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The individual inventor as a driver of social and sustainable innovations in Sweden: Understanding their motivations, the invention process, and why patents matter less.

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Abstract

Individual inventors have played an important role in shaping modern economic growth with their inventions. However, the upsurge in corporate and institutionalised research and development (R&D) has overshadowed the individual inventor in both academia and policy research. In Sweden, the individual inventor continues to provide socially and environmentally beneficial innovations that solve problems faced by themselves and other members of their communities. Globally, patent applications by individual inventors have dwindled leading researchers to question the role and importance of the individual inventor. On the contrary, individual inventors are choosing not to patent their ideas due to frequent patent infringements they witness from large firms. This study researches the motives of the individual inventor to invent and why that is motivating them not to either patent their inventions or how patents matter less to them. Using a case-study approach, within-case and across-case analyses are done to explore commonalities and differences with individual inventors. Eight (8) individual inventors were selected for interviews in addition to answering questions via online interview forms. The study found that both inventors with patents and without patents were motivated by their desire to contribute to society and to promote a cleaner environment. Patents mattered less to the individual inventor but rather trade secrets, brands and partnerships with existing firms were more important to the individual inventor in developing their inventions for end users. Also, product development and market launch are critical to promoting individual inventors.

Keywords: Social innovation, individual inventor, sustainable innovation, inventrapreneur, Sweden.

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Chapter One - The individual inventor and innovator

1.1 Introduction

Throughout innovation history, the invention of new technologies that drive technical and economic change in modern societies comes about through different actors and processes. The process of technical changes as espoused by Schumpeter involves firstly invention followed by innovation and finally the diffusion of the technology (Antonelli, 2009; Arthur, 2007). While the economics of innovation is widely studied, the economics invention and the inventor have received little attention (Arthur, 2007). The invention of new technologies and ideas originate from individuals, startups, small and large firms as well as institutions such as universities and research councils (Graham et al., 2009; Heller & Eisenberg, 1998; Veer & Jell, 2012). In addition, Heller & Eisenberg (1998) observed that the invention process can be viewed as an upstream and downstream activity. Upstream is when large firms and institutions such as biomedical, pharmaceutical firms and Universities invest in research and development with the view to patenting their inventions. At the downstream, other firms whose aim is to innovate utilise the inventions from the upstream research to build products. In the process, downstream activities can also lead to further inventions.

The dynamics of the actors and processes involved in the invention process is important in understanding how each invention can contribute to an innovative society. While some inventions are “accidental”, that is where a researcher or institution makes a discovery as part of their daily work, others are planned due to a need for a solution or as a complement to existing innovations (Arthur, 2007). The current search for a cancer cure is an example of a need where biomedical and pharmaceutical companies invest resources into a search for an invention.

Whether an invention is accidental or planned as part of an organisational goal, the motives for doing so varies from one inventor to the other. Inventors need to be incentivised to allocate resources in the search process. Governments in countries and regions such as the USA and EU have elected to institute various intellectual property rights (IPR) as a way of helping inventors reap the rewards of their work or gain the necessary recognition for their inventions. The major form of IPR that is used in the innovation field to protect an inventor’s invention is through the issuance of patent rights (Chu & Pan, 2013; Granstrand, 2006; Heller & Eisenberg, 1998; Moser,

2013; Veer & Jell, 2012). The pro-patent era which started from the U.S. and diffused to Europe and Japan (Granstrand, 2006) brought about the establishment of patent laws and patent offices to help inventors protect their inventions for a period of time.

Inventors patent their inventions for various reasons although chief among them is the desire to prevent imitations of their ideas (Blind et al., 2006; Graham et al., 2009; Rassenfosse & Guellec, 2009; Veer & Jell, 2012). They prevent imitation by blocking other firms and researchers from commercialising or using their patents illegally. The research regarding the motives for patent filing appears varied but interrelated. In a study of high technology firms in the U.S, Graham et al. (2009) report that startups use patents as a signal to investors since it communicates the potential of the business. For others, patents are a way of blocking others from competing in the same space to enable the company recoups its investments before patents expire. Both studies done by Blind et al. (2006) and Graham et al. (2009) found industry difference in the likelihood of an inventor to patent his/her invention. While Pharmaceutical, biomedical and biotechnology firms considered patents as a strategic instrument for growth, IT companies were less likely to patent (Graham et al., 2009). Also, the motivations for patents across pro-patent firms differ when a nuanced analysis is done.

A dimension which is key to this study is the motives of individual inventors to invent. Though they form the minority of the innovation groups, they have the potential to create micro-level startups that will solve social and sustainability problems. According to the OECD (2011) social and sustainable innovations should lead to improvement of the quality of life of individuals and communities which are not addressed by economic innovations. Therefore, the individual inventor's invention can relate to social and sustainable innovation. This connection between the individual inventor as a provider of social and sustainable innovations is not given much attention in both theoretical research and in public policy practice. Udell (1990), probably one of the older research works on individual inventors, expressed this worry when he intimated that the innovation environment for independent inventors was at best very inconsistent even though he acknowledged there were a few programs at the federal and state level to support their development. Recently, Veer & Jell (2012) acknowledged the persistence of the neglect of the independent inventor when they observed that only a few theoretical studies exist on the motives

of individual inventors for filing patents and so adopted an explorative approach in studying the linkages between individual inventors and patent motives.

While most firms and research institutions focus on economic innovations focused on high-profit rewarding sectors, (OECD, 2011), individual inventors provide solutions that meet basic societal needs aimed at social welfare and environmental sustainability. This is due to the fact that, as alluded to earlier, most of their inventions originate out of daily challenges they face just as other members of society. Also, the individual inventor invests fewer resources into the invention process. Therefore, some individual inventors choose not to patent their inventions (Graham et al., 2009) but move to develop their inventions for the benefit of themselves and their communities. Not all inventrapreneurs have the turpitude to fully develop their ideas for use by their communities. For those who do, Udell (1990) coined the term *inventrapreneurs* to refer to these individual inventors who,

“through their own efforts or jointly with others, attempt to turn their inventions into innovations by forming an enterprise for the purpose of research and development and/or commercialization of technology”(Udell, 1990, p.232).

In contemporary times, there is a focus on social innovations and the decisions, motives and behaviour of the inventrapreneur are crucial to solving global challenges as outlined in the UN Sustainable Development Goals. One of the factors that have been argued to hinder the spread of knowledge for downstream sector innovations for poor and vulnerable communities is the filing of blocking and protective patents (Heller & Eisenberg, 1998). Patent filing process is costly and not all inventors can afford; more so for the inventrapreneur. For instance, Graham et al. (2009) found that individual inventors and startups in the US cited the high cost of filing and maintaining patents as a top reason why they failed to patent. A growing constellation of inventrapreneurs who choose not to patent is promoting open innovation and knowledge sharing. Those who do not patent are hereby referred to as *free inventrapreneurs*. The activities of free inventrapreneurs reduce the cost of products and makes knowledge available for other inventors whose focus is producing social innovation for sustainable development. Patents have been argued to restrict access to new knowledge for further innovation (Heller & Eisenberg, 1998). This increases the cost of innovation as only few firms control pieces of inventions that others could use to pioneer inventions that will solve global challenges facing society. Suffice to say,

inventrapreneurs even though a smaller group, can prove significant in providing low-cost social innovations that respond to the SDGs in a way that commercial product and process innovations fail to. The processes and motives for the invention, innovation and distribution of innovations by the inventrapreneur are less complex as compared to large firms with structured research and development (R&D) departments.

1.2 Research Problem

Independent inventors like Thomas Edison played a key role in driving modern economic growth. The institutions of innovations supported their activities and growth during the period leading to the early 1900s. By 1910, independent inventors accounted for majority (86%) of patents granted in the United States (Dahlin, Taylor & Fichman, 2004). Since the advent of commercial R&D by large firms and universities, patents granted to individual inventors has dropped significantly since to 15% by 1998 (Dahlin, Taylor & Fichman, 2004) . The declining role of the individual inventor in patent records has led policymakers to question the role of the individual inventor in modern-day economic growth. The use of quantitative patent data in determining how the individual inventor fits into innovation for society ignores the changing dynamics and behaviour of individual inventors over these periods. The growth of upstream commercial R&D has crowded the patent space and the individual inventor has to go through costly and complex patent verification process to avoid legal battles with big companies. Also, individual inventors are vulnerable and cannot fight back when big companies infringe on their patents. Therefore, the change in economics and powerful control of the patent and invention sphere has pushed the individual inventor out of the attention of academia and policymakers.

Individual inventors are still inventing and records with inventor associations present evidence of this (for instance in Sweden). Even though they are inventing, some are choosing not to file for patents. Their motivations to invent and also, not to patent their inventions have not been studied. There are some individual inventors who still patent their inventions and again, not in-depth studies have been done to understand their motives for doing so. This is important to underscore the contributions of the individual inventor in ways that are oblivious to academia and policymakers. The reason for the dwindling patent granted to individual inventors in recent years has not been thoroughly studied. There may be reasons for their less dominant role in patent data but not a reduction in their role in driving innovation. Understanding this is crucial to harnessing

their activities for solving global social and environmental sustainability challenges facing the poor and vulnerable.

1.3 Research Purpose

The purpose of this research is to understand the motivations of individual inventrapreneur to invent and why they choose to either patent or not patent their invention as a form of IPR protection. Understanding how individual inventrapreneurs move from the conception of the idea, through product development and finally selling the product to end customers will help in providing the resources and networks for their success. From the literature, patents serve as a signal to investors for small firms and individuals but the non-patent holding inventrapreneur who chooses not to patent has to compete and seek funding to scale their businesses.

The research hopes to add the literature on the motives for the individual inventrapreneur, not to patent or patent and provide inputs to inform public policy on how to grow this group of inventors to tackle social and sustainable challenges facing society. Though a small group (Udell, 1990), inventrapreneurs can create a knowledge pool where they allow shared and collaborative usage of their inventions. By understanding the motivation of the inventrapreneurs and the approach to commercialising their inventions will help in understanding the social support needs of the inventrapreneur. Apart from contributing to a nuanced analysis of the individual inventor as a drive social and sustainable innovations, this study will help innovation managers and public policymakers realign support systems to address the needs of individual inventors. This will help in democratising scientific knowledge (Göransson, 2017) for solving micro level societal and sustainability problems.

In Addition, this study focuses on the activities of individual inventrapreneurs in Sweden where social and sustainable issues are a priority for governments and the private sector. The findings of this research will serve as an example for developing and emerging economies where strict IPR laws are not well developed to create the social support milieu that drives individual to invent and provides solutions for social welfare.

1.4 Research Approach: A summary

To achieve the research purpose, the research is approached in two folds. First, a systematic review of the literature was conducted to delineate the conceptual framework and identification of themes and categories based on which data collection and analysis was centred. This process involved a search for articles pertaining to individual/independent inventor, social and sustainable innovations. The search was conducted on academic databases like Web of Science, Scopus and Google Scholar and the top-ranked articles and books were selected. However, the author had the discretion to select relevant articles and reports that were referenced in some other journals. During the review process, a series of research gaps were identified. Research gaps according to Robinson, Saldanha & Mckoy (2011), are topics or areas for which missing or insufficient information limits the ability to reach a conclusion. Using the case studies, this study will contribute to the literature on the individual inventpreneur as playing a critical role in driving social and sustainable innovations in Sweden. This formed the bases on which inductions are made.

The second part involved the design and presentation of research results aimed at filling the gaps. A case-study approach was adopted affording an opportunity to carry out an in-depth analysis. Selected individuals were purposefully selected based on which the research was conducted. All selected inventions focused on social and sustainability dimension and were contacted using the network of the Swedish Inventor Association (SUF) except one case. Within-case discussions, as well as across-case analysis, were carried out with the aim of identifying commonalities as well as differences in the cases. Most academic works on the individual inventors and their activities tended to focus on quantitative analysis or a combination of both quantitative and qualitative approaches. Quantitative approaches (see Chu & Pan, 2013; Moser, 2013; Veer & Jell, 2012) collect data from patent offices to either determine the motive of invention patents or analyse the impacts of various patent on innovation and development. Apart from the primary data collected from the case studies, secondary data was collected from newspaper publications on each invention using the Mediearkivet search database. This was to help on triangulation of the results from the case studies and provides alternatives views regarding each invention.

1.5 Structure of Thesis

This thesis is divided into 6 chapters. Chapter 1 covers the introduction to the thesis and purpose of the thesis. Chapter 2 provides an overview and discussion of literature related to the individual inventor and their motives to invent and also, choosing to patent or not. Further, the literature on how the individual inventrapreneur can be a medium for growing social and sustainable innovations is discussed. Chapter 3 provides a detailed analysis of the research methodology and why it was employed. Chapter 4 presents the empirical data from study highlighting important observations. In chapter 5, the obtained results are discussed and various implications are highlighted. Finally, in chapter 6, the conclusion is done aiming at a possible framework for the individual inventrapreneur in the growth of social and sustainable innovations. Some recommendations for future studies will also be made in this final chapter.

Chapter Two – Literature Review

2.1 Introduction

This chapter reviews relevant literature on the individual inventors and their motives for inventing and commercialising their inventions. The conceptual framework on social utility and how IPR like patents may restrict this is explored in the literature. While large firms file for patents for varied reasons, the individual inventor is paying less attention to patents as part strategies to commercialise their inventions. The motives to patent or not, and how individual inventors use patents as part of their inventions is explored. The study contributes to the emerging literature on the inventrapreneur by providing evidence from the Case-studies to fill the research gaps on the motives of the individual inventrapreneur to either patent or choose not to. These gaps were identified based on the literature review and these were used as a basis to carry out the research design and analysis, presentation and discussion sections.

2.2 Conceptual Framework on Social Utility

Social and sustainable innovations research and policy have gained attention in the past two decades with a call on both the private and public sectors to provide solutions that address global issues such as inequality, climate change and ageing populations. According to the Organisation for Economic Co-operation and Development (OECD), “social innovation ... is about satisfying new needs not provided by the market ...” (OECD, 2011, p.21) and the new needs referred to could be a service or product. It is not only new needs but unmet needs that are not provided for due to market failures (Cetindamar & Beyhan, 2017; Phills, Deiglmeier & Miller, 2008). Competitive market systems will allocate resources to inventions that will yield a higher profit return or maintain the firm’s competitive position. To recoup investments, firms patent their inventions as a means of blocking imitation by other companies (Veer & Jell, 2012). This increases the cost of innovations and locks the power to produce essential technologies in the hands of a few firms (Heller & Eisenberg, 1998; Horner, 2014; Moser, 2013). The motive of social innovation is to produce products and services that are affordable, with the social good as the main objective (Mulgan et al., 2008; Phills, Deiglmeier & Miller, 2008). Therefore, the unattractive nature (low cost, social focus with low-profit margins) of social innovations makes

them receive less attention from corporate R&D firms because of the low-profit margins associated with them.

Social innovation theory maximises the social utility of problems and ideally feeds into the act-utilitarianism theory. Act-utilitarianism holds that an individual's act is morally right if, and only if, it produces at least as much utility as an alternative action when the utility of all is counted equally (Moore, 2003). Explaining further, if granting limited rights to an individual to the use of knowledge or property will result in greater social utility, then it is justified. However, patents rights have been known to lead to exclusive rights and gains which harm the greater social utility to be derived from the act of granting patents. The singular act of granting patents benefits the private firm than it does to society.

The privatisation of research at both the upstream and downstream sectors is a major contributor to the neglect or lack of inventions thereof, for societal problems that the market system ignores (Heller & Eisenberg, 1998). Continuing with this thought, Moser (2013) and Statman & Tyebjee (1981) argue that the monopoly resulting from patents leads to higher prices because it diminishes competition in the market. On the flip side, there are some schools of thought that view patent protection as ideal since such protections will encourage inventors to launch many newer inventions for the benefit of society (Statman & Tyebjee, 1981). Patents do not democratise knowledge. They rather create the tragedy of the anticommons (Heller & Eisenberg, 1998) where a few people hold rights to the knowledge that could be used widely at both the downstream and upstream sectors for many other inventions that have wider societal benefits.

Individual inventors who invent outside the corporate settings spend fewer resources in their invention process and, some actually accidentally discover their inventions (Udell, 1990). Also, they are not bound by licence agreements and contracts that they have to sign with the institutions for the commercialisation of their inventions. Individual inventors are likely inventing out of personal problems that they face and hobbies they enjoy (Udell, 1990) and their inventions apply to the lives of other members of their communities.

First, while some of the individual inventrapreneurs choose to patent their inventions others do not. The individual inventrapreneurs apart from motivations for social and sustainability reasons are likely to produce at a cheaper cost and meet the unmet needs of society (Åstebro, 1998).

More importantly, the non-patent holding inventrapreneur who decides not to patent his/her inventions is likely to produce social solutions that impact the lives of other members of their communities. The free inventrapreneur promotes act-based utilitarianism since other firms are not stopped from further using their inventions to produce (Heller & Eisenberg, 1998). The free inventor whose idea is out in the market does not have a monopoly over the production of similar products but rather leads to competitions which give the consumer greater social utility through a wide variety of innovations to choose from.

2.3 The inventrapreneur: detailed overview

The sources of inventions originate from different sources. Inventing new ideas could be out of an individual's or team creativity and, it could also be out of a systematic process of institutional research. The individual inventor's invention arises out of their creative process at their work, home and as they go about their daily activities (Singh & Fleming, 2010; Udell, 1990). In legal terms, an inventor, whether individual or corporate, must be cited in the patent registration documents either as the inventor or co-inventor. This gives the inventor the IPR to the sole use of that invention (Valerio & Deal, 2005). The use of patent citations to determine who is an inventor is a narrow view of ascertaining who an inventor is. This is because not all inventors file for patents. The definitions of the individual inventor should go beyond the group inventors that are able to file patents. Singh & Fleming (2010) used the term "lone inventor" to refer to a situation where the inventor "...is socially isolated and either does not work with co-inventors in a team, does not work for an organization, or both". The keywords here are "socially isolated" which means that the inventor has no interactions with society but focuses on working on their inventions from their garages. The "lone inventor" perspective of an individual inventor limits the propensity to have such a person as an innovator as well. It was therefore not surprising that Singh & Fleming (2010) concluded in their research findings that the "lone inventor" was less likely to contribute meaningfully to society through their inventions.

In this research, the conception of an individual inventor is not a socially isolated person whose invention process is not an interactive one with the real world. Also, it departs from the legal perspective where an inventor is one who has to be listed in a patent filing. Rather, the individual inventor is one who invents based on creativity resulting from their experiences from work, problems they face in their daily lives and uses their immediate environment as the test lab for

their ideas. As old as his definition is, Udell (1990) offers a broad and open definition of the individual inventor as below:

“An independent inventor is an individual who singly or cooperatively invents on his or her own behalf, rather than directly for a corporation institution or government agency”
(Udell, 1990, p.231).

Such individuals may choose to file for a patent or not and, are not socially isolated in their invention process. Based on the literature, I came up with a framework for analysing the individual inventor and how they are likely to be motivated in the application of their inventions for the benefit of society. Udell (1990) for instance categorised the individual inventor into *pure inventors and inventrapreneurs*. According to him, pure inventors have little interest and ability to organise resources for the commercialisation of their inventions. They, therefore, sell their inventions to companies for a fee. Pure inventors are likely to file for patents as a way of selling off their patents to recoup their reward. The inventrapreneur on the other hand, through their own efforts or in partnership with others, commercialise their inventions. The inventrapreneur may decide to either patent or not patent their inventions. Those inventrapreneurs who patent their ideas protect their inventions from imitation have various motives for doing so. They spend resources to protect their patents to make sure there are no infringements. On the contrary, the free inventrapreneurs choose not to patent their ideas but move to commercialise them in the market. They rather prefer to use alternative strategies such as trade secrets and business execution and brand building to beat the market competition (Graham et al., 2009). The number of individual inventrapreneurs who are patenting their inventions are said to be declining (Lettl, Rost & Von Wartburg, 2009) and the literature does not explore further why the decline and what other options inventrapreneurs are adopting for grow their innovations. The only research that seems to point to that direction, which this study seeks to complement is the works of Graham et al. (2009). This study builds on the works of Graham et al. by exploring why individuals invent and the processes they go through. The study will provide knowledge to academia on why the individual inventrapreneurs will prefer other options other than patents to remain competitive and grow their innovations for social good. Where there are patents, the motivations for patents are different from what pertains to corporate and institutionalised inventions.

The *free inventrapreneur* avoids the cost of filing and protecting patents to reduce the startup cost. The free inventrapreneur who chooses not to patent may face challenges in terms of resources to commercialise as compared to their counterparts who patent due to lack of startup capital (see Blind et al., 2006; Mian, 1996; Rassenfosse & Guellec, 2009; Veer & Jell, 2012). One can argue, therefore, that social innovation policies that support the free individual inventrapreneur to commercialise can best promote and encourage many would-be inventors to come forward with their inventions. Such a programme could have an objective of supporting social inventions put forward by free inventrapreneurs. Such their inventions pooled together to serve as a knowledge base for other inventors and promote open innovation and greater social utility (see Heller & Eisenberg, 1998). However, there is a gap in the literature on what motivates the inventrapreneur to either patent or not and how that and how that drives or stifles social innovation and utility.

The significance of the individual and independent inventor in pioneering breakthrough innovations have been highlighted by Udell (1990) in his research. He recounts the stories of the founders Nike Corporation, Apple Computer and Hewlett-Packard. All these inventors filed for patents to protect some important components of their inventions. The literature, as well as public policy, however, does not elucidate on how the social ecosystem can be developed to use the free individual inventrapreneur to drive incremental as well as radical social and sustainable innovations. The motivations not to patent reduce the burden of recovering the cost of patent filing and protecting it. Little is discussed on the *free inventrapreneur* and their roles in the invention and innovation literature.

2.4 Patents vis-à-vis the tragedy of the Anticommons

Intellectual proper rights (IPRs) remain one of the motivating drivers of innovation activities in modern economies. Intellectual property rights are the legal forms of protection of knowledge, good and services resulting from the work of an entrepreneur, firms and researchers. Moore (2003) defined IPR "... as non-physical property that is the product of cognitive processes and whose value is based upon some idea or collection of ideas". Broadly IPRs cover a host of measures such as patents, copyrights, trademarks (Maskus, 2014; Williams, 2010) that inventors

employ to protect their inventions, products and services from use by others. They grant ownership to the sole use of the intangible assets for the production of innovative physical products. The literature on IPR and innovation use patents as a proxy for IPR especially when it has to do with inventions resulting from R&D (Chu & Pan, 2013; Heller & Eisenberg, 1998; Lerner, 2009; Moser, 2013). Thus, patents remain a critical indicator for measuring innovation at both the firm and national levels. It is argued that intellectual property rights serve as a reward system to researchers, firms, investors, as well as public and private universities to invest resources into inventing new ideas. Intellectual property rights, such as patents and copyrights, aim to incentivize innovation by allowing firms to capture a higher share of the social and economic returns to their research investments (Williams, 2010).

The debate about patents and intellectual property rights, in general, is an old age one in literature and there have been varying schools of thought about the impact of IPR on innovation. There are those who argue that it drives innovation by helping firms reap the rewards from their investments through blocking and protection (Blind et al., 2006; Heller & Eisenberg, 1998; Moser, 2013). This creates a positive cycle of innovation and private individuals, firms and universities who have clinched on to this school of thought invest resources to facilitate patent filing. Large firms and universities allocate R&D resources to patents which help staff and the institutions, in general, to file for patents, monitor patent infringements, negotiate licence agreements and legally sue where there are violations of patents (Graham et al., 2009).

Heller & Eisenberg (1998) believe that the fragmented nature of patents increases the cost of transactions for firms and individual inventors at the lower tier of innovation. It also leads to the underutilisation of knowledge as a few upstream firms (large firms) keep patented ideas while many other firms at the downstream could use such knowledge in different sectors for solving some of the most pressing societal problems. Blocking the use of inventions through patents means that other inventors need to invest substantial resources into developing unique products and services that will not infringe on existing patents (Chu & Pan, 2013).

Another dimension of the invention *cum* patent literature is whether patents really are important, especially for the individual inventpreneur. I refer to the study conducted by Graham et al. (2009) which found that startup founders are choosing not to patent their ideas citing reasons such as the cost of filing patents, unwillingness to disclose information, choosing to use trade

secrets and the cost of enforcing patents as barriers. There is growing stream of literature that casts doubts on the role of patents in driving innovation thereby challenging the traditional view of patents as a driver of innovation (Heller & Eisenberg, 1998; Moore, 2005; Moser, 2013; Smith, 2009; Veer & Jell, 2012). Public policy advocates and civil society organisations are concerned about how protectionist IPR like patents could restrict access to knowledge and technologies for solving global issues such as climate change, food insecurity, biodiversity loss, and access to essential medicines (Heller & Eisenberg, 1998; Maskus, 2014).

Irrespective of the contrary viewpoints to the effects of IPR on innovation, the filing of patents remains important to individual entrepreneurs, small firms, and large research organisations such as universities. Patents may have an economic benefit to a few while resulting in a higher social cost, especially for lower-income groups. Moser (2013) argues that the overall effects of stronger patents on innovation are difficult to predict. Where patents are fragmented, it results in negative externalities because future inventors hold back for fear of costly litigations due to patent infringements (Graham et al., 2009; Heller & Eisenberg, 1998; Moser, 2013).

2.5 Motivations for patents for inventors

Inventors have varying philosophical motivations for filing patents. In a separate survey of firms by Graham et al. (2009) and Veer & Jell (2012), they present ample reasons from their studies regarding why an individual inventor, startup and large companies may choose to patent or not. Individual inventors and early-stage startup may face resource constraints to commercialise their ideas. Besides securing investment, patents are filed to prevent others from copying their inventions (Graham et al., 2009) and also to generate licence income (Veer & Jell, 2012). For large firms, there are varied reasons for filing patents and the motives change depending on the industry. Blind et al. (2006) found that in Germany the rubber and plastic, biotechnology and chemical engineering industries view patents a strategic tool for protection or blocking others from competing. In the U.S.A, Graham et al. (2009) found that software companies were less likely to patent as compared to their counterparts in the biotech and medical devices industry. Graham et al.'s research further revealed that startups refuse to patent because they do not want to reveal secret information in patents declaration.

The current body of literature is bare and little on the motivations of the individual inventor to file for patents on several of fronts. First, the motivation for individual inventors to choose to patent or not have been inadequately explored and is a grey area in literature. To the best of my knowledge, Graham et al. (2009) and Veer & Jell (2012) remain two of the major academic works on individual inventors why they choose to file for patents or not. Veer & Jell (2012) briefly explored the subject of the individual inventor and their motivations for a patent while Graham et al. (2009) did so using early-stage startups with a focus on the CEO or CEO.

It has emerged that the cost of filing and maintaining patents have led many inventrapreneurs to choose not to patent but use other IPR strategies like trade secrets, niche markets and networks (Graham et al., 2009). The group of inventrapreneurs who choose not to patent are the free inventrapreneurs just as was explained above. More so, individual inventors are considering the social and environmental factors as the key motivations for their invention. This is a focus area for this thesis to contribute to individual inventor's decision not to patent their invention and why this may be motivated by the social impact of their inventions and contribution to an open innovation society.

The individual inventrapreneur uses cost-effective production process and shared resources through inventor associations and business incubators to commercialise their ideas (Udell, 1990). They, the individual inventrapreneur, can be a potential source of growing affordable product innovations that serve the needs of the less privileged in society. Social innovation policies support to encourage the growth of individual inventrapreneurs by providing them with resources that will encourage many inventors to transition to become innovators in the market will form part of the recommendation of this study.

2.6 Actor-network support for the inventrapreneur

The individual inventrapreneur usually lacks the complementary set of resources needed to commercialise their inventions and yet they are the least supported (Udell, 1990). The literature mainly focuses on the financial resource constraints facing the individual inventrapreneur. However, they need a well-developed support system beyond financial resources to respond to their needs. A supportive network of actors if not well-developed, would stifle efforts by the

individual inventrapreneur to contribute meaningfully to social and economic welfare. In a survey of independent inventors at the Canadian Innovation Centre in Ontario, Åstebro (2003) found out that individual inventors have a 7% chance of commercialisation. This emphasises the need to actively support their innovation activities in the market. In the table below, the various resource requirements of the inventrapreneurs when provided could ease the process of the innovation are highlighted and used as focal points for future discussion.

Table 1: Actor-network support for the inventrapreneur

Action	Description	Actors	Examples of Actors
Vetting of inventions	Vet inventions and evaluate idea to determine commercial quality	- Inventor associations, - innovation centres - business promotion services	- Swedish Inventors Association - Canadian Innovation Centre
Legal support	Support inventors to protect their intellectual property rights under the patent and trademark laws of individual countries.	Patent Attorneys and Agents	- LegalCorps
Product development support	Individuals and firms that provide a variety of technical services, including research and development, technical evaluation, prototype development, product design and product testing	- Prototyping companies - Construction firms	Persevere Engineering Solutions (PES)
Business development	Marketing consultants and research firms help in business development.	- Marketing and promotional groups - Business development companies - My Innovation Advisor Service	Impact Innovation Group
Government support	Government services to help inventrapreneurs	Non-Nuclear Energy Act of 1974	- Energy-Related Inventions Program in the USA in 1974
Inventor groups and associations	Social organizations for inventors, a growing number are providing meaningful assistance to inventors through educational seminars, referral services and one-on-one consulting.	National country inventor associations across the globe	- Swedish Inventors Association - Inventors Association of Australia - Canadian Centre of Innovation

Sources: IFIA (2018) and Udell (1990)

From the actors, it appears that legal services, product and engineering support, business development and activities of inventor associations remain key to the growth of inventrapreneurs (Udell, 1990). For the free inventor, *inventor associations* provide most of these services to help them move from invention evaluation through prototyping and finally to commercialisation of their inventions. Besides that, inventor associations provide inventrapreneurs with social networks, patent attorneys and marketers that promote the innovations of inventrapreneurs. Such networks can be fragmented and provide no guide to how it can be organised to benefit the individual inventrapreneur. This study seeks to add to the literature on the social support network that will promote the growth of inventrapreneurs, especially the free inventrapreneurs.

2.7 The free inventor and social and sustainable innovations

The free inventrapreneur's decision not to patent their ideas means they may lack the signals that will help them attract investors, gain customers and attract industry partners (Blind et al., 2006; Veer & Jell, 2012). Navigating through the journey from the invention to commercialisation will require a supportive innovation system provided by governments or other inventor social groups. Any form of government support of the free inventrapreneur is a form of signal to investors (Islam, Fremeth & Marcus, 2018) as it proves the existence of the market potential for the invention. Services offered by inventor associations are highly subsidized and provide a complete package comprising: legal services, marketing, engineering and production and market entry (Åstebro, 2003).

There is an emerging group of inventrapreneurs who are commercialising their inventions in social and sustainable innovations. These individual inventors are impacting lives using their inventions in areas of green technology, healthcare and disability. Despite their localised impact, studies on individual inventors only focus on how to offer legal protection and profiling individual inventors to determine their importance (Udell, 1990). The work by Veer & Jell (2012) explored why individual inventors patent but their study did not cover motivations of inventrapreneurs to invent and also, why they choose to either patent or not. Helping the free inventrapreneur commercialise his/her invention is an area that this thesis seeks to contribute to the debate. Also, there is the potential of inventrapreneurs to create social innovations for a

smaller target group that may remain unattractive to the upstream inventors (Åstebro, 1998). Yet, there are not enough studies to the best of my knowledge that explore alternatives IPR arrangements that will grow this minority group of inventors. The current body of literature has not explored into details the kind of socio-economic milieu that will support the emergence of individual inventrapreneurs as an alternative to driving social and sustainable innovations.

Creating a patent-free invention pool, similar to patent pools as espoused by Lévêque & Ménière (2011) where free inventrapreneurs can co-create using knowledge from other inventors can further generate social and sustainable innovation.

2.8 Conclusion

The literature on individual inventor has mainly focused on the profiling and discussing the activities of the inventor in the commercialisation of inventions. Using patent data, researchers point to the dwindling number of patent filings by the individual inventor as an indication of their diminishing roles as agents of innovation. However, other views point to the fact that the individual inventor is placing less importance on the role of patents in their innovation activities. The cost of patents, patent infringements and the worthlessness of patents are factors that drive individual inventors to choose not to patent. Of equal importance is the emerging importance that individual inventrapreneurs place on social and sustainability issues. To promote the social utility of their inventions, inventors choose not to patent. Patent-holding inventrapreneurs use their patents in a different way other than as a form of protection and blocking others.

Chapter Three - Research context and methodology

3.1 Introduction

In this section, the research context and approach is presented. The innovation milieu of Sweden and how it supports social and sustainable innovations is presented. The sample selection procedure of cases and why the qualitative approach to the survey was adopted is discussed together with the research design, interview guides and data coding. Here, the characteristic of the inventors and how they either fit or not into the research is covered as well.

3.1 Social and Sustainability Milieu in Sweden

Promoting the activities of the individual inventor has been part of the evolution of the innovation and growth in Sweden. In 1886, the Swedish Inventors Association (SUF) was formed to provide a community for inventors and small business owners to build networks and support one another (SUF, 2018). Broadly, the Association aims at promoting the innovation climate and, in particular, the individual's ability to contribute to the future renewal and prosperity of society. The goal of the organisation which it is to support individual inventors' to contribute to societal renewal makes it an appropriate population to select cases from. Apart from that, the Association has 30 local member associations spread across the country, with the national coordinating office in Stockholm. Local Associations, however, have their own management and financing structure which are independent of the National Office (see SUF, 2018).

Besides the activities of SUF, Sweden over the years has made significant strides in the adoption and usage of innovations that seek to meet the SDGs by 2030. For instance, VINNOVA, which is the Swedish Government's Innovation Agency, has funded several projects and research aimed at solving societal challenges and promoting environmentally friendly innovations. One of its recent programmes, the Challenge-Driven Innovation Programme seeks to deliver innovations that tackle societal problems in areas of healthcare, education and sustainable cities (VINNOVA, 2017). The 2017 Programme report is convinced that Sweden has the prerequisites necessary to be at the forefront when it comes to developing innovative solutions for societal challenges. Also important is the fact that, Sweden has received over 162,877 applications from asylum seekers in 2015. The Government is, therefore, funding projects that drive innovations

aimed at providing alternatives to commercial innovations. This will help to meet the needs of these vulnerable populations.

In terms of funding, network, communities and policy support, Sweden has a demonstrable atmosphere to accommodate the activities of the inventrapreneur in promoting social and sustainable growth.

3.2 Research Method

This research was carried out as an explorative qualitative research aimed at theory building. The research gaps that this thesis seeks to fill will be fulfilled using this method. Similar studies that sought to investigate the activities of individual inventors have used a mix of both qualitative and quantitative research methodologies (Blind et al., 2006; Veer & Jell, 2012).

To undertake this qualitative research, a case study research design methodology was adopted. This was done using selected inventrapreneurs who have either commercialised or are in the process of product development with their inventions. Case study methodology allows for the in-depth and detailed approach (see Flyvbjerg, 2006; Robert K. Yin, 2013) to studying a phenomenon. Since this thesis seeks an in-depth study of the motivations of the inventrapreneur and how they promote social and sustainable innovations, case study approach will lead to the gathering of relevant empirics for this purpose. In the paper of Blind et al. (2006) and Veer & Jell (2012), mixed method approach was used with emphasis on the quantitative data gathered from secondary sources. Quantitative studies use patent survey data from patent offices and follow up to conduct interviews with the inventors. This study used data from interviews conducted with the inventrapreneurs as part of the in-depth case study approach. Using the selected cases, a within-case and across-case approaches were adopted to identify unique, as well as common occurrences of responses from cases (Lioness, Kavanaugh & Knafl, 2003). Also, case studies approach is good for creating theoretical constructs, propositions, research gaps and theories from case-based empirical evidence (Eisenhardt & Graebner, 2007) that was used to carry out the analysis. Lastly, the case study approach allowed for contemporary analysis of the phenomenon in addition to any archival data used.

3.3 Research Design

The individual inventrapreneurs for the research were drawn mainly from the SUF (Svenska Uppfinnareföreningen) which was founded in 1886 and, is the oldest inventors association in the world. Its core principles are to promote the individual's ability to contribute to the future renewal and prosperity development in society. Cases were identified in conjunction with the SUF. I contacted Inyang Eyoma Bergenstråle from the SUF who agreed to help me reach their members after the thesis topic was discussed. After we both agreed on the thesis scope, I designed the research interview guide which we both reviewed. Once we agreed on the interview guides and questions, the members were emailed with a description of the thesis scope and those who were interested participated in the research. How the SUF was able to get its members to participate was not made known to the researcher. For instance, I had no access to the contact/members list and I do not know how many people were contacted resulting in the seven cases selected.

A combination of open-ended and semi-structured questionnaires was used either as guides during the interview or filled out as a Google form where an interview could not be arranged. All interviews were conducted in English since the interviewer has limited knowledge of the Swedish language. During interviews, the interviewer took notes and the conversations were recorded as well with prior permission of the interviewee. Where the respondents were not available for an interview, the questions were sent to them in a Google form which they answered. The questionnaires were designed in both Swedish and English to allow for the interviewee to make a choice. Interview responses in Swedish were translated into English using Google Translator. There were follow-up questions where the researcher needed to clarify some pointed from the answers given. This helped collect enough empirics for discussing the research gaps and contributing to areas for future research.

The possibility of a bias can arise from case studies of this nature due to the inventrapreneurs tendencies to give desirable social answers (Veer & Jell, 2012). To address this, the study used a secondary data retrieved from a media archiving platform relating to each case. This was meant to give alternate perspective on each case besides what the interviewee said during the

interviews. A media archiving tool called *Mediearkivet*, which is the largest media archive for the Nordics region was used for the search for secondary data on each case. The objective is to get secondary reports about each case where it exists to supplement what was gathered from the interviews with the inventrapreneurs. Media archive data reveals alternative views about the cases and offers historical perspectives as covered by the news. To identify relevant articles on each invention, I searched the names of the inventors using quotation marks (“”) to return results where the exact name of the inventor was mentioned. I also added the name of the invention to further filter the results. The results were retrieved and read to extract relevant comments and descriptions, motivations of the inventions, funding and the process the inventor went through before commercialisation. These articles ranged from interviews with the inventrapreneurs to articles written by journalists about the inventors and their inventions. Also, the secondary data on each case from the archives were in Swedish which translated into English for easy analysis.

3.4 Research Sample

The SUF, from where most Cases were drawn from, is made up of other professions like individual inventors, lawyers, government officials and university staff. However, the focus of this thesis was on the *individual inventrapreneur*. Anyone outside this scope was not interviewed. Also, both individual inventrapreneurs who have patents and those without patent were captured in the study since the objective is to understand how the individual inventrapreneur is able to innovation with or without any strong IP protection of their inventions.

To select cash studies for in-depth research, a theoretical sampling approach (Eisenhardt, 1989) was adopted. Theoretical sampling was used to help in purposefully selecting inventrapreneurs whose inventions help to replicate or extend the emerging phenomenon of the inventrapreneurs and their motives for the invention. Through the SUF, seven (7) inventrapreneurs were contacted while one inventrapreneur was contacted outside the group; meaning he is not a member of the SUF. The inventrapreneur who is not a member of the SUF was added as to the cases to provide alternative views and avoid group (SUF) bias. In all, eight (8) cases were captured as part of the part of the research and each of the cases was at various stages of their invention process. Six (6) of the cases were male while two (2) were female inventors. Even though gender representation

was not a criterion in this study, striking a balance would have presented balanced views from all genders. However, the few representations of women should not affect empirics and the results are a result. Focusing on social and sustainable inventions, the study also selected inventors across different sub-categories and sub-sectors. The secondary data obtained from archives returned several hits and the researcher reviewed each article to find which one was relevant to the study. The inventpreneurs selected for the study, stage of innovation and Mediarkivet archival data retrieved and analysed are presented in the table below.

Table 2: Selected Inventpreneurs for the case study

Inventpreneur	Invention	Gender	Stage of case	Mediarkivet hits	Website
Per Löfberg	Emerging cookstoves	Male	Used by end customer	6	http://emerging.se
Michael Rausman	P41 (Pee For One)	Male	Passed product developing	6	
Marie Paulson	Swing Ping Pong	Female	Used by end customer	12	http://www.ggsmile.com
Jan-Erik Nowacki	Watersack (Tjockslang)	Male	Trials done by NGO	2	
Per-Håkan Edqvist	PacNova	Male	Tested in the market with samples	2	https://www.pacnova.se/
Marit Sundin	AddSeat	Female	Used by end customer	9	http://www.addmovement.se/
Anonymous	Aqordo: Digital notpärm	Male	Samples tested in market	5	http://www.aqordo.nu/
Asko Päiviö	Dagvattenfilter	Male	Product development	1	None

Source: Author's Research, 2018

*Some inventors do not have websites but participated in the interviews.

3.5 Research Data, Analysis and Presentation

Data for the research was from two sources. The first source was from primary data gathered from personal interviews and surveys of eight (8) individual inventrapreneurs who are members of the Association except one. The data gathered provided information on the inventors and their inventions, their motivations for inventing and why they either decide to patent them or not. Information on the background of each inventor and processes they went through to commercialise their inventions was captured. The network of partners that helped them in the commercialisation of their inventions were also captured. Both primary case interviews and the archival data from *Mediearkivet* captured the same data points and only sought to complement each other. The coding process outlined in the next paragraph applies to both the primary and secondary data.

Data were analysed by coding responses into themes that were based on the research gaps and themes from the systematic review. The coding and analysis were based on the approach suggested by Burnard et al. (2008). The codes were developed using theoretical codes from the systematic review and empirical codes from the data collected. Each case was analysed and coded into the following thematic areas which are the contribution of this thesis. The data analysis framework is presented in Table 3 below.

Table 3: Coding themes and data points

Theme	Description	Areas for coding
Patents/free inventrapreneur	Is it patented or not and how is patent used	Yes- why the decision to file patents No- why the decision not to patent
Challenges to innovation	What challenges they faced in invention & commercialisation	Product development, funding, commercialization
Competition strategies	How do they compete in the markets?	Patents, brand protection, trade secrets, partnerships e.t.c
Motivation for invention	The motivation for the invention	To make money, to help my society, to solve personal problem e.t.c
Role of Networks	The role of personal and other networks played in the process	Personal as well as institutional networks, key partners and how partnerships worked
Motivation to patent or not	The motivation for either patenting or choosing not to	Cost of patents, protection, leverage and registering the invention

The invention-innovation process	The process of moving from invention to commercialisation focusing on the activities	Ideation process, funding, product development, business development
Invention and social+sustainable+SDG	Is the invention targeting or promoting social + sustainable innovation	Focuses on green and clean tech, for the vulnerable, elderly, disabled or the poor
Background	The profile of the inventor and invention	Profession, age, gender, hobbies of inventor and invention

Source: Author’s construct, 2018

The data was analysed using a within-case and across-case methodology as described by Eisenhardt (1989) and Eisenhardt & Graebner (2007). Within-case is basically a description and write-up of each case as gathered from the interviews and from media archives. The write-ups were done in a story form dependent on the data and there was no specific format. However, the within-case analysis covered the focus and thematic points outlined in Table 3 above. The narratives were done using basic tables and graphs. Unique occurrences within cases were identified and will be used for the across-case sections and, also in the final discussion of results.

The second analysis was to do a basic cross-tabulation of across-case analysis. Using the themes and codes identified above, the study looked for within-group similarities coupled with intergroup differences as suggested by Eisenhardt (1989). The symbol √ was used where a case corresponded to a code and blank space where it does not or is not applicable. The results are then discussed vis-à-vis the current literature to identify areas of similarities and divergence.

Chapter Four - Empirical Presentation

4.1 Introduction

This section covers the presentation of the results from cases analysed and are presented first as within-case and followed by across-case analysis. Each case study is presented separately in the within-case analysis. The narration is done by juxtaposing it with the literature when an interesting point is identified.

4.2 Within-Case Presentation

Each of the cases is described as a sub-section and follows a narrative format.

4.2.1 Case 1: P41 (Pee For One) by Michael Rausman and Birgitta Rausman

In the case study, Michael Rausman responded to participate and did not indicate anywhere in the interview that the idea was co-invented with his wife, Birgetta Rausman. However, from the search on Mediearkivet, it has been reported in the newspapers and Michael is quoted as saying he co-invented the idea with his wife. As the use of the secondary data was for triangulation purposes, this study includes the wife as a co-invented even though the responses were solely from Michael Rausman.

P41 revolutionizes the collection of women's urine samples for laboratory and clinical tests. Women have difficulty with collecting urine samples for laboratory tests at hospitals. According to Michael, they have to use a mug which is discomforting. Also, the P41 vessel simplifies the collection of samples from children and elderly because the soft disposable vessel can be put in a diaper. The inventors, Michael and Birgitta combined their individual skills to bring the invention to fruition. While Michael is a Creative Director of Advertising Agency, Birgitta is a Nurse who may have observed the problem patients faced and collaborated with Michael to design a solution. The invention is patented and published in the Swedish Patent Journal. Product prototypes have been developed and tested in a few hospitals. Even though the invention is not utilised at hospitals, about 2,000,000 urine samples are collected annually in Sweden presenting an opportunity for the inventors. He plans to tap into this market when he launches the product. The main motive for filing patents is to register the invention and not as a form of protection. For

him, the only way to protect his invention from intrusion is to have a large company as a supplier to help litigate in case of patent infringement.

Michael and Birgitta work on P41 on part-time bases, similar to what was observed from the research by (Whalley, 1992) where he found that most individual inventors were working on part-time base. This again highlights the role of previous work background of the inventrapreneur in the invention process. For Michael, he plans to license his patent to other suppliers in the world and this explains why filing for a patent was key to his innovation process. The P41 inventors are willing to share their invention with other inventors but with limitations, suggesting the use of licence agreements as a way he would like to share his invention. As a patent holder, a big challenge to P41 is patent infringement by a large firm because inventrapreneurs do not have the resources to fight a legal battle. To quote him,

“I cannot go to court because it costs too much money for an individual inventor to litigate against a large company”, says Michael Rausman, P41.

The process of the invention starts with having an idea and a design after which the inventrapreneur has to find *money and partners* for product development. The importance of networks and inventor associations for the individual inventrapreneur remains crucial. Even though P41 did not get much help from the SUF, being a member legitimizes their invention when they meet partners. For P41 to benefit, activities such as lectures, workshops and innovation day could be organised in different places in the country. This will increase the networking opportunities among the 30 local associations.

4.2.2 Case 2: Emerging Cookstoves by Per Löfberg

Emerging CookStove was invented by Per Lofberg and Mathias. While Mathias is based in Zambia, Per is based in Sweden and this case interview was conducted with Per Lofberg. No contact was made with Mathias. Inspired by the Cradle-to-Cradle design philosophy, the inventors of Emerging Cooking Solutions (ECS) sought to create a cooking solution that replaces the use of charcoal and firewood for cooking in developing countries. Since 2012, they have pioneered the use of charcoal pellets for cooking in Africa, a cost-effective alternative to

environmentally detrimental charcoal that can serve as a model for many countries. The pellets are made from recycled biomass such as sawdust which helps to reduce the negative impact of the linear industrial production process on the environment. Per Lofberg, who has a background in Arts and Business, sees this invention (cookstoves) as cleaner, better and efficient way to cooking in households thereby reducing deforestation. As a result, they decided not to patent the idea but open-source the designs so other companies can produce cookstoves across sub-Saharan Africa. Besides, patents are expensive and will reduce or defeat the impact they plan to make. To quote him,

“the problem of deforestation is bigger than him and the company. They can gain more goodwill from the invention than from capital gains” (Per Lofberg, Case interviewee 2018).

During the ideation stage, they got support from SIDA to do a presentation in Zambia and later partnered with local firms for the commercial production of the stoves and pellets. The Engineering Department of Lund University (LTH) was instrumental in the design of institutional cookstoves which they sell to schools, hospitals and orphanages in Zambia. Other partners in the product development stage were Zenit Designs AB and Zemission AB for the design and construction of stoves respectively. With designs from Sweden, they worked with metal fabrication companies in Zambia for local production. Like many inventpreneurs, ECS is constrained by lack of adequate funding to expand and reach a wider market. Apart from SIDA, they have received investment from Danir AB who are shareholders in the company. They have also run Crowdfunding Company and raised about \$16,000 for product development. In the case of ECS, banks in Sweden do not invest in companies operating outside Sweden while most investors shun social inventions like theirs. Since 2012, ECS has distributed about 5000-7000 household clean cookstoves and about 100 institutional stoves in Zambia. With their SupaMoto stove, a household can reduce CO2 emissions by 4-5 tonnes and 35% to 50% savings on income. Per Lofberg currently works on part-time with the Lund Kommune while his partner works full-time in Zambia.

4.2.3 Case 3: Watersack by Jan-Erik Nowacki

Watersack is a technology that enables water to be stored when it rains to solve the practical problem where cities construct dams and ponds to contain. It is an artificial pond that is created with plaster to store excess water during rainfalls. The water can be emptied to allow fresh water to flow back in. Jan-Erik made this invention as a way of helping his home municipality as a politician. The social good was his motivating factor. Therefore, he decided not to apply for patents and asserts that patents are worthless and the inventor is the least to benefit from his/her patent. Also, patent infringement is rampant and the individual inventor does not have the resources to fight these infringements. As a Technology Licentiate from KTH, the inventor donated the idea to a social organisation as his way of providing clean water and protecting the environment. For him, anyone individual inventor who is willing to work with his invention is permitted to do so. Watersack is commercialised by a third-party company who is interested in the invention. *Jan-Erik's satisfaction is the fact that his invention being used for the good of society.*

4.2.4 Case 4: PacNova by Per-Håkan Edqvist

With experience working in the packaging and logistics industry, Per-Håkan invented an innovative packaging system for retail stores that reduce the number of plastics needed to package goods for transport and in shops. As a pensioner, Per-Håkan's packaging invention is motivated by the fact that he wants to make society better, as he put it, "...while I live, I can contribute to a more sustainable society". Despite this motivation for the social good, he applied for a patent to make the invention sellable to suppliers. He financed the patent filing application process with personal finance but is looking for a partner who will come in to continue with the commercialisation as he cannot do it alone. Despite holding patents, PacNova's innovation is aimed at environmental sustainability and Per-Håkan hopes to be competitive through trade secret which is in the patterns regarding the packaging; a knowledge that the inventor holds to himself. While SUF provided little help for PacNova, the local association provided him with contacts to ALMI Företagspartner which helped in product development. ALMI Företagspartner is a Swedish government agency which invests and assists startups to grow. According to Per-Håkan, the SUF can help members to build a network of angel investors who can help

inventrapreneurs take their ideas to market. Capital for expansion remains a challenge for PacNova to move from small scale to large markets across Sweden and the Nordics.

4.1.5 Case 5: Aqordo- A Digital Notepad

This inventor did not provide his/her name and wanted to remain anonymous. With a background as an IT consultant and over 20 years of experience as a singer, the inventor realised that handling musical paper notes was a problem and he developed a solution to digitize them. Christening it as the “Spotify for notes”, Aqordo is digital and web-based messaging system for writers and musicians to have access to their notes at any place. It also reduces the huge paper archives that musicians and composers have to keep. With Aqordo, the singer can arrange his/her notes online and integrate these notes into their computers and tablets. Since this was a personal problem the inventor faced, the motivation for the invention was to solve several different issues through a new concept for the benefit of millions of users worldwide. Due to the high cost involved in the patent application, the inventor rather chose to spend the resources he/she had in building a prototype and selling to early adopters to evaluate his idea. To stay competitive and expand, the inventrapreneur has chosen to use trade secrets to protect his brand.

Another way to staying competitive is gaining access to large companies that are willing to partner with him under a share agreement. As a free inventor, he/she is willing to share the inventions with other individual inventors to use his invention but only with him/her as the majority owner. Regarding the network support system, he/she will like to have, the inventor believes the SUF should invest in product development for an equity stake or build a network of resources that can assist with product development.

4.2.6: Case 6: Dagvattenfilter by Asko Päiviö

While working as a hotel owner, Asko Päiviö coincidentally invented a filter for stormwater that treats liquid waste to remove impurities. For instance, his invention filters medical residues such as wound treatment waste by preventing them from getting into contact with the environment. Unlike the other inventors discussed above, Asko Paivio invented so he could earn money out of his inventions. For this reason, the inventor filed for a patent with the hope of making money

through the sale of the patent. The SUF is a place where he can get to talk to people and is looking forward to meeting like-minded entrepreneurs. The invention is in the early phase of development and he is currently working to get partners to move on to the product manufacture and commercialisation phase.

4.2.7 Swing Ping-Pong by Marie Paulson

The Swing Ping-Pong game, which is for children, the disabled and elderly was invented by Marie Paulson who worked as a sports teacher prior to the invention. The invention is an eye/hand coordination exercise, motor skills, concentration and balance - for people with or without disabilities, who acquired a brain injury and the aged. Marie's invention was inspired by her desire to develop a game that could give her 4-year old son a way to engage in playing table tennis just like adults do. However, this game had to be different from the usual ping-pong game since a child could not run around and control the ball. As a result, she found a way to create a stationary ping-pong that hangs from the roof or door frame. According to the inventor children with disabilities are dear to her heart and that explains why she continues to improve her invention. The product has evolved to be used in mainstream sports groups such as Ping-Pong clubs as well as rehabilitation centres.

During the product development, the inventor worked with Health Technology Centre at Halmstad University where the product was tested and researched. The SUF has also helped her gain access to networks and building her brand as well. She was awarded the Inventor of the Year award in 2008 by SUF. According to Marie, the collaboration with the university has been instrumental in her innovation journey. Collaboration with the university does not only lead to quality product development but also gives legitimacy to the innovation. The research by Halmstad University has provided scientific support to the capability of the innovation to improve the senses as well as movements of physically challenged individuals. It has proven to be a useful invention for exercise. Also, a product that was initially targeted at young children became relevant for the elderly, as well as people who are physically challenged. This realization became vivid after the product was launched in the market. The product now targets people in care homes and rehabilitation centres as well. Going from idea to commercialisation takes time

and effort, says Marie Paulson. She uses trade exhibitions and fairs like Formex and the Technical Fair to build her network and market her innovation.

The product has been patented but has witnessed patent infringement when it was launched. Even though the idea is patented, its impact as a social and sustainable innovation is evident. Presenting her inventions to Attendo in Borås, Pernilla Gabrielsson who works at Attendo is quoted as saying:

“Because we are working on a health and sustainability concept, it (Swing Ping-Pong) suited us perfectly. ... We tested it in two different departments and the response was positive directly”. (Gustafson, 2017).

Further, a 100-year woman resident at the Attendo homecare was able to test and play with the innovation (Gustafson, 2017). Therefore, the impact of the innovation promotes the social well-being of the elderly. Here, even though the invention is patented, it serves a social good.

4.2.8 AddSeat by Marit Sundin

AddSeat is an invention that Marit invented first and foremost to solve a personal problem she faced as an amputee. Using her predicament, she searched for a solution that would complement her manual wheelchair. This was to ease movements in her daily activities both at home and outside. Current solutions on the market fell short of her needs and left her hanging in her desire for ease of movement as a physically challenged person. AddSeat is designed to transform a two-wheeled gyroscopic vehicle. The differentiation of AddSeat from current market solutions is that it is raised and lowered with suspension and can be pushed back to get the centre of gravity further behind and get a stronger braking effect. She partnered with Hedemora Adaptation, a company that customizes motor vehicles, to produce the first prototype. She had a long-term relationship with the company (Hedemora Adaptation) who helped in the production of her first innovation (the sit-ski) dating about a decade ago. Using this personal network, the owners of Hedemora invested in the AddSeat idea and played a key role in the product development.

For Marit, scanning your personal networks as individual inventpreneur is key to finding the right partners who can help in product development and market entry. In a news report by the

Entrepreneur, this is what Marit had to say about the importance of personal networks in the invention process.

“...these are contacts and networks when it comes to finding partners. Sometimes things may happen by chance, a bit on a banana scale, but the truth is that it is about scanning their network” (Entrepreneur, 2016).

In 2014, Marit was named the “Inventor Woman of the Year” in 2014 by the Swedish Inventors Association which generated some form of media attention for her invention. The invention is not patented in spite of its uniqueness. Scholarships and grants were the main sources of funding for product development at the initial stages and Marit says every Krona received went into developing AddSeats which is sold to other physically challenged persons at affordable prices. The first release of the product was a total of 10 seats which were sold and reinvested into product development.

To scale the innovation across and beyond Sweden, funding remained a challenge. Through a networking event, the inventor met an investor who not only invested in the company but contacted a large manufacturer called Samhall, located in Svenstavik, where AddSeat is currently manufactured. Besides the investment received, AddSeat has run a Crowdfunding campaign where they raised over one million Krona in loans to invest in sales and expansion. For Marit, the Crowdfunding campaign was a success and she plans to organise another one but using a different strategy. This is what she told the Entrepreneur in 2016:

“It was a very successful campaign and therefore, we will soon be launching a new crowdfunding campaign, but this time offering shares in the company”.

For Marit, the greatest profit from AddSeat is the change the innovation has made to her life and another physically challenged person by giving her the freedom of movement and ability to keep her children close by as they walk.

4.3 Across-case analysis

In this section, a brief discussion and analysis of commonalities and differences across cases are presented. This was done using themes that were coded from the study.

It emerged that, patents were seen as less important as most inventors believed big companies will infringe on their patents rights. Hence there is no need to spend resources on filing for patents. The inventor of Swing Ping-Pong witnessed patent infringement on her invention and therefore had to redesign her website and company brand when it happened. On the contrary, 3 out of the 4cCase with patents filed for it as a way of gaining legitimacy, attracting suppliers for partnerships and registering the invention in their name. The motives to file for patent included registering the invention in one's name, legitimacy and access to partners were the reasons other a way of blocking or protecting their ideas. The 4 inventrapreneurs who chose not to file for patents attributed it to the worthlessness of patents, its costly nature and how patents will reduce the social impact their innovations will have. Going through the patent process has the tendency to increase the cost of products and also possibly diverting resources away from the core activity of product development.

In terms of motivation for the invention, there was only one unique inventor who explicitly mentioned he invented and filed for patents to enable him to sell the patent for money (Asko Pavio, inventor of Dagvattenfilter). Apart from that, all the cases reviewed revealed the desire of the inventrapreneur for environmental and sustainability impact (*Emerging cookstoves, PacNova, Aqordo, Watersack and Dagvattenfilter*) and making life easier for the physically challenged, the poor and the elderly (*AddSeat, Swing Ping-Pong and P41*). Even though ideas were patented, they still provided solutions that aimed at creating social and environmental impact as envisaged by the inventors. Only one inventor decided to donate his inventing to a third-party for commercialisation because he wanted to contribute to his local community as a politician, says *Jan-Erik Nowacki*.

Since patents provided a very little competitive edge for the inventrapreneur in this research, other strategies such as brand building, trade secrets and developing the right business partnerships counted as more significant. For instance, PacNova which holds a patent rather believes that his key selling point is the *patterns and knowledge* that he has built over the past 20

years working in the packing and retail sector. Building the brand can be achieved by partnering with institutions or industry partners to help in the manufacturing and distribution process. .

The study found more commonalities in terms of challenges faced as inventrapreneurs. All inventrapreneurs lacked the full arsenal of resources to commercialise their inventions. Funding sources remained a challenge to all inventrapreneurs. Three cases reviewed (AddSeat, Emerging cookstoves and Aqordo) received grants for the building of prototypes. AddSeat and Emerging cookstoves used other non-conventional crowdfunding activities to raise funding for their product development. One innovation (Aqordo) stalled during product development because the inventor could not raise additional funding after an initial \$5000.00 grant he won at Venture Cup competition. As pointed out, all inventrapreneurs are working professionals and others own existing businesses from which they plan to invest in commercialising their current inventions. Across the cases, sustainable funding remains a challenge and the approach to finding resources for commercialisation hinges on the networks of the inventor. Also, building partnerships with large suppliers are ways inventrapreneurs are exploring to grow their innovations.

The innovation process is fairly similar to all inventrapreneurs. It starts with ideation and design of concept which is usually done by the inventrapreneurs themselves. The building of a minimum viable product (MVP) is also done at this stage as a proof-of-concept. The inventrapreneurs champion their invention to third-parties using initial designs and MVPs. After this stage, the inventrapreneurs decides if they want to file for a patent or move on to the next stage of commercialisation.

After the design and MVP phase is the product development phase. This process involves manufacturing the prototypes either by the inventrapreneur or in conjunction with third-party laboratories. From the interviews, no inventrapreneur has all the resources to build the prototype alone and so would tap into the resources of business incubators, large firms and inventor associations to do this. This is a technical process and requires different players with different expertise which the inventrapreneur cannot do alone. Examples abound from the Cases. AddSeat initially partnered with at Hedemora, Swing Ping-Pong worked with Health Technology Centre at Halmstad University and Emerging Cookstoves worked with LTH at Lund University, Zemmision and Zenit Designs in building their products. While product development was

identified as the most important, it remains a key challenge since inventrapreneurs lack funding to engage in full-scale product development and quality control of their inventions.

After product development is market entry and the launch of the product. Again, getting the inventions to the end user also overwhelms inventrapreneurs as well. The inventors of P41 and PacNova, who both hold patents, are looking for large suppliers as partners to help grow their innovations in the market. Those inventors who are above 55 years of age are less likely to be involved in the daily operations and will like to play a minimal role in the commercialisation phase. The younger inventrapreneurs, given the resources, are willing to be actively engaged in daily activities of the invention, even if there are third-party partners.

From the cases, the key actors and activities of the inventrapreneur are similar to those highlighted by Udell (1990) where he stressed the importance of product development. In Tables 4 and 5 below, an across-case analysis from the interviews is presented to identify commonalities and differences. This was segmented into those with patents and those without patents.

Table 4: Across-case analyses from the interviews for patented inventions

Theme	Code	<i>P41</i>	<i>PacNova</i>	<i>Swing Ping-Pong</i>	<i>Dagvattenfilter</i>
Patents use	Licencing	√			
	Attract suppliers	√	√		
	Sale				√
	Register invention in my name		√	√	√
Challenges to innovation	Infringement	√		√	
	Finance	√	√		√
	Behavioural challenges			√	
	Product development		√		
	Market entry		√		
Competition strategies	Partnership with a large supplier	√			
	Trade secrets from patters		√		
	Brand building			√	
Motivation for invention	Make life simpler	√		√	
	Sustainable society		√		
	Environmental sustainability		√		
	Earn money		√		√
	Contribute to open innovation				
Role of Association Networks	Credibility	√ (SUF)	√	√ (SUF)	
	Product development			√ (Halmstad University)	
	Business development				
	Meet other colleagues				√
Invention and social+sustainable+SDG	Climate change		√		√
	Physically challenged			√	√
	Clean water				
	Human welfare	√		√	
Inspiration for invention	Previous work	√	√	√	√
	Hobby				
	Personal problem				

Source: Author's construct, 2018

Table 5: Across-case analyses from the interviews for non-patented inventions

Theme	Code	<i>AddSeat</i>	<i>Emerging Cookstoves</i>	<i>Watersack</i>	<i>Aqordo</i>
Challenges to innovation	Infringement				
	Finance	√	√	√	√

	Behavioural challenges				
	Product development	√			√
	Market entry	√			
Competition strategies	Partnership with a large supplier	√			√
	Trade secrets from patters				√
	Brand building				
Motivation for invention	Make life simpler	√	√	√	√
	Sustainable society				
	Environmental sustainability			√	√
	Earn money				
	Contribute to open innovation			√	
Role of Association and Personal Networks	Credibility	√			√
	Product development	√	√		
	Business development	√	√		
	Meet other colleagues				
Motivation not to patent	Cost	√	√		√
	Defeats impact of the invention		√		
	Worthless			√	
	Rather use the money for product development	√	√		√
Invention and social+sustainable+SDG	Climate change		√		√
	Physically challenged	√			
	Clean water			√	
	Elderly and children welfare				
	Clean energy		√		
Previous work relationship with invention	Previous work			√	√
	Hobby	√			
	Personal problem	√			

Source: Author's construct, 2018

Apart from one inventor, all 5 inventrapreneurs were motivated by a desire to do something good for society by contributing to a sustainable society and environment. The inventor of PacNova, Per-Hakan captured this succinctly when he said: "...motivation is to do something for society and not money at my age". All inventors were working professionals who were either retired or reaching the age of retiring from work. This is not to suggest that inventrapreneurs did not have profit motives or sought to make money from their inventions. But inventions can have social and sustainability impact while still being profitable (Mulgan et al., 2008; Phills, Deiglmeier & Miller, 2008) and three of the inventors who filed for patents have the objective of either selling it or licensing it for profit. Another motivation for patenting was for them to attract a big company to collaborate in reaching wider markets. Also, a partnership with big companies was a way to dominate the market and fight any future patent infringements. Apart from that, the inventrapreneurs concluded patents were worthless and people will infringe on their patents,

especially big companies. Innovations aimed at environmental sustainability remain a key focus area and may be a result of Sweden's efforts at promoting sustainable innovations.

Also, it emerged that inventpreneurs are overwhelmed by the processes involved in product design and development, market expansion and more especially, financing the innovation process. In Sweden, the government, as well as the SUF, play little role in making resources available to individual inventpreneurs. Most inventions fail to have wider social and economic impact as a result. Financial grants won through competitions are avenues where inventpreneurs get resources to finance their inventions in the case of AddSeat, Aqordo and Emerging cookstoves. Others, however, finance their innovations through income from other private companies that they own. Inventions like *P41* and *Dagvattenfilter* were financed using private company resources owned by the inventpreneurs.

Chapter Five – Discussion of Findings and Implications

5.1 Introduction

In this section, the results of the study are discussed vis-à-vis the research gaps and themes presented in earlier sections. This is done by juxtaposing the findings to current positions in literature aimed at making a contribution to future research and also towards policy making.

5.2 Up-close with the Inventrapreneur: Their background, sources of invention knowledge and motivations to invent.

The profile of inventrapreneurs in Sweden as found from this research bears semblance with the results of a quantitative study on the profile of US inventors by Whalley (1992). Like Whalley's research, the inventors are adult professionals who are inventing as a part-time activity or a pension retirement activity. The average age of invention was 55 years with the youngest inventor at age 45. The processes of invention and commercialisation are complex and require resources and prior knowledge to find problems that need to be solved. In the case of Sweden, there is a connection between an inventor's previous work and their invention. That is, previous work is often a source of knowledge for their inventions. Connecting working or retired inventrapreneurs with their current or former companies could be a way of building synergies for boosting inventrapreneur activities. Other factors such as the hobbies or social activities of an inventrapreneur are likely to determine their ability to invent. The research by Whalley (1992) did not go further to highlight why the older generation is the most predominant in the independent invention and innovation group. This study adds that when working professionals are about to retire or are retired, they seek to find ways to stay engaged post-pension time as a form of investment. This is a way of contributing and sharing their knowledge for the welfare of society. Also, they (older inventrapreneurs) have access to their professional network, experience and seed capital that can be used for building prototypes and developing their inventions.

Further, it points to the desire of the older generation to either find new challenges or contribute to society. The motivations to invent, as was found, were less about the money but a way of contributing to society and creating a sustainable future. Re-echoing the words of the inventor of

PacNova, "... motivation is to do something for society and not money at my age" (over 55 years) while ECS inventor was looking for a way of creating a sustainable society through the reduction of CO2 emissions.

While the older generation may have the resources and knowledge to invent, it raises issues about the long-term viability of such inventions. A mix of older age and youth could create a new paradigm where the exuberance of the youth is brought to bear in the operations of startups while the older generations focus on using their knowledge and resources to guide the younger inventors. A few inventrapreneurs were committed to their inventions as full-time activity raising scalability concerns and whether investors are willing to invest in individuals who are working part-time on their inventions.

5.3 Revisiting the patent debate on the individual inventrapreneur

There is evidence in the literature that the number of individual inventors filing for patents is dwindling. Supporting this view is the findings by Dahlin, Taylor & Fichman (2004) which found that whereas independent inventors were granted 86% of all US patents in 1910, they were granted only 15% in 1998. The reduction in patent applications has led stakeholders and researchers to belittle the role of individual inventrapreneurs in the innovation system. The reduction in a patent filing by individual inventors may be due to the little significance they place on the role of patents as a strategy for business success. This argument also ignores the economics of patents in relation to the individual inventrapreneur. Filing for patents is an expensive process and it appears that individual inventrapreneurs prefer to commit such resources to product development and market growth. Secondly, from the research, inventrapreneurs believe that large companies will infringe on their patents anyway and so will choose alternative strategies. The few companies who have patents do not view them as a key to success. This suggests an emerging trend where inventrapreneurs and startups are choosing not to patent as found in Graham et al. (2009) and does not point to their dwindling impact.

Revisiting the motivations for invention, the inventrapreneurs decision not to patent was motivated by the social and environmental impact of their inventions and their contribution to an

open innovation society. For instance, the designs and all technical details for Clean Cookstoves produced by ECS have been open-sourced and made available on the company's website. This was motivated by the fact that the inventors will like many more companies to produce more clean stoves that will use recyclable charcoal pellets to reduce the rate of deforestation.

This was not different for inventrapreneurs with patents. Out of the 4 patent cases analysed, 3 inventors with patents were motivated to patent as a way of attracting large suppliers so that their invention can help solve issues of clean water and the reduction in plastic usage for packaging groceries and logistics. The patent was, therefore, a way of attracting large companies to help grow and commercialise their inventions for social good. Both patent and non-patent holding inventrapreneurs believe there are other ways to take their inventions to market with little prominence given to patents. What was resoundingly clear was the fact that all inventors did not view patents as avenues to protect or block others from using their inventions. Since the cost of filing and maintaining patents involves financial resource, inventrapreneurs are choosing alternative ways of going to market with their inventions.

5.4 Alternative IPR strategies for the individual inventrapreneur: Patents and without patents.

Corporate and institutional inventors file for patents for various reasons such as blocking others, protecting an idea and as a strategic position to beat the competition (Graham et al., 2009; Heller & Eisenberg, 1998; Veer & Jell, 2012). On the flip side, Dahlin, Taylor & Fichman (2004) report how patent filing by individual inventors has nose-dived over the years. Later research by Graham et al., (2009) however, found that startups and individual inventors found patents process to be expensive and they lacked the resources to fight legal battles when their patents are infringed upon. This study found similar results where some inventrapreneurs described patents as worthless while one (1) inventrapreneurs with patents experienced infringements.

Similar to findings by Graham et al. (2009), inventrapreneurs are choosing trade secrets, brand protection and goodwill as strategies to commercialise their inventions. This study finds the goodwill approach to be interesting. Inventrapreneurs, due to their focus on social and sustainability innovations, benefit from goodwill which leads them to gain access to financial

grants from state and quasi-state institutions as well as family investors. Also, through goodwill, some are able to get free services from partners who work on their inventions pro-bono. Other unconventional strategies include signing revenue share agreements with existing companies who provide free product development services but share the revenues when the products are sold on the market. Even inventrapreneurs with patents still adopt trade secrets and brand protection as a way to stay competitive.

Promoting open innovation and democratising knowledge is one way the free individual inventrapreneurs seeks to contribute to social good. From the case analysis, inventrapreneurs were open to sharing their inventions with others through a form invention pool for the benefit of all. However, the rules and procedures for operationalising this were not explored. This group of free individual inventors, though with noble intentions, suffer a double jeopardy in dealing with competition and market success. First, without patents, they struggle to attract the needed resources for growth. Second, their ideas can be replicated by large companies who have the resources for market distribution thereby eroding any potential social impact that these individual inventors could make.

5.5 The inventrapreneurs' actor-network: Invention processes, actors and activities of the inventrapreneur

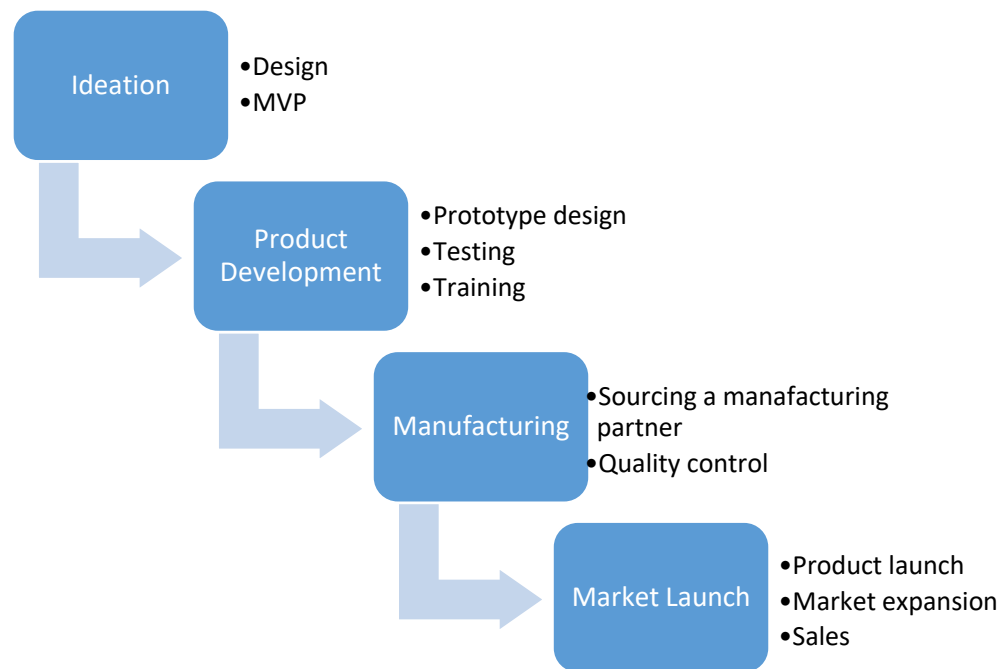
Not all inventors move to the next stage of commercialising their inventions. However, those who do, do so using different processes. It is not a linear and homogeneous process. The inventrapreneur is the most challenged in terms of the actors in the innovation invention literature. Heller & Eisenberg (1998) highlight how large companies in the upstream innovation system are able to invest resources into R&D but the individual inventor lacks this leverage from the onset. At the start of the invention, the individual inventor faces the tasks of managing product design, product development and market sales. This highlights the need for an ecosystem that will create a collaborative social milieu for the different actor to guide the activities of the inventrapreneur at every stage of the process. Similar concerns about the need for social support to inventrapreneurs have been espoused by Udell (1990) and Whalley (1992). They argue that

inventrapreneurs live in an unorganized world and most of them do not work on their inventions as a full-time activity, an observation supported by empirics from this thesis.

At the design stage of the invention process, some inventrapreneurs worked with academic institutions and product design companies to help them build working prototypes. This is a collaborative approach that supports the inventrapreneur to commercialise. Other inventrapreneurs utilised the benefits of being members at local Chapters of the SUF to gain contacts to relevant partners for product design and product development. Apart from SUF, other organisations like ALMI, Borlänge and Brewhouse Incubators are actors that support the inventrapreneurs to start new businesses. These organisations provide some form of assistance in product development and finance. The support system that inventrapreneurs get is not organised and relies on the personal networks of each inventrapreneur. After spending resources on product development, inventrapreneurs are overwhelmed by the commercialisation process of business development. There is a seeming disconnect between product development and testing on one hand and market launch on the other hand. While inventrapreneurs can take up the process from design to product development, deploying the product to market requires more resources than they often have readily available.

The processes from invention to innovation of the individual inventor are similar to what corporate and institutional inventions go through. It starts with an idea, the inventrapreneur designs the product whether on paper or by building a minimum viable product (MVP) which is then used to build prototypes as part of product development. Post-product development, the process enters the manufacturing stage where innovations are commercialised for distribution and supply to the market. One of the inventrapreneurs, Marie Paulson, thinks the simplest process of innovation is “idea, design and manufacturing”. While this process is neither new nor is it unique to the individual inventrapreneurs, the resource requirements and challenges are unique to inventrapreneurs as captured by Udell (1990). In Figure 1 below, a representation of the process and the activities undertaken are illustrated.

Figure 1: Innovation processes for the inventrapreneur



Source: Author's Construct, 2018

In the first stage of the process, the resources and activities required by inventrapreneur include support from home, positive work ethic, personal time and financial resources. The inventor has to be able to commit these activities in the design process. In building the MVP version of the idea, inventrapreneurs have to commit personal resource into the initial designs to as proof-of-concept before it graduates product development phase. At the product development stage, Per Lofberg and Marie Paulson outline how they collaborated with third-party institutions for product design and development. Marie Paulson collaborated with the Health Technology Centre at Halmstad University, during the development phase of the Swing Ping-Pong innovation while Per Lofberg worked with Engineers at Lund University of her prototypes. This is a stage where third-party resources and expertise are needed and critical to the viability of the innovation to serve its needs in the market.

In the commercialisation phase of innovations, absolutely crucial is the help of the manufacturers in the innovation process of their inventions. Since individual inventors do not have the capacity to execute this alone, they partner with existing parties to do so. Mass production requires

enormous resources which can only be achieved when the inventrapreneurs partner or receive help from third-parties.

To reach the market, forming the right team to launch the product into the market marks the final process. It appears that inventrapreneurs look for ways to distribute their products beyond the borders of Sweden. In all these processes, funding remains key and it will later be discussed in the section on challenges to the invention. Manoeuvring through these processes requires more resources than the individual inventrapreneur can afford. In the case of Peter Lindberg, it took four years to bring to fruition his removable floating office space innovation and required a number of millions of Krona.

In Sweden, the SUF and its local members have not been vibrant and unable to provide the appropriate social support for inventrapreneurs. The emergence of technology incubators and science parks like IDEON are attracting individual inventors because they provide the resources that may ease the invention process for the inventrapreneur. To be relevant, the SUF can organise innovation days and seminars to promote networking among members and other partners across the local associations. The Inventor Associations can as well provide product development services and charge a fee as part of this process. This came as a top priority of things that are pushing inventrapreneurs back from pursuing their inventions.

5.6 Inventrapreneurs providing solutions that drive social and sustainability need

The commercialisation and industrialisation of inventions at both the upstream and downstream sectors (Dahlin, Taylor & Fichman, 2004; Heller & Eisenberg, 1998) continue to affect the production of low-cost social and sustainable innovations. Due to huge investments in R&D firms have to charge huge costs for commercialised inventions in order to recoup their profits. This often leaves poor consumers disadvantaged unless the product becomes a mass product years after it is introduced. Alternatively, individual inventrapreneurs provide social solutions to problems faced by the poor and vulnerable. Their invention processes as outlined above are less expensive and have the propensity to provide low-cost innovations. To quote Åstebro (1998)

“there is also evidence that the development of new inventions by independent inventors is at a lower cost than similar inventions in large corporations; independent inventors have been found to bring their products to market with development costs about one-twelfth those of established firms and with gross profit margins comparable to those found in the pharmaceutical industry”(Åstebro, 1998).

The inventrapreneurs from the study were focused on inventing in areas that addressed the needs of the vulnerable social groupings like children, disaster-prone communities, the physically challenged and elderly men and women. Segregating it into patent and non-patent holding inventrapreneurs, there was no clear evidence to support that fact that free inventrapreneur (non-patent holding) engaged in more social and sustainability innovations than did those with patents. Both groups of inventrapreneurs will need similar resource support to build a critical mass for driving social and environmental sustainability. As discussed earlier, a social support system that creates a network of actors to guide individual inventrapreneurs in the different stages of commercialisation of inventions will produce solutions that contribute towards achieving the 2030 SDG goals. This view was espoused by Lettl, Rost & Von Wartburg (2009) when they indicated that social support networks provide independent inventors with resources that are available to corporate inventors. From the study, the inventrapreneurs in Sweden lacked such a well-developed social support system that would provide invention design and prototyping and the manufacture of such inventions. In addition, business development services during the commercialisation stage remain inadequate.

Independent inventrapreneurs compete with corporate inventors for resources to produce social and sustainable innovations. While individual inventrapreneurs, more especially free inventrapreneurs, are providing grassroots solutions in Sweden aimed at meeting the SDGs come 2030, they are at a weak position in terms of commercialising their inventions for the wider market. Policy research is needed to find a connection between the individual inventrapreneurs and emerging or large firms to partner in making resources available to the free inventrapreneur. In Sweden, the SUF can create a credible database of individual inventrapreneurs and match their needs with growing companies that do not have the resources to engage in commercial R&D. Vertical and horizontal integration of the individual inventrapreneurs with existing firms

for both product and commercial development will be a viable policy direction. Such approach will help address the damning views about the individual inventrapreneurs who are being described as “weekend hobbyists” whose impact on innovation is insignificant (see Dahlin, Taylor & Fichman, 2004).

5.7 Challenges for both inventrapreneurs with and without patents

In analysing the challenges faced by inventrapreneurs, the coded responses by each inventrapreneur was extracted and placed in a text file. Using statistical computer software called R Programming, a text mining was done to identify the most frequently reported challenges faced by inventrapreneurs as shown in Figure 2 below. This presents a graphical view of the prominent and emerging areas that inventrapreneurs are much constrained.

Figure 2: Word cloud of common challenges to innovation by inventrapreneurs



Source: Author’s construct, 2018

From the figure, the challenges faced are related to product development, sales and marketing and capital to finance these processes. Connected to these reported challenges is the lack of money to finance the cost of product development and employing the required workforce. As

common with startup financing as observed by Coleman (2004), access to finance is an on-going problem for startups, more especially that banks are not willing to fund such ideas. Banks and institutional investors consider innovations by inventrapreneurs as risky and are not willing to invest. Aside from the banks, finding anyone to invest in inventrapreneurs remains unattractive and was succinctly captured by Per-Håkan Edqvist (Inventor of PacNova) when he said:

“Banks are interested in real estate. Business angels leave the company after some time during the process of invention”.

Surmounting these challenges will require innovative product development relationship between the inventrapreneur and manufacturing firms. To overcome the cost of product development and manufacturing, the cases reveal an approach that works to help the inventrapreneur commercial with little resources. This involves the inventrapreneurs striking deals with the manufacturers and contractors who freely undertake the first product development in anticipation of payment when products are sold in the market. Other inventrapreneurs get product development services as pro-bono from existing firms in the industry. These collaborative strategies with existing firms are a mutually beneficial relationship but require transparency and trust from both parties. The suitability of this approach to the activities of the inventrapreneur is crucial in reducing the financial huddle encountered during product development. Also, Inventor Associations and business incubators can provide such services to inventrapreneurs; especially in product design and development.

Chapter Six –Recommendations and Conclusion

6.1 Introduction

This is the concluding section of the thesis. It presents the contributions of the study to academic research as well as for policy.

6.2 Academic recommendations

To build innovative products and services that address social and sustainability does not mean innovations have to be free of charge. Social innovations have been construed over the years to mean offering services or charity work by civil society and NGOs. This has posed long-term sustainability issues for financing such social innovations. However, inventrapreneurs can lead the way in providing innovations that are frugal and targeted at the local needs of communities and vulnerable groups. Academia needs to focus its research on how the independent inventrapreneurs can drive social and sustainable innovations and still remain profitable. This will encourage individuals and startups to invest resources in the process.

Patents are losing their worth as a competitive strategy and incentives for the individual inventrapreneur. Inventrapreneurs lack the capacity to fight patent infringements and hence inventrapreneurs are less likely to patent and those who do patent, view it as a way of registering their invention and attracting supply partners but not to protect their inventions. The motive for the inventrapreneur to not patent bothers on their desire to contribute to the welfare and environmental sustainability. Patent records may, therefore, prove to be inadequate as a source of data for studying the activities of inventrapreneurs. Future research on inventrapreneurs should not only use patent records but contact inventor associations to identify and conduct broader research on the motives of the inventrapreneur. This approach is similar to previous works by Graham et al. (2009) as well as in this thesis. Without this, researchers will continue to underestimate the importance of inventrapreneurs even though they can be pooled to provide low-cost social and sustainable innovations.

Patents also, do not influence the motives of the inventrapreneur. Both inventrapreneurs with and without patents have a motive to contribute to societal welfare and sustainability through their inventions. Future research is needed on how best to support both groups in the innovation

process, especially during product development. The best models and approaches to building the appropriate social support milieu will need further research. As this study focused on a few cases, a wider qualitative approach to studying the motives of the inventrapreneur and how they can serve as drivers of social and sustainability innovation is needed. Since inventrapreneurs relay on alternative IPR strategies other than patents, research is needed on ways they can better protect their brands and trade secrets using approaches such as employer agreements, stricter third-party contractual agreements to protect the inventrapreneur

6.3 Policy Recommendations

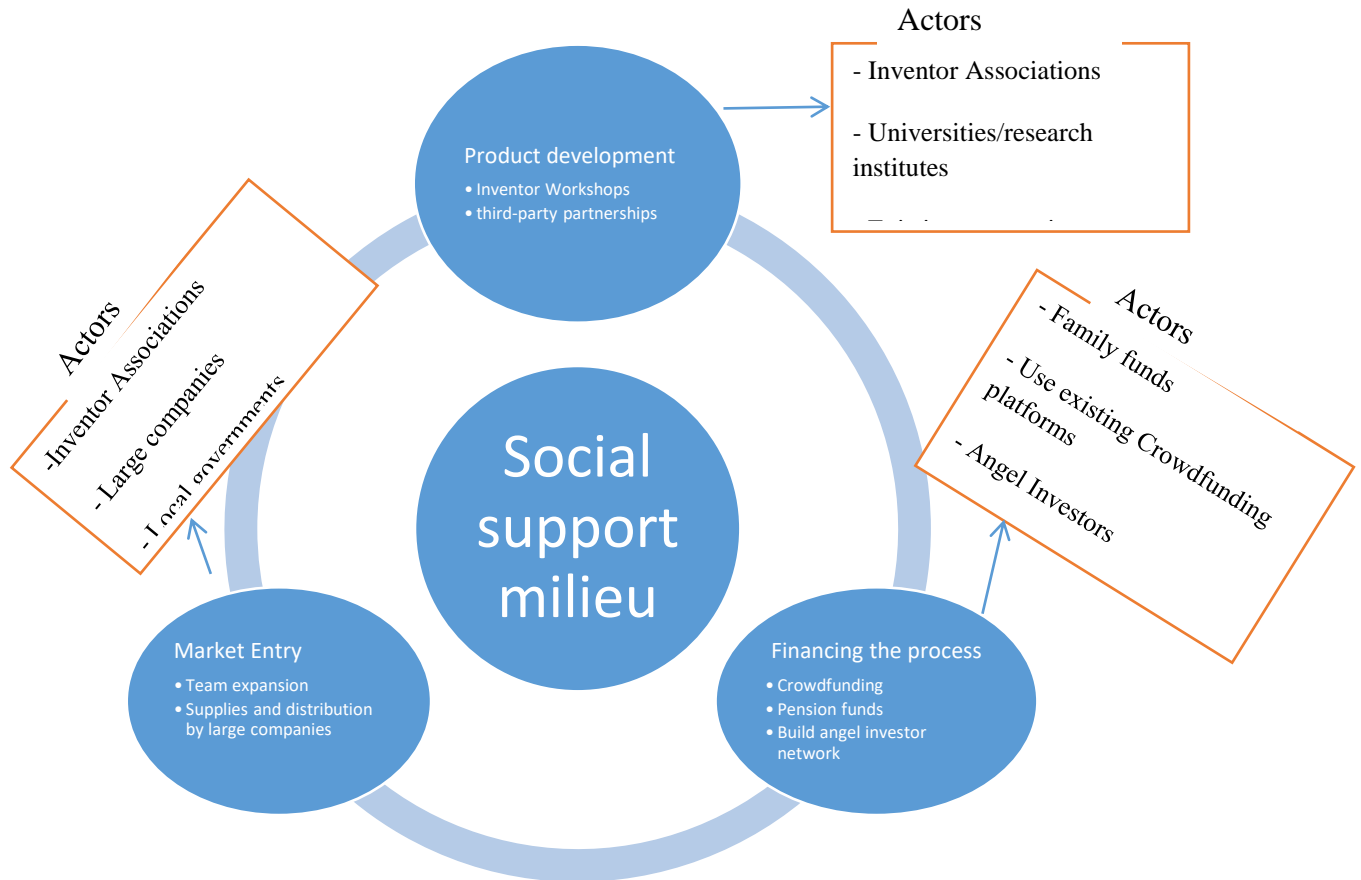
This study has identified that promoting inventrapreneurs as drivers of local solutions that solve social and sustainability issues requires building a *social support milieu* that addresses product development and market development challenges. Key to building this milieu also requires new and innovative ways of financing activities of inventrapreneurs which will be discussed later.

In terms of product development, setting up invention workshops where inventrapreneurs can get help in designing, constructing and developing their prototypes as a proof-of-concept is key. ALMI and Vinnova can partner with SUF in building invention workshops where inventrapreneurs can enrol and graduate every quarter or semi-annually. When a batch of inventrapreneurs is about to graduate, the SUF in conjunction with the local associations will organise demo days where all these inventrapreneurs exhibit their inventions. During demo days, banks, financial investors and large companies are invited to identify viable innovations to invest in. With this, SUF will adopt a stricter procedure for vetting and accepting inventions and charge commissions on successful inventions that are commercialised. This will encourage private equity firms to partner SUF to provide the financial impetus to help more inventrapreneurs.

Besides the inventor workshops, there is evidence from research that inventrapreneurs have used their personal networks to build relationships with existing companies for product development. This process can be organised with policy backing where private companies provide such services in exchange for equity or future revenues when the product is sold in the market. Research institutions like universities can open up their science and engineering laboratories to inventrapreneurs who can build their products using students and researchers at the universities.

This can lead to building synergies with younger people who can collaborate with ageing inventrapreneurs in ensuring the future longevity of their innovations. In Figure 3 below, a social support milieu geared at helping the inventrapreneur is illustrated.

Figure 3: Social Support Milieu for the growth of Inventrapreneurs



Source: Author's construct, 2018

The framework above presents the key areas that need to be developed through policy to promote the activities of inventrapreneurs in Sweden. Product development has been discussed above but it will require different arrangements that will reduce the complexities of product development. After product development, inventrapreneurs have two approaches to market entry. First is for the inventrapreneurs to build their own teams to carry on with marketing and sales. This process requires enormous resources in terms of time, money and capabilities. For inventrapreneurs who prefer to go this route, strong financial and managerial resources are

needed. It thus, however, emerged from the study that the entrepreneurs are professionals who are at the on retirement and close to retirement and may not have the energy to fully drive the process.

Inventrapreneurs are open to partnerships with existing companies who are willing to use their resources to manufacture, supply and distribute the products in the market. The inventrapreneur will continue to play a key role in product development and further innovation while the big company drives market growth. Local government authorities can also serve as initial customers for social and sustainable innovations produced by inventrapreneurs. Connecting inventrapreneurs with existing companies is an activity that innovations intermediaries like SUF can play while local authorities incentivise companies that are willing to partner with inventrapreneurs to commercialise.

Innovation finance, and more importantly for the inventrapreneur, is needed to drive the process. There are competing demands for funding by all innovation actors and this leaves out inventrapreneurs at the fringes. Crowdfunding on digital platforms like Kickstarter and Indigogo have provided a financial boost for most social and sustainable innovations to raise seed capital. Either the SUF can lead Sweden to launch its version of crowdsourcing platforms or assist inventrapreneurs who are members to run campaigns on existing platforms for startup capital. Also, family funds and grants can be sought after as a way to complement the efforts of institutions such as Vinnova and ALMI. Generally, encouraging citizens to invest in startups for equity will be a good way to promoting community support and ownership of such inventions.

While these are policy recommendations on the right social support milieu for inventrapreneurs, there is the need to further explore this through broader consultations. Also, providing a database that connects inventors with financial investors, large firms to create a favourable social ecosystem is an area for future action-oriented research.

6.4 Conclusion

Sweden's drive for social inclusion and sustainable growth is made possible by the many innovations that lean towards environmental sustainability. However, the challenges of contemporary times where inequality is rising and countries are faced with refugees crises require solutions from all actors to provide innovations that solve the needs of all segments of

society as well as promoting a clean and sustainable environment. One of such actors in the innovation the literature is individual inventrapreneurs whose inventions can promote the attainment of the SDGs. Encouraging and growing working professionals to use their knowledge in inventing solutions to problems faced by themselves and their immediate communities will encourage bottom-up growth process. Their impact can be felt if the social environment promotes open innovation and network support to create a critical mass of inventrapreneurs who collaborate in the commercialisation of their inventions.

To this end, individual inventor pools, based on trust and shared benefit, will reduce the knowledge and resource load that overwhelm the inventrapreneur. The attempt to downplay the impact of inventrapreneurs using a number of patent filings is a wrong approach to doing a systemic analysis of the inventrapreneur. Corporate and institutional innovators have the resources to carry out research. Instead of creating a dichotomy between these groups, policymakers and researchers need to focus on ways of integrating these two groups. More importantly, most small and emerging firms do not have the resources for R&D. Therefore, mapping and connecting these firms with inventrapreneurs will create a mutually beneficial relationship where knowledge and inventions flow from individuals to these firms. When such inventions are commercialised, the inventrapreneur benefits from royalties while the company adds a new product line to its portfolio. Given the observation that inventrapreneurs are more likely to focus on social and sustainability issues, from the case of Sweden, such an arrangement will also create the proliferation of inventions and innovations that promote the SDG goals.

Admittedly, more research is needed on a model and framework for such an approach. But inventor associations can lead this role and build a model framework to protect the interests, as well as goals of inventrapreneurs and their inventions when they engage with firms. This will allow inventrapreneurs to leverage the resources of emerging firms to commercialise their inventions. Also, building inventor workshops to help with product design and development is key to promoting their activities. A caveat could be to offer favourable terms to inventrapreneurs whose inventions focus on social and sustainability issues. While this will reduce the financial burden with regard to funding product development, an alternative way to financing the inventrapreneur is needed. This is particularly so since most inventrapreneurs work part-time on their inventions so they can get an extra source of income to support their families. While

funding options are beyond the scope of this research, exploring crowdfunding options both within and outside Sweden can help provide respite to the individual inventrapreneur. It does appear most inventors make use of grants won from competitions to support their innovation but an angel investor pool solely for the individual inventrapreneur may well prove beneficial

6.5 Limitations of Study

The data for this study was based on 8 case-studies of individual inventrapreneur and a generalization based on this has to be made with caution. An expanded survey of more independent inventrapreneurs will provide justification for generalisation. Secondly, Sweden is a country that promotes welfare and sustainability innovations and this may have influenced the number of inventrapreneurs focusing on social and sustainability inventions. Therefore, a comparative study with market economies like the US will help understand how country dynamics influence individual inventor behaviour.

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Appendices

Appendix A – URL to research interview guide questionnaire:

https://docs.google.com/forms/d/1TbEogY9MliNXXHw5BM_AnCJQ5qzsVZX8je4AVU3mgt0/edit

Appendix B – URL to survey responses excluding those I recorded and transcribed

https://docs.google.com/forms/d/1TbEogY9MliNXXHw5BM_AnCJQ5qzsVZX8je4AVU3mgt0/edit?usp=sharing

