirics. Furthermore, interviews indicate that the patentability is an important factor that affects their willingness to involve customers, which can be explained by the fact that inventions that have been publicly disclosed before an application have been submitted is not patentable (Patent- och registreringsverket, 2016). The inventors that had no plans to patent involved more customers in their process and were more open to involving external stakeholders. Some seek support from actors within the innovation support system for advice as well as some financial support. This was also found by Norrman & Frankelius (2013).

Empirics showed that many inventors specify a broad market rather than segmenting the market and looking for early adopters, and although some connected the need for their invention to trends, not one could provide estimations of total market size or share in absolute numbers. Instead, they were mainly focused on developing the technical solution. This is supported by literature which claims that IIs are technology focused (Macdonald, 1986). It is further supported by the fact that more independent inventors apply for patent due to technical possibility than market related opportunity (Åstebro & Dahlin, 2005). Not all inventors apply for patent, but in this study seven out of ten did. Most argued that they wanted to keep competitors away, some that they wanted something to sell to potential licensees. These reasons are also found among reasons why US start-up choose to patent (Graham & Sichelman, 2008). However, while a rational relation to patent is to evaluate the risk of being copied, as well as the damage that it would imply and make a cost-benefit analysis (Graham & Sichelman, 2008), that reasoning was not done by any of the interviewees, which once again is shown by the fact that they do not base the patent on the market opportunities (Åstebro & Dahlin, 2005).

No theoretical support was found for the argument that the IIs' relation to patent prevents them from interacting with customers and stakeholders, rather than the fact that the patentability is threatened by disclosing the invention before an application is submitted (Patent- och registreringsverket, 2016). Thus, no conclusions can be drawn, and the conceptual model should be viewed with caution.

5.1.2 Idea Genesis

IIs do not seem to go through a divergent ideation process. They rather work with one idea of a solution to the problem at a time, and continuously develop the idea by iteratively sketching, building and testing. This particularly differs from the design thinking approach, which advocates that many and diverse ideas should be generated, and that many of those ideas should be further considered and prototyped parallelly, before the designers attach themselves to one specific solution. Furthermore, the IIs work alone, in contrary to organizational and entrepreneurial design models which suggest teams with various expertise and perspectives should be involved (Stanford, 2010; Cooper, 2006; Ries, 2011).

5.1.3 Development

The invention is further developed by sketching, building and testing iteratively. Even after a patent application is submitted, empirics points to that little external input is searched for. The reason mainly appears to be that they do not want to make changes that would make the patent or design protection obsolete. The interaction that does occur leads to few changes, as they do not adopt the feedback that is provided. This can also be explained by literature with the fact that IIs suffer from confirmation bias and are overly optimistic (Udell, 2004; Åstebro, 2003). Also, the fact that they are described without any indication of extrovert or customer interest indicated that this is true for many independent inventors (Smeilus, 2015).

Furthermore, empirics implied that many wants to develop a professional prototype as they think that will help them seal a licensing deal. Finally, as have been noticed previously by other researchers, IIs are technology focused and many ignore business related tasks until there is nothing else left to do. Thus, many have a hard time knowing how to precede from a prototype (Norrman & Frankelius, 2013).

5.1.4 Conceptual model

Figure 24 illustrates a conceptual model of independent inventors' invention processes.

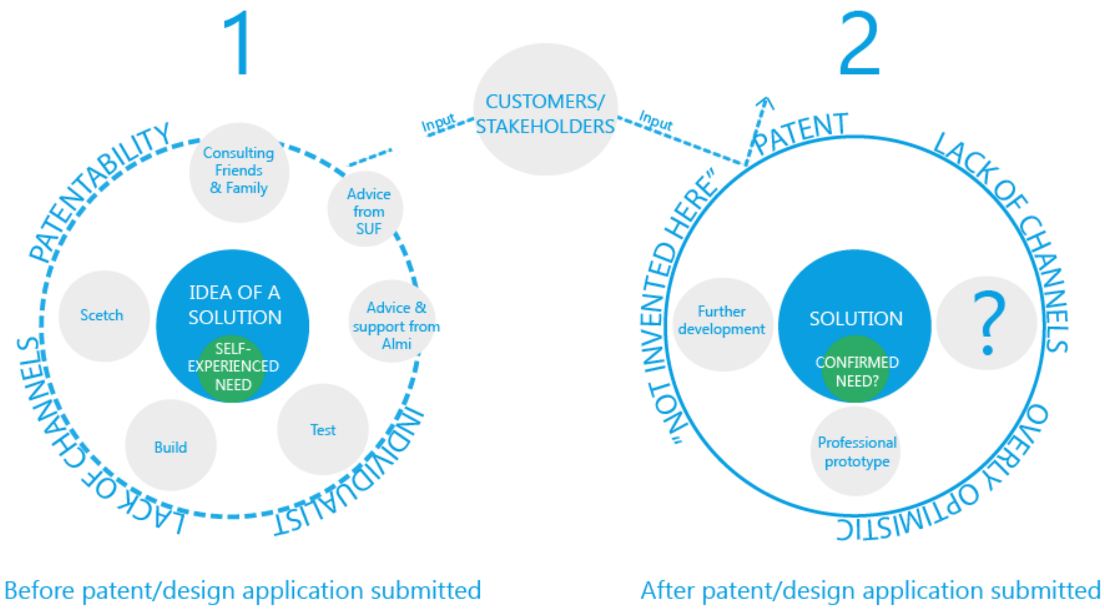

Figure 24: Conceptual model of independent inventors' invention process

The model visualizes IIs' invention process in two stages. Before and after a patent or design-protection application is submitted. The large circles illustrate what is preventing inventors from searching for, and adopting, customer and stakeholder input. The activities within the circles are not necessarily performed in a certain order; thus, they are distributed around the solution.

The green circles symbolize a need. In the first phase, it is a self-experienced need. As few efforts are done to confirm that there is a market need for the invention, such as by empathizing with end users, the green circle in the second phase has a question mark to symbolize the lack of confirmation.

"Consulting friends and family" and "Support innovation system" are crossing the large circle as patentability could be at risk by disclosing the idea to them, if they were to break the confidential trust.

The line between the circle in the first phase and customers/stakeholders is broken to illustrate that little contact is search for by the inventors at the early stage. In the second phase, the line is "bouncing" on the patent-circle to illustrate that the little feedback or input that is gained often leads to few changes in the solution.

5.2 The gap

5.2.1 Front end

Literature is focused on the front end from a corporate perspective, and no previous research was found specifically on the II's front end process. The incentives and resources differ greatly between companies that wishes or must extend or renew their product portfolio to stay ahead of, or keep up with, competition and independent inventors who, by definition, do not have to invent but rather do it because they wish to realize an idea of a solution. Åstebro's research shows that the probability of commercial success is greater for companies than for independent inventors (Åstebro T. , 1999).

Although that may be due to reasons such as external relations and established channels, it is possible that the early FFE process also affects the outcome. Studies does indicate that the FFE is the most complex phase of the innovation process but often offers the greatest opportunity to improve the total innovation capability (Reid & De Brentani, 2004).

Literature shows that expected sales is one of three main factors determining the commercial success of inventions (Åstebro & Dahlin, Opportunity knocks, 2005). For it to be expected sales, there must be a need. Klofsten (2005) further claim that a high degree of market anchorage enhances the chance for commercial success, and states that it is specifically important for actors with small resources.

Literature shows that IIs often have many new product ideas (Smeilus, 2015), which was also found by empirics; many of the interviewees worked on several projects parallelly, or had previously developed other inventions. They could hence be described as good at recognizing opportunities. IIs typically identify a solution to a self-experienced problem. However, once they get the idea, they do not take a step back to understand the end users' problems and needs, as DT suggest. DT recommends the designer to step away from outcome assumptions at an early stage as it hinders one to empathize with users and truly understanding the problem. This is the empathize phase, and is typically not done by the inventors. Many argued that it was because the patentability would have been threatened if including customers, which is true if they would show the solution (PRV). However, empathizing the way it is suggested by design thinking does not mean disclosing the solution, as the point of this phase is that all outcome assumptions should be ignored. Furthermore, some inventors also argued that customers do not know what they want, and do not understand technology, thus it is merely a waste of time to include them. No one described a process of trying to better understand the intended end users better, or even expressed that they had considered it an option. It is possible that they simply did not know about the approach nor methods to do it and which benefits could derive by doing so.

The risk of not diverging in the first phase, is that one solves a problem to which there is no need (Brown, 2009). As many do not confirm the need but assumes there is a need based on the own experience and confirmation from friends and family, there is a risk that they believe there is an opportunity when there is not. Inventors look to confirm rather than explore, which is an important distinction as it affects the opportunities to truly understand the need and develop great products. Stanford (2016) present many potential tools to use to empathize.

NCD suggest opportunity analysis as an important element in the model to evaluate the potential at an early stage. However, the model provides no methods for understanding and empathizing with end users as design thinking suggest. They do, however, also recommend customer involvement.

Finally, the lean start-up approach suggests one starts by formulating hypothesis regarding the entire business model, and start by identifying the riskiest assumption and test it as soon as possible with an MVP. Not much time is spent on planning and defining. It is at that point important to be open to change problem definition if customers show no interest or find other applications for the invention. Also, it could be the intended customer assumption that should be changed, in which case a new test should be done with those customers.

Some inventors connected the thought need toneve trends, but they did not start by doing so; they rather looked for trends to confirm a potential market for the idea. This implies a risk of confirmation bias. Most inventors had partly defined a customer segment, but it was broad and they did not necessarily connect the solution to the needs for that particular segment. No one had made financial estimations. IIs typically have many ideas, and no indication of formal assessment, such as an opportunity analysis as preformed in NCD, in the front end was found, either to decide which ideas to start developing or whether to proceed with an invention. This was further supported by Klofsten (2005) who found that IIs decision of which projects to involve in is often a random choice.

It is easy to quickly jump to the conclusion that not making an early assessment of the commercial and technical feasibility is negative. On one hand, that would be a valid conclusion. Åstebro (2003) advocates that projects with no potential should be closed down at an early stage so that resources instead could be devoted to projects with higher technical and market potential. On the other hand, considering few feasibility criteria at an early stage is encouraged by DT, as there might be elements in those ideas which addresses some important aspect of the need which deserves to be further explored (Stanford, 2016). Also, the inventors' responsiveness and quick movement from idea to action is perhaps advantageously as ideas rapidly are tested, which is somewhat similar to the lean approach, although the approach still differs with respect to many other aspects. Furthermore, inventors' optimism and "never give up" spirit could be very useful if combined with an open mindset which is ready to pivot or change direction if indications are given that one way sill not work. However, due to the biasedness, that insight must likely come from an external actor, such as a business coach or real interaction with the end users.

Table 4 provides a compilation of the key insights derived from analysis of the front end phase.

Table 4: Key insights front end (opportunity/find problem to solve)

Different starting points: IIs: idea of a solution. No corporate strategy or product portfolio to consider and smaller resources.
Few activities in the FFE, in particular those connected to market estimations. IIs are technically focused.
Low customer interaction in front end. IIs does not know any methods to empathize with end users. They aim to confirm rather than to explore which is suggested by organizational models and lean.
Inventors are optimists. It could be great asset if focused on the right things. A need to help indicate when they need to pivot, and important that they are open to it.

5.2.2 Idea genesis

Theoretical models suggest many solutions should be generated in an ideation phase. NCD address this phase in the ideas genesis element (Koen, et al., 2001). DT involves an ideation phase, in which it is essential that all outcome assumptions are left behind, and tons of ideas are generated (Stanford, 2016). Many inventors did not go through an ideation phase, they rather continuously developed their initial idea, and did so individually with much limited interaction with customers. One reason why inventors did not do this could potentially be explained by the fact that many find it hard to find the right contacts (Norrman & Frankelius, 2013). Literature also explains this with that notion that many inventors are in love with their inventions, which could further explain why they are not interested in adopting external input which may indicate other that the invention is not desirable or meets the underlying user needs. It is similar to the not invented here- syndrome, often referred to as the phenomenon to describe corporate research and development departments' unwillingness to adopt technologies developed from external parties due to their pride in having the best skills and technology in-house (Mehrwald, 1999).

The risk of not diverging in the second phase, is that there may be other ways to better solve the problem than the first initial idea that the inventor had. This is also closely connected to the first phase of empathizing, because it is difficult to understand how the solution should be designed without understanding the needs of the customers. There may also be solutions which for instance are cheaper to manufacture or would be better from an environmental perspective, which might be critical for the financial viability of the project.

Figure 25 illustrates that there are many solutions to each problem statement, and that the solutions may or may not meet the customers' needs. It also symbolizes the point of patent design-around. If there are many other ways to solve the same problem, there might be little incentives to spend much money on a patent.

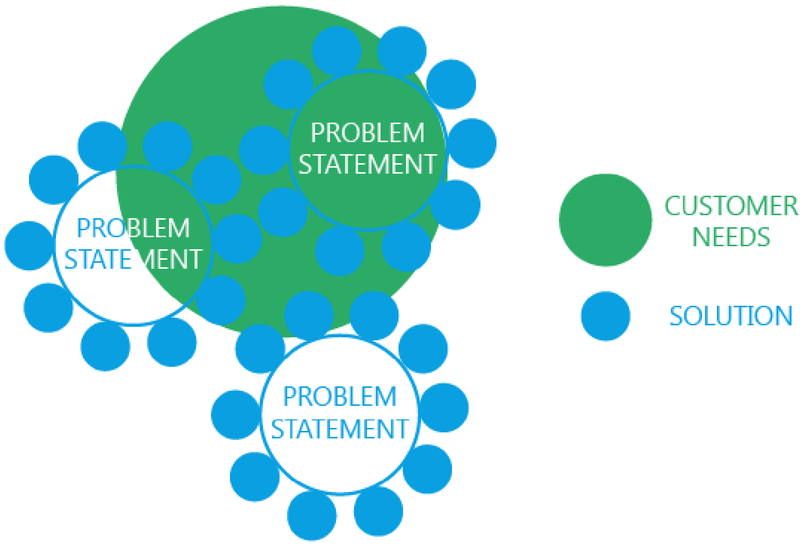

Figure 25: The relation between needs, problem statements and solution

Other organisational processes, such as NCD and Stage-gate, also include ideation stages, in which customers are strongly suggested as source of ideas. DT further suggest diverse groups including designers, users, customers and experts that collectively develop ideas, and build on the idea of others (Stanford, 2016). Naturally, IIs do not have the same resources as companies, but they could probably find ways to involve more people, and use NDA:s to maintain patentability. DT also suggest that more than one idea should proceed from the ideation phase to development stage. Simple prototypes should be done to test several ideas so that the designer does not stick to one solution at an early phase (Stanford, 2016).

The lean start-up does not specifically address an idea genesis phase. However, an openness to pivot at any time based on customer learnings means the ideas may change at any time (Blank, 2003).

Assessment

As IIs typically do not go through an ideation phase in terms of collectively generating many ideas, there is not much to discuss regarding their assessment approach in this phase. DT however, provides formulated methods for selecting ideas to proceed with. After an ideation session is preformed, the ideas are typically assessed by the team that came up with the ideas altogether. The butterfly method and the four categories method are two examples of these types of assessment methods. It is suggested that more than one idea is brought forward to the prototyping stage, and that feasibility does not get a too strong voice at this stage. In the Stage gate model assessment is handled by external executives with business skills and much experience, implying very different conditions (Stanford, 2016).

Table 5 provides a compilation of the key insights derived from analysis of the idea genesis phase.

Table 5: Key insights: Idea genesis

No divergence
Individually develop instead of teams
Low customer/stakeholder involvement
Not always comparable to organizations due to different resources

5.2.3 Development

IIs quickly start building prototypes, low to high resolution. It is an iterative approach, in which they learn by building. Most inventors do this individually, in difference to organizational and entrepreneurial design models which suggest teams. Still, customer involvement is low, especially compared to what is suggested by DT and lean start-up. Furthermore, independent inventors do not have a corporate strategy to consider, nor resources or competence to perform professional market assessments, such as stage gate suggest (Cooper R. , Managing Technology Development Projects, 2006). Consequently, many inventors ignore market related activities and instead focus on the technical development of the product (Macdonald, 1986), which was also found by the empirics in the study.

In the Stage gate model, business related issues are addressed in the scoping stage and build business case. Smelius (2015) found that many successful inventors in the sense that they reached licensing agreements, perform some activities in the scoping stage but not in business case stage. Empirics indicates that IIs first address business related issues when there is nothing left to do. Furthermore, as many are uncomfortable with customer relations and sales, they want to have an as market ready and impressive product to show off as possible when approaching stakeholders or partners. Thus, many make professional prototypes of their inventions.

Two inventors planned to involve industrial designers in the final development phase. However, involving them in such a late stage would mean little room for making important design decisions connected to the needs of the end users, it would potentially more be like “putting lipstick on a pig”.

Table 6 provides a compilation of the key insights derived from analysis of the idea genesis phase.

Table 6: Key insights: Idea development

Quickly move to action
Build and test iteratively. Make many prototypes.
Little customer/stakeholder involvement.
Work individually; no teams as organizations and start-up suggest.

5.3 Compilation key insights

Table 7 presents a compilation of all key insights.

Table 7: Compilation all key insights

Few front-end activities performed - **Different starting-points**
No divergent phases - **The need; look to confirm rather than explore** - **Do not consider many ideas parallelly**
Little focus on business throughout entire process - **Small resources and competence compared to companies** - **Could be good for creativity**
Little customer/stakeholder involvement - **Empathizing does not risk patentability** - **Work alone, personal characteristics; individualists** - **Patent affect external involvement** - **Inventors lack contacts and channels to reach the right customers and stakeholders**
No formal assessment - **Small resources and competence compared to companies** - **Biased optimists and much personal drive** - **Instead, they quickly move to action & learn by building**
Lean start-up could be good approach to some

5.3.1 Few front-end activities preformed

Åstebro (2005) showed that IIs only face a 6.5% chance to reach commercialisation with their inventions. Success is determined by many criteria, but a prerequisite is that the inventor works with solving the right problem. Research on NPD processes are much organizational oriented, but shows that the early phase is critical for the outcome of the project, and that doing the homework in the early phase pays back. Smith & Reinertsen (1991) described activities that should be performed in the FFE through their NCD-model. Many of these activities aims to identify market or technical opportunities, as well as analyse and assess its commercial potential. DT stresses the importance of finding the right problem to solve by empathizing with the end user to make sure there is a need for the invention (Brown, 2009). Similarly, in the case of independent inventors, Åsterbro & Dahlin (2005) argued that it is important to, at an early stage, determine the commercial potential of the invention. Yet, it seems that many inventors ignore activities connected to the early phase. Naturally, activities related to searching for new opportunities are not relevant to those inventors whose starting point is an opportunity. However, efforts to evaluate the opportunity is not preformed either.

5.3.2 No divergent phases

All inventors interviewed had an idea of a solution as a starting point, and while getting the idea, they did not take a step back to make room for truly understanding the problem and underlying needs. They try to confirm that there is a need rather than make efforts to explore it. In contrast, DT suggest that the designer should step away from solution outcome assumptions, and move in to an empathic phase to ensure that the right problem is solved. Once a problem statement is formulated, design thinking suggests that another divergent process should be conducted through an ideation phase, to generate many possible solutions to the problem (Brown, 2009). For this phase, it is critical to engage a diverse group of people, including customers, to reach solutions that are viable, feasible and desirable. Also, after an ideation phase, many possible solutions should parallelly be further considered and simple prototypes should be done so that the designer does not stick to one solution too fast. The independent inventor rather seems to develop the invention iteratively by themselves, with an idea of a solution as a starting point, as illustrated in Figure 26. This could be explained by studies on the personal characteristics of IIs, at which no signs of extrovert or customer focus is found (Smeilus, 2015). What many do similarly to what DT and Stage gate suggests, is that they sketch, build prototypes and test iteratively. However, a difference in the approach of doing so is that IIs still do not include the end users.

It should be noted that inventors and organizations have different starting points. While companies typically look for ways to innovate to extend their business and keep the long-term competitiveness, the reason why inventors start developing their ideas is that they have experienced a problem which they wish to solve. Hence, the organisational approach is more open by nature. This may be a benefit, as it means they thus are more open to completely different problem statements and solutions, but it may also be a disadvantage as they may not have experienced the user need in the same way as the inventors sometimes has by being one of the end users. This also means that the empathic phase might be less important for inventors to go through. However, it is still strongly suggested that they do so, as customer insights should not be based on one single customer, and there is a risk of being biased to its own invention.

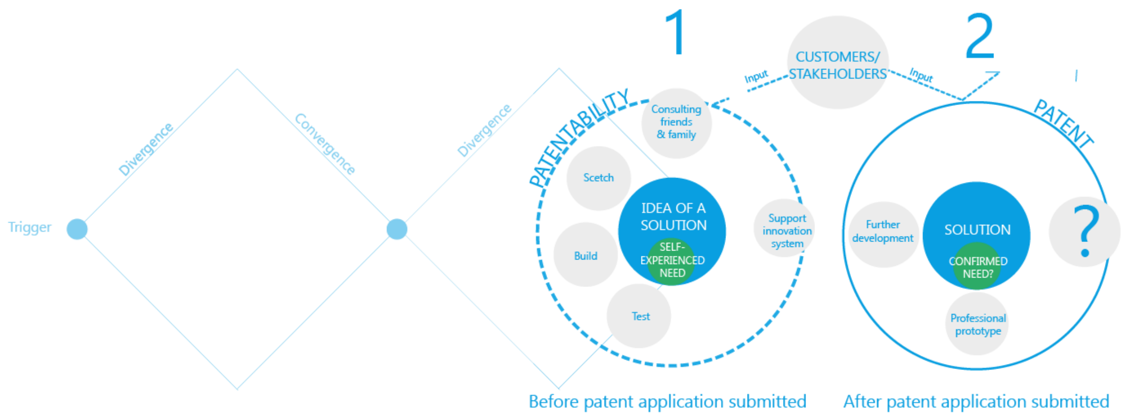

Figure 26: IIs' begin with an idea of a solution

5.3.3 Little focus on the business

Market potential focus is low throughout the entire process. All independent inventors interviewed directed little attention to market related problems in favour to developing the technical solution right away. Few had even specified the target customers, and no one had estimated the market size or expected market shares. Financial key metrics, such as gross margin or pay-back time was also not calculated. This can be explained by a lack of interest and knowledge (Norrman & Frankelius, 2013), and falls well in line with the fact that few aspire to be an entrepreneur (Parker, Udell, & Blades, 1996), and that many apply for patents on technical opportunities rather than market related opportunities (Åstebro & Dahlin, Opportunity knocks, 2005).

In the NCD model, opportunity analysis, idea selection and concept and technology development all include market potential considerations. In the stage gate model, an extensive business case is developed before proceeding with development of the concept and that is after the scoping stage has already been conducted. Design Thinking implies that only products that customers really want and like are developed. Thus, there will be a need and an attractive solution. The creative process is thought to be at risk if to many restrictions concerning feasibility are set at an early stage. However, the ideas are evaluated with viability, feasibility and desirability in mind.

The lean start-up approach continuously pay attention to the entire business model, and through real feedback, the business model is refined by a trial and error approach. The method's advocates, such as Blank (2013) and Ries (2011), argue that markets cannot be estimated correctly anyways, hence, no time should initially be spent on conducting a business plan built on guesses. Instead, the entrepreneurs should develop their offer and learn what the market wants from real feedback from actual customers. It could be a good choice for IIs as less market estimation skills are needed. There may however be other reasons why it would not work.

5.3.4 Low Customer/Stakeholder Involvement

Independent inventors are individualists (Smelius 2015), and typically develop their inventions by themselves in contrast to what organisational models suggest. The external interaction they did engage in was asking friends and family to confirm that there was a need for the product. However, their approach to do this was mainly to ask them closed questions. The main reason for this strategy is that the patentability would be lost if the invention would be disclosed in public.

In contrast to the low customer engagement showed by inventors, all organisational and entrepreneurial models studied agree that involving customers is important for the development of new products. In the NCD customer integration evidence is found in the opportunity analysis through market research, and in the idea genesis phase customers are suggested a source of input. Stage Gate suggest customers are involved in the discovery stage through customer visitation programs. The DT approach evolved around the human centeredness, which demands end user involvement. Other stakeholders should also be involved in the ideation phase. Lean start-up encourages customer integration as soon as possible, and even suggest an early core version of the product should be presented or even sold to customers as soon as possible to test the entire business model (Ries, 2011 Blank, 2013). Moreover, the incubator managers interviewed claimed customer interaction is so important that it is an acceptation criteria for the incubators. As Öbrink (2016) stated, it never works if they have not real customer data. The incubator managers also stress the importance of a business coach to provide an unbiased view.

Also, the fact that IIs perceive themselves as creative (Smeilus, 2015) is interesting and could perhaps partly explain why many are sceptical towards adopting customer input. Although being a corporate term typically used for R&D departments closed attitude towards external input, the “not invented here”- syndrome, (Mehrwald, 1999), is perhaps also relevant for independent inventors.

Åstebro & Dahlin (2005) and Udell’s (2004) argument that IIs suffer from blind optimism could also explain the phenomenon that many do not change their ideas based on external input. If inventors ignore feedback from experts telling them that there is no idea preceding with the invention for commercial incitements as its likelihood of succeeding is very low, they probably also do not want to accept similar indications from customers or user, pointing to that they solved the wrong problem, or that other existing solutions better meet their needs.

Norrman and Frankelius (2013) claim that inventors struggle to find the right contacts which is also found in the empirics. Also, no characteristics except from perhaps curiosity points to extroverts or customer interest. Thus, even though it might be a good approach for them, there is a risk that they would not be able to do it. Also, many inventors aim for a licence deal, and for that purpose it is not evaluated whether the lean start-up approach would be appropriate.

Patent

Empirics points to that the explanation to low customer engagement is due to the risk of losing patentability before application submitted. After application is submitted, many do not want to make changes as that would make the patent obsolete. Explicit support for this was not found in literature.

The patents seem to be leading some inventors onto a path which keeps them from evaluating their inventions from an unbiased perspective, as they at that stage already have put a lot of time and effort into their projects by then. The empiric implies that five of ten inventors’ intensions are to sell a license to a company, and to have anything to sell, they believe they need a patent. However, not all companies even want a patent; some might want to keep it a trade secret, and that opportunity is lost once an application is submitted to PRV. And even if they do, they could wait until they know there is an interested customer, at which case the licensing company might be willing to pay for the patent cost themselves. There is often no need for a patent to start negotiations with licensees, as most companies agree on signing NDAs. By keeping the conversation around the need rather than the solution is an option. However, by not applying for a patent at an early stage, but still aiming to keep that door open in case the licensing company wants it, might have an even more excluding effect on user involvement.

Who should and should not apply for patent is a complex question which is outside the scope of this thesis. However, the consequences that patent imply on IIs' processes are important. Patents are often a costly process, especially if the patent should cover several countries. While each case must be treated differently, it is important to manage the patent strategically (Graham & Sichelman, 2008). That means evaluating the options and the effect that the patent has, as well as evaluating the cost benefit relationship. Also, understand what the patent does and does not do, as well as which function it is meant to fill is important to know. If it is to scare competitors or to use it as a marketing strategy, it might not matter if it does not completely cover the solution. And if it is to reach a licensing deal, they could at least be included in the process of developing the product. To companies the cost of a patent is relatively small, but for IIs it is much money, especially in the long run as yearly fees must be paid in each country. Furthermore, many inventors develop mutual inventions.

5.3.5 No formal assessment

The empirics provides no evidence to support that a formal assessment of the ideas is conducted by the inventors at any stage, such as gates as suggested by the stage gate model. One explanation could be that they do not have as advanced resources as corporations, nor business skills required to make appropriate evaluations as basis for an assessment. However, studies on independent inventors indicate that half of those assisted with assessment by the Canadian innovation Centre, ignored feedback which that recommended them to quit due to very low chances to succeed (Åstebro, 2003). This indicates that some may not want to adopt assessment feedback. This is further supported by other independent inventor literature, which shows that they are overly committed to commercially or technically flawed inventions due to cognitive bias (Udell 2004).

Incubator managers stresses the importance of having a business coach to address more perspectives and help with market evaluation (Öbrink, 2016), (Wilcke, 2016). Although this might be helpful, it is essential that the inventors are open to the feedback, which may not be the case.

Norrman & Frankelius (2013) conclude that although it is difficult to on beforehand "pick the winners" among a group of inventions, it is possible to, with high probability know which projects will fail. Åstebro & Dahlin (2005) argue that an early analysis of the potential of inventions is important so that time and money is not wasted on projects that are doomed to fail. However, this cannot be done by the inventors themselves, but is rather a job for professionals with long experience, such as SUF or other actors within the support system.

NCD describes opportunity analysis as a complex process often requiring methods such as multiple quantitative metrics, quick feedback or risk assessments (Koen, et al., 2001). IIs lacks skills and knowledge to do that. Stage gate suggests gates to evaluate whether to proceed with the project after each element. IIs interviewees shows no signs of such gates, which is also supported by literature (Smeilus, 2015). One explanation is that these gate-assessments at corporations are done by management, a group further away from the project than the one who are developing it. IIs have no management to turn to. It could also be explained by the theories of cognitive bias, or as Åstebro & Dahlin (2005) argue, that IIs suffer from blind optimism.

Design Thinking supports democratic assessment (Brown, 2009). However, an interesting element in the DT literature is that while evaluating ideas derived from an idea genesis phase such as a brainstorm, it is encouraged not to be too concerned with the feasibility of the ideas, as there may be important aspects to the ideas that are more controversial which should be further explored. Sometimes, the final design is a combination of many different solutions. What might not seem feasible technically or financially, might be just that if combined with another solution or refined. Also, by adding a lot of restrictions at an early stage means the creativity might be blocked. It might be an advantage that inventors do not have the business- mindset, as it allows them to think more freely as the though “that will not be economically viable”. DT clearly state that one should separate the ideation phase and the evaluation phase, or at least actively chose if mixing them.

The Lean start-up method implies the entire business model is assessed by testing in the reality with a trial and error approach. What does not work in a small scale, probably will not work in a larger scale either.

Finally, it should be said that the optimism could also be advantageously, as it comes with an incredible drive and determination to give their inventions life. If combined with an openness to pivot when needed, the optimistic never give up spirit might be beneficial.

5.3.6 Lean start-up

The Lean start-up methodology provides guidelines which are heavily used in the start-up world. The benefits of the lean approach are that no advanced plans based on analyses of markets, which many inventors cannot do anyways (Norrman & Frankelius, 2013). The trial and error approach rather helps the inventors to learn what works and not before much money and effort is spent, thus it might be a beneficial approach for II.

The lean start-up approach works iteratively through a process of building, measuring and learning. To plan the learning process is important. No inventors studied worked through a process even similar to the lean start-up approach; they did not use customers as essential core resource in their process, nor did they plan what they needed to learn from the few meetings they did have with outsiders. Statistics indicate that invention process adds complication to the start-up process (White & Reynolds, 1994) and increases the risk for of never reaching commercialisation by two to eight times (Katz, 1989), (White & Reynolds, 1994). Another potential issue which adds to the complicated invention processes is the patentability. When including customers, the patentability could be lost. It is difficult to explain how the lean start-up approach could be entirely adopted by IIs who want a patent.

6 Conclusions, recommendations & final remarks

6.1 Answering RQ1

RQ 1: How can independent inventors' invention process be described?

A conceptual model describing IIs invention process is presented in Figure 27.

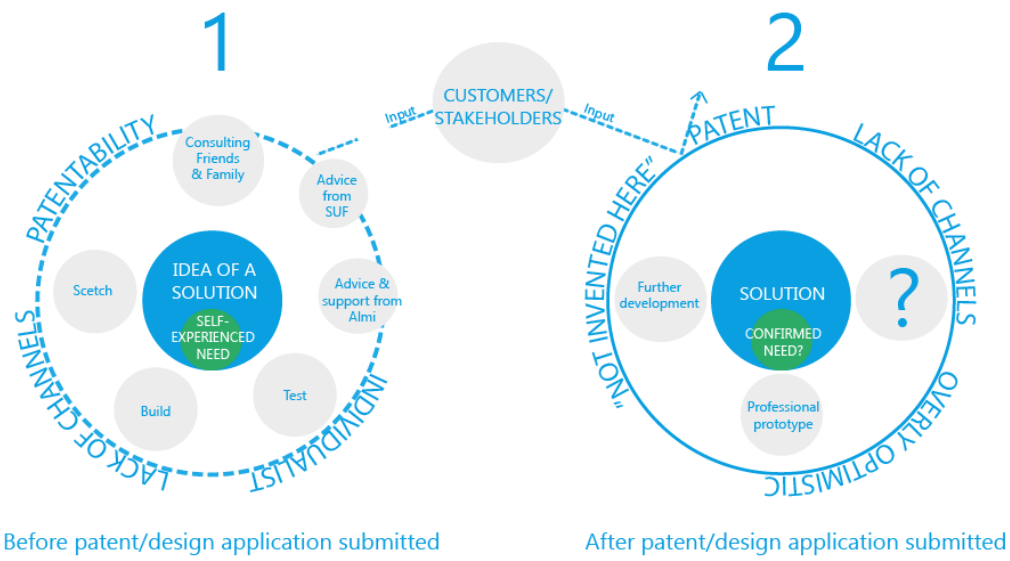

Figure 27: Conceptual Model of Independent Inventors' Invention Process

The model describes independent inventors' invention process in two phases; before and after patent or design application is submitted. As the activities are not performed in a fixed order, they are distributed around the core which is the invention or solution to a problem.

Phase 1: IIs typically experience a problem and instantly start to look for solutions to that problem. This is illustrated with the filled green and blue circle. They quickly move to sketching, building and testing the idea iteratively. Many involve friends and family to confirm the need for the invention, and search support from the innovation system, often to get help with a patent application or financial support. Few search for, and involve external stakeholders and customers. Main reasons for that is that they do not want to risk patentability, which is illustrated by the large dashed circle. However, few have a patent strategy; many apply for one to have something to sell or to keep competitors away, regardless the cost-benefit relationship. Furthermore, they are individualists who consider themselves creative, hence they do not see the value of bringing in externals to the development process. They do however gladly admit that they would need help with business related issues as they prefer to focus on the technical solution. Furthermore, many do not know how to reach relevant potential customers or end users, which is represented by “lack of channels” in the model.

Phase 2: Once a patent application is submitted, which is why the large circle in the model is now solid, inventors further develop their inventions. Many wants to make professional prototypes to have something to show off to potential licences or partners. They believe that the more finished the invention is, the more attractive and easy it will be to sell. Input received from customers at this stage is often not adopted as major changes would mean the patent no longer covers it, hence the bouncing of customer/stakeholder input on the patent-circle. The inventors do not consider whether they have solved the right problem, that is if there is a need for the product, at this stage, or if their approach to solve it is the best one, as that would imply large sunk costs, and because they are convinced of the brilliance of the invention.

6.2 Answering RQ2

RQ 2: What is the gap between independent inventors' invention processes and organizational and entrepreneurial design processes suggested by literature?

Many of the inventors studied have shown exceptional construction and creative skills, and it is not clear if they will finally reach commercialisation or not. Therefore, no valuation of their approach has been done. However, the gap between what literature suggest and the process performed by many inventors differ, and as many inventors struggle to reach commercialisation, perhaps they should consider to seek inspiration from organizational or entrepreneurial models. These gaps have been presented as key insights which are derived from the benchmark with four invention approaches are presented in Table 8.

Table 8: Key insights based on gap

Few front-end activities performed - **Different starting-points**
No divergent phases - **The problem; look to confirm rather than explore** - **Do not consider many ideas parallelly**
Little focus on business throughout entire process - **Small resources and competence compared to companies** - **Could be good for creativity**
Little customer/stakeholder involvement - **Empathizing does not risk patentability** - **Work alone, personal characteristics; individualists** - **Patent** - **Contacts**

No formal assessment - **Small resources and competence compared to companies** - **Biased optimists and much personal drive** - **Instead, they quickly move to action & learn by building**
Lean start-up could be good approach to some inventors

6.3 Discussion of Results

Some things were already known about IIs when initiating this study, such as that inventors are much technology focused (Norrman & Frankelius, 2013). Hence, not surprisingly, it was found that the gap implies that IIs involve in fewer business related activities than what organizational and entrepreneurial design models suggest.

In organizational models, although mentioned, little attention is devoted to patents related activities. The reason why it is thought to affect IIs more, is that the cost is relatively much larger for IIs than for established companies. Also, to many inventors there is a pride in holding a patent, thus, it has an intrinsic value to them. Company executives probably do not take pride in a patent in the same way, and they have little reason to proceed with flawed projects. Stage gate suggest gate-keepers consisting of a group of managing executives who analyse the potential with a distance to the product. They are probably not as biased and emotionally attached to the ideas as independent inventors who has done all job themselves, including the assessment of the potential.

The conceptual model indicates that patents only prevent interaction with external stakeholders to occur, but it can also be a prerequisite for IIs to be able to involve customers and external stakeholders in the process. Patent or not, it is the relationship towards the patent that is important, as well as keeping an openness towards change if the need or problem is different than what the inventor thought, or if another solution solves the problem in a better way.

It is possible that all actions and dimensions of the inventors' process was not captured through the data collection. The inventors might not be aware of what they do, how they do it or why they do it themselves. If the right questions were not asked to get them to talk about things that could give clues to that, it is possible that important aspects never were disclosed or captured.

Some elements suggested by corporate models are not applicable or comparable to IIs approach as the circumstances and available resources, knowledge and channels differs. For instance, if an II lack skills to make market estimations, they might not be able to do it themselves nor have financial resources to hire someone else to do it for them. Also, the starting point is very different for inventors compared to corporations. Inventors does not have a corporate strategy to consider, and they often want to test the brilliance of their ideas, independently of its commercial potential. However, there are some things found from the deepened understanding of their process and through the benchmark that should be applicable.

Empathize- There is no reason why IIs should not do this, as it does not threaten the patentability or demand financial commitments. They need to learn that they should do it as well as methods to do it.

Patent- It is not good if customers and stakeholder input is continuously excluded because of the patent. It might be beneficial to change inventors' relation to patents.

Team- Many inventors work alone; input and engagement from other stakeholders would be valuable. They could be creative and ask relevant participants to engage in an ideation process, and use NDAs to ensure that confidentiality is kept.

Assessment- Many do not know how to make estimations or which key metrics to calculate, and they are very biased. There may be a need for a business coach to help them address business related issues and identify high risk issues by looking at it from an unbiased perspective.

Lean start-up- Is an approach that is completely different from how inventors work. Could be good for those who are open it as it means building in business issues and need but let reality judge. Must then be educated. (Stanford, 2016)

6.4 Contribution to academics & recommendation for future studies

No holistic model to describe independent inventors' invention process was found in previous literature. This thesis helps filling that gap in the literature. However, focus was kept at the early phase of the innovation process, and future studies are suggested to extend this conceptual model with commercialisation considerations.

Furthermore, a study researching the effects of educating and coaching IIs through a lean start-up process, and analysing hinders and positive effects from doing so would be valuable as it would provide insights on the possibilities to modernise traditional inventive processes which could potentially lead to more commercialized inventions.

6.5 Contributions and recommendations to SUF

6.5.1 Encourage inventors to start by taking a step back and empathize

Many inventors go straight from idea to solution. By encouraging them, in the very beginning when they are about to start a new project, to take a step back and observe, interview and empathize with their potential customers, before falling in love with one solution, they would increase their chance to, at an early stage, understand if it is really a problem worth solving, or if in fact there is something else they should solve instead. As no inventor interviewed were familiar with this phase, they should probably be introduced to tools or approaches to empathize as well as other design thinking methods. Stanford school of design have developed tools and exercises that can be done to learn or adopt a human cantered design approach (Stanford, 2016). To understand the need and empathize does not imply risking patentability.

6.5.2 Relation to patents

The results from the empirics in this thesis indicate that intellectual property, in particular patents, affect IIs' invention process, and is a major reason to why many do not involve customers and external actors in the process. Literature strongly stresses the external involvement's importance for commercial success, hence, if that is the goal for the project IRT, it is highly relevant to change IIs' approach to patents.

6.5.3 Teams

Many inventors are individualistic and did not consider completely different solutions, such as suggested in an ideation stage. DT and other organizational models require developing teams for the idea generation phase. DT suggest diverse teams with stakeholders, end users and subject experts to be involved, to get many perspectives and insights. Although it might be difficult with a tight budget and limited channels to find an as big group of people as the method suggest, they could probably find some. SUF could encourage their members to open up and do ideation.

6.5.4 Assessment

Many inventors are biased and thus does not always realize when they need to change approach, customer segment or parts of their solutions, and many are not interested in business and market related issues. They could be offered coaches to give them real feedback as suggested by incubator managers, as well as new perspectives and unbiased evaluations. Coaches could also help them question assumptions and evaluate the business potential. IIs are overly optimistic of the technical and commercial potential of their inventions and do not always see the risky parts that may be critical to deal with to succeed. But for coaches to have any effect, the inventors must be open to new insights and be willing to change.

6.5.5 Seek inspiration from the start-up community

Many formal business and market related activities are not performed by IIs. Much, including incubator managers, points to that it is crucial to involve customers in the process. Many IIs have either interest nor skills and resources to make as massive evaluations as corporate models such as stage gate suggest. Lean start-up makes few estimations and no business plan before a business model that will work is found. It could be a good approach also because it would mean they would test the entire business model and successively build channels to reach the customers. But to do so, they need to have a different relation to IP protection. Also, it is not clear how compatible this method is to establishing licensing deals which many inventors desire. Some inventors are not interested in starting a company, some may have another employment and some may not be interested in the activities that self-employment implies.

6.6 Final remarks

6.6.1 Much focus on patent

Much focus in this thesis has been devoted to patents. Not all inventors apply for a patent. Of the interviewed inventors in this study, seven out of ten did, thus the conceptual model much assume a patent. There is a possibility that the sampling primed inventors with patent-likely inventions. For instance, there might be a culture of patent within the association, or the winning inventions from the pitching might have been selected as they the panel were biased towards a positive view of patents.

6.6.2 Not even great inventions sell themselves

To bring a product to market, entrepreneurial skills and persistence to overcome the initial resistance that arise when introducing new products to the market is needed. Several types of knowledge, capabilities, skills, and resources must be combined. Sometimes, what is stopping an invention from being commercialized is not lack of market demand, or that the invention is not technically good or novel enough, but rather a question of the inventors' ability to understand markets and sales, as well as to combine all the necessary factors. In fact, few independent inventors aspire to be an entrepreneur. Thus, history is replete with cases in which the inventor of major technological advances fails to reap the profits from his breakthroughs. Hence, by for instance using the design thinking approach, there is a risk that inventors develop a great product to which there is a need, and that the solution truly meets, and there are great financial margins, but the inventor does not reach out with it anyways due to lack of channels or entrepreneurial commitment. The focus in this thesis did not include much commercialisation related activities, to fit the project within a 20-week limit. Commercialisation relevant activities are instead suggested for future studies, but it should be noted that that topic is of high relevance and essential to gain a complete and holistic view of IIs innovation processes.

6.6.3 Sustainability- an ignored aspect

Independent inventors are creative problem solvers and have historically played a major role for the Swedish economic development. This thesis has suggested ways for SUF to help more inventors develop desirable inventions with a greater chance to be commercialized, but no focus has been directed to how a process should be designed to provide more sustainable inventions. The invention must always meet the needs of the end customers, but what about the needs of the environment or exposed people? The aim of IRT, which was the trigger point for this thesis, is to help more inventions to reach commercialisation, as Sweden would economically profit from more global successful inventions. Maybe a more important goal is to reach a more sustainable society. If that instead would have been the focus, and this thesis would have benchmarked against models specifically designed to develop inventions for a more sustainable future, the gap and hence key insights would probably have looked much different.

6.6.4 Final comments

Inventors are a creative resource which we should encourage to promote innovation. However, they also need support. Few evaluate which projects to invest time in, or make sure the problem they found a solution to is worth solving. By helping them doing so, more time and resources could be devoted to projects with better commercial potential or projects that are more beneficial from a sustainability perspective. Also, there may be other undiscovered and unused ways to extract and capture the potential of their creative and problem solving minds more efficiently.

The aim with this thesis was to contribute to a deeper understanding of independent inventors' invention processes, and to find how it differs from some organizational and entrepreneurial design models. That has been done, and the insights have been used to give recommendations, both for further academic studies and to SUF, which, if implemented, should bring them closer towards the goal of IRT; to help more independent inventors reach commercialisation.

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Appendices

Appendix A: Interview guide independent inventors

The interviews were held in Swedish, thus so was also the interview guide.

Öppningsfrågor

Varför började du uppfinna?

(om målet: om det från början var ett hobbyprojekt eller kommersiellt syfte från start)

Vill du berätta vad du har uppfunnit?

(okej att inte ge tekniska lösningsdetaljer).

Vad är ditt mål med ditt uppfinneri?

Att utveckla uppfinningen i ett eget bolag eller vill du sälja den som licens? Annan väg?

Huvudfrågor

Om innovationsprocessen

Kan du berätta hur din process föll ut: från den allra första stunden till där du är idag?

Fördjupa oss i det allra tidigaste skedet.

Välja problem: Fokus- gjordes ett förarbete för att bestämma vilket behov som skulle lösas?

Kan du beskriva den allra första delen i din process?

(Trender, market opportunity?)

Vad fick dig att påbörja processen?

Hur uppmärksammade du att det fanns ett behov för din uppfinning?

Bekräftade du att det fanns ett (bredare) behov för din uppfinning?

(Varför/varför inte? Hur?)

Vad gjorde du för att skapa ytterligare förståelse för behovet?

(Divergade? Observerade/intervjuade?)

Valde du sedan mellan flera problem att lösa?

(Isf: hur utvärderade du?)

Utveckla lösning: Fokus – ideation and evaluation of solutions

Vad var ditt nästa steg?

Genomgick du en process där du genererade många alternativa lösningar?

(Varför/varför inte, hur mycket skiljde sig lösningarna från varandra?)

Valde du sedan mellan flera potentiella lösningar?

(Hur utvärderade du? Hänsyn till marknad/konkurrenter?)

Blandade du in fler i denna process eller gjorde du det själv?

(Varför/varför inte? Vilka: kunder?)

Har du börjat sälja eller på annat sätt inkludera intressenter?

(När i processen? Varför? Hur?)

Har du nått en första kund?

När i processen blev den inkluderad?

Har du förändrat din process från ”din första uppfinning” till den senaste?

Baserat på vad?

Vad hände sen?

(Vad planerar du att göra i fortsättningen?)

Om IP/patent:

Har du för avsikt att skydda din uppfinning?

(Typ av skydd, varför, syn på patentet)

När i processen gjorde du det?

(Varför just då?)

Funderade du kring andra alternativ?

(Varför/ varför inte?)

Om affären

När började du tänka på den affärsmässiga potentialen?

(Varför? Hur? Finansiella nyckeltal?)

Utvärderade du den affärsmässiga potentialen i de olika skedena?

(Metoder & faktorer)

Stängningsfrågor

Vad behöver du lära dig för att komma vidare med din uppfinning?

(Build-meassure-learn, plan the learning?)

Är det något du vill tillägga?

Appendix B: Interview questions Incubator managers

Får jag använda ditt namn/detta i mitt exjobb?

Är det okej att jag spelar in?

Kan du börja med att berätta om er verksamhet?

Vilka är kraven för att bli antagen till er inkubator?

Hur hjälper ni era bolag?

Varför? Hur rekommenderar ni dom att jobba?

Vilken är den vanligaste anledningen till att bolag överger sina projekt?

Vad mer är viktigt för att dom ska komma vidare?

Vilket är det största problemet du ser att bolagen som kommer in till er har som hindrar dom från att komma vidare?

Något du vill tillägga?

Appendix C: Evaluation criteria at pitching activities

The pitches were done in Swedish, hence so was also the evaluation criteria.

Teknik

Genomförbarhet

- *Är den tekniska lösningen bra och fullständig?*

Prestanda

- *Är tekniken är bättre än alternativen?*

Forskning och utveckling

- *Hur mycket är kvar att utveckla? Hur stor är den bördan?*

Säkerhet

- *Förväntas potentiella faror eller oönskade sidoeffekter?*

Miljöpåverkan

- *Kommer uppfinningen att leda till föroreningar, nedskräpning eller missbrukande av naturresurser eller liknande? Eller tvärtom, ha en positiv effekt?*

Produktion

Produktionsteknik

- *Finns teknik och kunskap för att producera det som behövs tillgängligt?*

Verktygskostnad

- *Hur stor börda är kostnaden att tillverka verktygen som behövs för att möta förväntad efterfråga?*

Produktionskostnad

- *Verkar produktion till en rimlig kostnad möjlig?*

Marknad

Behov

- *Löser uppfinningen ett problem för kunden?*

Potentiell marknad

- *Hur stor och hur bestående är den totala marknaden för alla produkter som har motsvarande funktion (substitut)?*

Trend av efterfrågan

- *Förväntas efterfrågan att öka, vara stabil, minska?*

Efterfrågans varaktighet

- *Förväntas efterfrågan vara långsiktig?*

Förutspåbarhet

- *Hur noga går det att förutspå efterfrågan?*

Produktlinje-potential

- *Kan innovationen leda till andra lönsamma produkter?*

Sociala fördelar

- *Kommer uppfinningen att bidra till samhällsnytta?*

Kompatibel

- *Är uppfinningen kompatibel med nuvarande attityder och sätt att göra saker på?*

Upplärning

- *Hur lätt kan en kund lära sig att använda produkten på rätt sätt?*

Tydlighet

- *Hur uppenbart är uppfinningens unika värde för kunderna?*

Utseende

- *Förmedlar utseendet önskvärda kvalitéer?*

Funktion

- *Fungerar uppfinningen bättre än alternativen? – eller fyller en funktion som inte erbjuds idag?*

Långvarighet/kvalitét

- *Kommer denna uppfinning att innebära ”lång användning”?*

Service

- *Kommer denna innovation att kräva mindre service eller billigare service än konkurrenternas?*

Pris

- *Har denna uppfinning en prisfördel relativt konkurrenterna?*

Existerande konkurrens

- Finns det redan konkurrenter på marknaden som kommer att göra insteget svårt och dyrt?

Ny konkurrens

- *Kommer uppfinningen antagligen mötas av nya konkurrenter som kan hota marknadsandelar?*

Marknadsföringskostnad

- *Kan de förväntade intäkterna bära kostnader för marknadsföring för att nå marknadsacceptans?*

Distribution

- *Hur svårt är det att utveckla distributionskanaler?*

Risk

Lagar

- *Lever uppfinningen upp till alla lagar och standarder? (Eventuellt för tidigt)*

Beroende

- *Till vilken grad tappar uppfinningen kontroll över dess marknad och försäljning beroende på andra produkter, processer, system eller tjänster?*

Skydd

- *Finns det möjlighet att skydda uppfinningen exempelvis med hjälp av ett patent (om det behövs)?*

Investeringstorlek

- *Hur stora investeringar krävs? Speciellt i ett tidigt skede. Krävs en extern finansiär?*

Potentiell säljvolym

- *Hur stor del av marknaden kommer kunna erövras och hur snabbt? Är denna volym tillräcklig för att rättfärdiga att påbörja projektet?*

Payback-tid

- *Kommer investeringen att vara återbetald i ett ”tidigt” skede?*

Lönsamhet/bruttomarginal

- *Kommer förväntad omsättning att bidra till större vinst än andra investeringsmöjligheter? (BM bör vara minst ca 40%).*

Appendix D: Compilation of inventor interview data

Inventor	A	B	C	D	E
Overview					
Radical?	No	No	No	No	No
Type	Consumer product, travelling equipment	Consumer product, ergonomics	Consumer Product, house & yard	Consumer product dependent on governmental institutions involvement	Boat industry
Patent status	Submitted (patent pending)	Approved	Planning	Considering but will probably go for design/trademark	Not patentable
Patent incitement	To have something to sell. Because he can (no strategy). Hinder others to copy.	Keep competitors away. No strategy.	Keep competitors away. No strategy*.	Keep competitors away. No strategy*.	Not patentable
Plan to licensee?	Yes	Yes	No	No	Yes
Entrepreneurial ambitions	If fail to license	If fail to license	Start and sell entire business	Yes, but need partner	If fail to license
FFE					
Market/ technology opportunity realized?	No (guesses large market)	Some connection to trends (neck injuries)	No (guesses large market)	No	No
Customer segment	Partly specified	Partly specified	Many segments identified, early adopters not specified	Partly specified	Broad
Estimated market size?	No	No	No	No (some estimates of total market)	No
Cost/revenue analysis?	No, but estimates lower costs than current solutions	No, thinks cheap to manufacture	No, but estimates lower costs than current solutions	No	No, but estimates lower costs than current solutions
Ideation phase?	No, stage wise development based on initial idea of solution	No	No	No	No
Stage-gate					
Sketched?	Some	Yes	Yes	Yes	Yes
Prototypes?	Yes	Yes, also 3D-printed	In progress	Yes	Yes
Build with hands?	No	Yes	Yes	Yes	Yes
Confirmed need?	No	No	No, but indication of need from few customers	For one side (double sided business model)	No
Formal gates/assessment?	No	No	No	No	No
Design Thinking					
Trigger point	Self-experienced problem	Self-experienced problem	Customer observation	Family-member problem	Self-experienced
Starting point	Idea of a solution while experiencing the problem	Idea of a solution while experiencing the problem	Idea of a solution while realizing the problem	Idea of a solution while realizing the problem	Idea of a solution while experiencing the problem
Customer/stakeholder involvement? (number)	10	10	2	30	6
When in process?	After patent application submitted	After patent application submitted	Before developing the idea	Throughout entire process	After news review (patent denied)
Type of customer/stakeholder integration	Closed questions F&F to confirm need	Closed questions F&F to confirm need	Requirements from customers. Friends & family	Interviews with users, stakeholders & experts (+ survey with 100 replies). F&F	SUF, F&F
Changed problem statement based on insights?	No	No	No	No	No
Changed solution based on insights? (Why/why not?)	No: first did not want to risk patentability, now worried the patent will not cover if too many changes are made. Considers involving industrial designers for good-looking product)	No: first did not want to risk patentability, now worried the patent will not cover if too many changes are made. Considers involving industrial designers for good-looking product)	No, customers are useless as they lack technical knowledge. Patentability at risk.	Yes	Consider a completely different solution based on input from other inventor, but no change in the initial idea.
Considered multiple solutions?	No, current solution very similar to the initial solution. Ignored existing similarsolution.	No, current solution very similar to the initial solution	Trying different solutions to successively improve solution	Yes, in particular in choice of technology.	Considering
Approach	Sketch, build and make professional prototype	Built first verion for herself. Made more prototypes, tested.	Design specifications, build, test, iteratively		Sketch. Have built many prototypes. Tests but not with users.
Professional prototype?	Planning	Planning	Planning (but expensive)	No	Planning (but expensive)
Lean start-up					
MVP?	No	No	No	No	No
Tested business model	No	No	No	No	No
Soled items	0	0	0	0	0

Inventor	F	G	H	I	J
Overview					
Radical?	No	No	No	No	No
Type	Consumer product, Kayak-industry	Application	B2B: Packaging industry	Not specified	Sports equipment
Patent status	Approved	No, first to market strategy (secret)	No, but approved design protection application	Planning	Submitted
Patent incitement	Keep competitors away. No strategy*.	Not: expensive. Instead first to market strategy & trademark. Compares to other apps which she believes does not have patents.	Design protection to have something to sell. Keep competitors away. No strategy*	To have something to sell.	Encouraged to do so by support (SUF & Almi). To keep competitors away
Plan to licensee?	No	No, partner	Yes	Yes	Maybe
Entrepreneurial ambitions	Yes, but seeks a partner	Yes, but lacks development skills	No	No	Yes
FFE					
Market/ technology opportunity realized?	No	Market opportunity but vaguely specified	No	No	No
Customer segment	Partly specified	Many segments	Partly specified	Not considered	Partly specified
Estimated market size?	No	No	No	No	Yes, through external help
Cost/revenue analysis?	No, but estimates lower costs than current solutions	No, but plans to copy business model from similar solutions to other problem	No	No	Yes, gross margin is calculated
Ideation phase?	No	No	No	No	No
Stage-gate					
Sketched?	Yes (also CAD-drawings)	Yes	Yes	Yes	Yes
Prototypes?	Yes	No, started develop instantly. Could have used invisionapp etc.	Yes	Yes	Yes
Build with hands?	Yes	No	Yes	Yes	Yes
Confirmed need?	No	Talked to many potential customers but without plan	For one side (double sided business model)	No	No
Formal gates/assessment?	No	No	No	No	No
Design Thinking					
Trigger point	Self-experienced	Self-experienced	Self-experienced	Self-experienced	Observed problem
Starting point	Idea of a solution while experiencing the problem	Idea of a solution while testing similiar solutions to other problems	Idea of a solution while experiencing the problem	Idea of a solution while realizing the problem	Idea of a solution while realizing the problem
Customer/stakeholder involvement? (number)	2	25	20	0	4
When in process?	After patent application submitted	From the initial idea	After design protection application submitted		After patent application was submitted
Type of customer/stakeholder integration	Closed questions F&F to confirm need	Questions F&F to confirm need and get suggestions for development	F&F. To sell. De handikappades riksförbund to confirm need.	Closed questions F&F	Closed questions F&F
Changed problem statement based on insights?	No	No	No	No	No
Changed solution based on insights? (Why/why not?)	No	Yes (added features)	No	No	No
				No, current	