MONETISING TANGIBLE PRODUCT IDEAS

HOW THE DIGITALISATION OF RESOURCES AFFECTS INDEPENDENT INVENTORS

MASTER'S THESIS | F.A. (Nick) Kroon

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JUNE 2017

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ABSTRACT

This thesis addresses the relation between the digital revolution and inventor productivity on the micro-level, with a focus on products with low to moderate complexity. The purpose is to stimulate innovative activity by means of getting insight in how the approachability of the invention process can be increased for the layperson and how self-efficacy of budding inventors can be increased. Four consecutive sub questions are answered starting with mapping common activities of independent inventors. Then for each of these activities resources are gathered that have been available in the past twenty-five years using both academic and non-academic literature and a market observation. Concurrently identifying resources used in the early nineties. Subsequently is a non-probability sample of sixty-one interviews with independent inventors reviewed to form a veracious notion on what resources are used today, how they are used and why. The findings so far are then recapitulated to identify resources attributable to the found alterations (internet as information source, social media, e-commerce, crowdfunding, computer-aided design and rapid prototyping). Lastly the effect of these resources on inventor performance is analysed using project management theory. The conclusion is described using a conceptual framework based on the aforementioned theory and on a doctoral dissertation about success factors of independent inventors. It is found that the digitalisation of resources has a profound positive effect on independent inventors in terms of performance, resource availability and resource acquiring capability. Independent inventors become more autonomous and social skills become less important. However, it was also found that skills related to processing excessive amounts of information, and related to computer-aided design software moderate the relation between the inventor's input and performance. Limitations of the research, as well as suggestions for further research are given and both theoretical and practical implications are described.

Keywords: *commercialisation, digital revolution, digitalisation, ideation, independent inventor, innovation, licensing, monetisation, new product development, open innovation, resources, tools*

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CHAPTER 1 INTRODUCTION

1.1 Background, context and complication

Not every innovative idea will change the world, but without them, the world would not change at all. Ideas are the foundation of innovation and everyone will be struck with one at some point in their life, if not on a regular base. Independent inventors distinguish themselves from the ordinary by following up on their ideas and therewith potentially changing the world for the better, one step at a time. The omnipresence of innovative ideas is evident, but are in that stage valueless. For society, and the ideator, to profit from such an idea, it has to be developed into a marketable product and subsequently be introduced to the market. Regardless of the process towards market introduction, the ideator has to be incentivised to, at least, start developing their idea up to a stage in which it becomes tradable intellectual property. Twenty-five years ago, the prospects were, rather daunting. In the early nineties, a report was published on a survey conducted amongst over a thousand US-based inventors (Whalley, 1992). Included were figures on obstacles and difficulties experienced by the inventors[1]. Funding profoundly formed the greatest difficulty, while lack of knowledge on development and marketing, and lack of access to raw material and equipment were also significant obstacles. Two years before that report, Udell conducted a study on the available contemporary services that support independent inventors with the development and commercialisation of their invention and found that these resources were at best underdeveloped (1990). The period following has been marked by the digital revolution, majorly affecting society. Relevant to this thesis is the impact it continuous to have on individuals, concerning their capabilities. Photography is a good example to clarify: people nowadays can bring about similar results as analogue camera era skilled photographers, without the technical knowledge and often in a fortunate stroke of serendipity. In other words, people today can effectively assume the positions of e.g. journalists (weblogs), music producer (dedicated software), reporters (YouTube), retailers (e-commerce) and so on, with the world as their perceived target group from the comfort of their own homes. Whereas the desirability of these consequences is not within the scope of this thesis, the desirability of an increase of innovative activity is. Hence, the question arises if these advances on digital sphere also affect the ease with which the role of independent inventor can be assumed. Evidently, independent inventors benefit from the digitalisation as well. In her handbook on making a 'million-dollar idea' into reality, successful and prolific inventor Lori Greiner reflects upon the merits of digital resources in retrospect.

> "When I got started in 1996, there was no Internet where I could access information. There were no forums where I could network with other entrepreneurs. No Kickstarter or Indiegogo. There was definitely no Shark Tank. There were few resources available to help an inventor with no connections and a limited amount of capital. It was tough!" (Greiner, 2014, p. 13)

Another inventor, Mark Sheahan, states in an interview the following.

> "[…] I must say that the Internet itself is still probably one of the most important tools ever devised that can help in the inventing process and business. The Web's powerful searching facilities, sources of information (both good and bad) and access to patents is empowering." (Andrews & Sheahan, 2011, p. 40)

With the advent of digital resources (tools) such as the internet, 3D printers and social media, it seems odds-on that the productivity of the independent inventor community has increased. Yet, the number of patents granted in the US over the past three decades show a constant rate for individual inventors, whereas that of their corporate counterparts show an almost sixfold increase[2]. Although patents show only a small portion of inventor activity, it does raise the question if the digitalisation did impact independent inventors at all. Even more because a recent study on the topic showed that independent inventors "are at a major disadvantage compared to corporations, universities, and other types of organizations" (Laplume, Xavier-Oliveira, Dass, & Thakur, 2015, p. 47).

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[1] Noteworthy results are included in Table 4 in Appendix A.
[2] See Figure 3 in Appendix A for a graph of the granted patents in the US in the period 1985 – 2015.

1.2 Research design

This thesis addresses the relation between the digital revolution and inventor productivity on the micro-level by seeking an answer to the following research question (RQ).

RQ How are independent inventors affected by the digitalisation of resources, in the Western world?

The following four sub questions (SQ) have been drafted to get to an answer.

SQ 1 What are common activities of the innovation process of independent inventors?
SQ 2 Which resources have been available for independent inventors since the early nineties?
SQ 3 Which resources are used by independent inventors these days?
SQ 4 What are the implications of digital resources for the performance of independent inventors?

The purpose of this research is to stimulate innovative activity by means of getting insight in how the approachability of the invention process can be increased for the layperson and how self-efficacy of budding inventors can be increased. The aim is to contribute to the efforts of organisations that stimulate innovative and entrepreneurial activity by providing a framework that can be used to better understand the needs and behaviour of individual actors. The focus in this study is on (consumer) products with low to moderate complexity (i.e. not high-tech). This thesis is thought to have academic relevance, given the limited amount of published research on independent inventors (Meyer, 2005; Weick & Eakin, 2005). No other studies were found that focus on the relation between digital resources and independent inventing. Therefore, it is assumed that this thesis contributes to the body of knowledge on independent inventors.

1.3 Thesis structure

In the next chapter, definitions of key terms are given and the conceptual framework is outlined (Chapter 2). Then the methodology used to answer the research questions is elucidated (Chapter 3). Subsequently, an answer is sought to the first sub question on common activities of the independent inventor's innovation process (Chapter 4). After which the second sub question is dealt with, analysing the different types of resources per each of the common activities (Chapter 5). Followed by an empirical account on the matter, describing the employment of resources, using sixty-one interviews with independent inventors and summarising the alterations between the early nineties and today in terms of resources (Chapter 6). On the basis of these findings, an analysis is carried out to identify the effects that digital resources have on the performance of this specific group of inventors (Chapter 7). Lastly, a conclusion is drawn on the effects the digitalisation of resources has on independent inventors, followed by limitations of this study, suggestions for further research and implications for various stakeholders (Chapter 8).

CHAPTER 2 THEORETICAL BACKGROUND

2.1 Definitions

2.1.1 Invention and innovation

In this thesis, the definition of invention is adopted from Schumpeter and Arrow. Schumpeter states that inventions are economically irrelevant until carried into practice (1934), while Arrow interprets invention "as the production of knowledge" (1962). Hence an invention is, hereinafter, defined as produced knowledge on the basis of an innovative idea, that is not yet economic relevant. The practice of inventing then becomes developing an innovative idea up to the stage at which it is viable for market introduction. This includes both the technical aspect and the market aspect. Innovation is related to invention but not interchangeable (depending on the definition). The definition of innovation is partially adopted from Schumpeter (1934). An innovation is a marketable (tangible or intangible) product (or service, method etc.) that is either an improved version of an already marketed solution to the very problem it 'solves', or a solution to a problem that was not yet solved. An innovative idea then becomes the foundation of such an aforementioned solution. Hence, the practice of innovating covers any effort required to successfully market an innovative product and therewith becomes an entrepreneurial endeavour (while such endeavour does not necessarily involve innovating).

2.1.2 The independent inventor

The prime topic of this study is the independent inventor[3]. The definition of such an inventor is adopted from Smeilus (2015) and reads: "an individual who creates new products, without formal obligation, outside of an established business." The counterpart of the independent inventor is the organisational (or sponsored, corporate) inventor, defined as "a person who invents within an organizational framework and is frequently sponsored in part or in whole by that organization [...] (Udell, 1990). Freedom to think 'outside the box' is what sets independent inventors apart from their corporate counterparts (Lettl, Rost, & von Wartburg, 2009). Lettl, Rost and von Wartburg discuss three factors that form the basis for this characteristic. First, the lack of explicit obligations to innovate, therewith having a high degree of autonomy. Second, they often have a clean slate, being industry outsiders (however, packed with knowledge of other industries). And third, they are less prone to organisational inertia (2009, p. 244). Independent inventors are represented in a wide variety, if not all, of industries and product groups (e.g. apparel, surgery, exercise devices, land vehicles) in terms of granted patents[4]. Udell (1990) further categorises the independent inventor into two groups: the *pure inventors* who have little interest in commercialisation; and the *inventor-entrepreneurs*[5] who "attempt to turn their inventions into innovations". The inventor in consideration in this thesis is the inventor-entrepreneur, as is elucidated in the next paragraph.

2.1.3 Commercialisation and monetisation

The title of this thesis starts with 'monetising tangible product ideas', which refers to the just mentioned goal of the inventor in mind. The (first) definition of '*monetise'* in the *Oxford Dictionary of English* is to 'convert into or express in the form of currency'. In order to convert the initial idea into currency, it has to be *commercialised* ('manage or exploit in a way designed to make a profit', *Oxford Dictionary of English*). Referring back to Schumpeter's definition of an invention, an economically irrelevant attribute, this implies that the person in consideration (likely the ideator) has to take on inventing activities to turn the idea into a marketable product. Subsequently, two options arise. Either commercialise through licensing the intellectual property (o*pen innovation*), or through market launch (*entrepreneurship*). The very nature of an invention is that it is new, thus the inventor who takes on entrepreneurship can be called innovator as well.

2.1.4 Open innovation or entrepreneurship

The choice between one of the commercialisation routes, is fully dependable on the inventor's preference and capabilities. Weick and Eakin (2005) found in an empirical study that inventors opting for entrepreneurship, compared to licensing, were most likely to achieve sales. Inventors opting for licensing, however, were more likely to achieve higher sales levels than those establishing a business (or selling the intellectual property outright). Commercialisation through the licensing of intellectual property (IP) is related to the open innovation model. This paradigm, attributable to Chesbrough, is the counterpart of the conventional closed innovation paradigm, and means that:

> "Valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well. This approach places external ideas and external paths to

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[3] In this thesis, the term "independent inventor" is used to refer to this group of inventors. Other terms used in the literature include: 'individual inventors', 'lone inventors', 'sole inventors', 'non-corporate inventors', 'private inventors' and 'Saturday inventors'.

[4] See Table 5 in Appendix A for an overview of the top 20 US patent classification system classes of the past two decades, by number of independent inventor patents.

[5] Also called inventrapreneur or technological entrepreneurs.

> market on the same level of importance as that reserved for internal ideas and paths to market during the Closed Innovation era.” (Chesbrough, 2003, p. 43)

Hence, from the perspective of an organisation that ‘has opened up’, intellectual property (of innovative nature) can be acquired (licensed) from external actors (inbound), such as independent inventors. Open innovation is a viable alternative to entrepreneurship, that requires different personal qualities. Alexy, Criscuolo and Salter (2012, p. 116), however, found that companies remain reluctant towards opening up organisational boundaries, as they “find it difficult to deal with unsolicited ideas because of high quantity, low quality, and the need to transfer IP ownership.” Engaging with entrepreneurship by either starting a venture or using an existing one, differs from licensing in that the inventor keeps full control over the invention. Where commercialisation via the open innovation strategy likely has an impact on meso-level (the focal company), has entrepreneurship the potential to have impact on macro-level. This is aptly described in the following quote from Morris, Neumeyer and Kuratko.

> “In the contemporary environment, the potential for any member of society to create some kind of venture has never been greater. These are ventures that are succeeding and failing, non-scalable and scalable, innovating incrementally and dramatically, better serving existing markets and creating new markets, and existing less than 1 year and for many generations. They empower individuals, enhance competition, create value, sustain communities, and generate economic growth and wealth.” (Morris, Neumeyer, & Kuratko, 2015)

2.2 The conceptual framework

Smeilus (2015) argues that inventors draw upon their personal resources and capabilities (soft and hard qualities), complemented by external resources to successfully navigate through the new product development process and realise a signed IP agreement. Based on extensive research, Smeilus found six criteria that influence the prospects of success (a signed IP agreement), that together describe three aspects. The three identified categories are inventor qualities (the inventor’s soft and hard qualities); resources (availability, acquiring capability and mode of acquirement); and project effectiveness (2015, pp. 505–516). Because Smeilus’ study is focused solely on IP licensing as commercialisation method, the project effectiveness criterion is determined not suitable for describing inventor performance. Therefore, this criterion is replaced with project management theory on performance, which is thought to better line up with the research. The theory made use of covers the ‘Iron Triangle’ model, a popular tool used by companies to get height on how the different aspects of a project are related to each other (Atkinson, 1999; Van Wyngaard, Pretorius, & Pretorius, 2011). These aspects are scope, cost, time and quality. The model, as is often depicted, is shown in Figure 2. A conceptual framework has been made using the nine mentioned factors and is modelled (Figure 1 below).

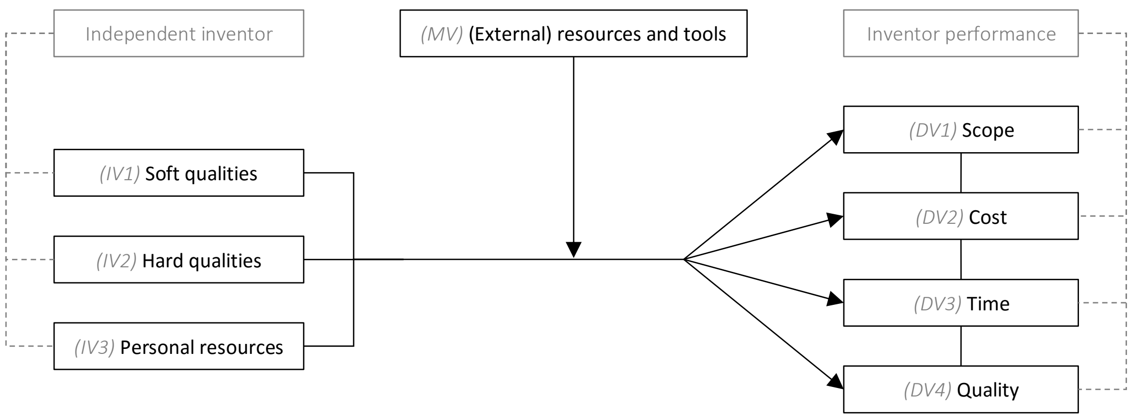

Figure 1. The conceptual framework. This model shows the relation between the success factors related to the independent inventor and the inventor performance, moderated by (external) resources and tools. (IV) denotes independent variable, (MV) denotes moderating variable and (DV) denotes dependent variable.

In the following paragraphs, the nine success factors are described. The first two categories (inventor qualities and resources) are described in the next two paragraphs. The description is an adaption from Smeilus’ definition (2015, pp. 505–516). The third category, inventor performance, is described in the last paragraph.

2.2.1 Inventor qualities

Soft qualities. The study confirmed that soft qualities (defined as personality traits, characteristics and attributes) required to invent where not the same as those required to develop and commercialise an invention. Soft qualities associated with success are the ones that enable an individual to withstand difficulties and prosper regardless these setbacks (e.g. perseverance, commitment, determination). Furthermore, are good absorptive and individual learning capacities important to make effective use of the resources. *Hard qualities*. Hard qualities relate, inter alia, to education and experience. It was found that, contrarily to the Human Capital Theory, higher level qualifications did not necessarily result in higher success rates. Practical experience with the processes of new product development and inventing in particular, however did and had the foremost impact. Those who had already pursued four or more inventions were twice as likely to succeed compared to those without experience. Another factor associated with success is practical experience through employment in the field of invention – likely resulting in a better understanding of industry requirements and identification of the right agents or organisation for assistance. Furthermore, closely-aligned education was also associated with success

2.2.2 Resources

Resource availability. The package of resources available to the inventor influences the prospects of success. The positive effect of high levels of financial and physical resources on resource availability is obvious. The possession of a high-quality relevant personal network is another factor that has a positive influence. Yet, over-reliance on the personal network for the supply of external resources were associated with lower chances of success. Another finding was that the type of industry in which the inventors operate had little impact on their success rates. Factors that the inventor cannot exert influence on, are related to the innovation system of which the inventor is part of. It was found that only the system's effectiveness in supplying resources and signposting inventors to the locus of these resources were associated with higher chances of success. *Resource acquirement capability*. The inventor has to create an actor network for obtaining external resources. The effectiveness of doing so depends on the willingness to collaborate with external parties and the capacity to enrol these resource into their invention development program. The ability to accurately specify the required external sources and knowledge also contributes to success. Economic transactions were argued to be the best method for obtaining external resources next to social exchange. Consequently, the following factors are associated with success. Having preference for economic transactions; being able to obtain the financial resources needed, if not by leveraging financial support (public sector grants); and the ability to effectively manage transaction costs. *Mode of resource acquirement*. One surprising finding of Smeilus' study was that a close alignment between the inventor's 'type' (e.g. introvert or extrovert) and the mode of resource acquirement (the balance between social exchange and economical transaction) is essential for success. "For instance, an inventor who is: self-confident, an extrovert, but has no personal financial resources should use a social exchange biased mode of resource acquisition" (2015, p. 510).

2.2.3 Inventor performance

During the years, the 'Iron Triangle' model has been continuously developed and has become an important part of the project management theory. A contemporary version of the model consists of (at least) six factors, whereas the 'Iron Triangle' only four. A consistency between these versions is that factors are related in such way that a change of any one factor likely result in at least one other factor being affected (Project Management Institute, 2013, p. 6). The four-factor version is used to describe inventor performance, based on the assumption that it is sufficiently detailed for this (type of) research.

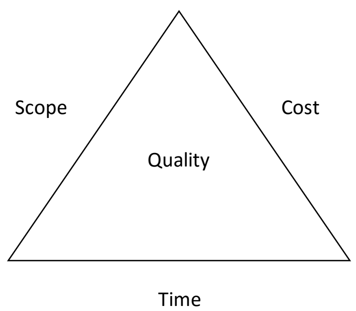

Figure 2. Popular representation of the 'Iron Triangle'. Adapted from "Strategic management of the triple constraint trade-off dynamics - A polarity management approach" by C.J. Van Wyngaard, H. C. Pretorius & L. Pretorius, 2011, *IEEE International Conference on Industrial Engineering and Engineering Management*, 824.

Because the model concentrates on organisations, it is not suitable to describe a self-commissioned project carried out by an individual in its current form. Therefore, a new model was constructed using the four-factor 'Iron Triangle', interpreted using the contemporary theory on the subject. This model is integrated in the conceptual framework (Figure 1) and describes the relation between the independent inventor and inventor performance, moderated by the employed resources and tools. The independent variables related to the inventor are constants (in this perception of the framework) as the focus is purely on the influence of the moderating variable. The moderating variable influences inventor performance by shifting from a set of conventional resources, to its digital counterparts. The effect on inventor performance is based on the four, interconnected, dependent variables (scope, cost, time and quality). Hence, the effect on inventor performance for one set of resources (conventional resources and its digital counterparts) for one particular activity is measured in four iterations of two cycles each. In the first cycle the conventional resources are tested and in the second the digital resources (or the other way around). In total, four iterations are made, one factor at a time. Instead of analysing how a change to the focal factor affects the others, are the latter constrained and is the effect on the focal factor analysed, when the employed resources (conventional to digital or vice versa) are changed. The definitions of the four factors are derived, and adjusted, from the Project Management Institute (2013, pp. 530–555)[6]. Though, the definitions of the factors when constrained are not. *Scope* is defined as the activities (or tasks) carried out by the inventor, instead of being outsourced. When constrained, the inventor will carry out the same set of tasks, or less. *Cost* refers to the available (estimated) budget for the monetising project as a whole. When constrained it means that the budget will not be increased. *Time* is defined as the scheduled time of completion. When constrained implies that the scheduled time of completion will not be postponed. *Quality* describes the degree to which the requirements of the ideal results or products of the various activities are fulfilled. When constrained, the degree to which the requirements are met will not be lower. An example of one iteration (thus one factor) is described to clarify the model. When cost is the focal factor, the difference between using conventional or digital resources for one specified activity is analysed without requiring more tasks to be carried out (scope), without postponing the scheduled time of completion (time) and without negatively affecting the degree to which the requirements are met by the result or product of the activity in consideration (quality).

[6] The definitions of the four factors are derived from the Project Management Institute (PMI), however the used terms are not consistent. Scope is derived from PMI's definition of 'project scope'; cost is derived from 'budget'; time from 'schedule model'; and quality from 'quality'.

CHAPTER 3 **METHODOLOGY**

3.1 Research scope

This thesis describes a qualitative, exploratory research after the question how digital resources have affected independent inventors. The limits of this research's scope are defined by the following four limits.
First, the focal products are of low to moderate (technical) complexity. Second, the study has been conducted from the perspective of the mainstream independent inventor[7]. Third, the study is geographically limited to the Western world[8] in terms of the location from which the inventor is active and in terms of accessibility of resources (only resources that are marketed in any of the countries are included). And fourth, only sources in either the English or Dutch language are used. In the following paragraphs, the used methods to answer each of the sub questions and the research question are described.

3.2 Common activities (SQ1)

The purpose of the first sub question (*What are common activities of the innovation process of independent inventors?*) is to get an overview of common activities and their goals carried out by independent inventors and is described in Chapter 4. Whereas independent inventors are generally marginalised by academics, they are not in the non-academic literature at all. Many websites are based on the very topic and handbooks are widely available. A search on books within the entrepreneurship section on *Amazon* with the search term 'inventor' results in over 180 books of which the majority are handbooks. Data has been collected by reviewing both academic (journal articles, conference proceedings, and study books) and non-academic literature (handbooks on inventing, survey reports). Triangulation has been used to process this data, as it is thought to assure the reliability of the research. This process has been visualised using the software application *Scapple* (by *Literature & Latte*). This application is termed a free-form text editor (it replaces paper and pen with an unlimited digital canvas) and is in some way relatable to mind-mapping software. Broadly speaking, the workflow has been as follows. Initially *Google Search* was used to get an idea of the process in general and details of the process. Next, journal articles were searched for on *Google Scholar*, *Web of Science* (*Thomson Reuters*), *Scopus* (*Elsevier*), *Research Gate* and *Google Search*. Relevant handbooks were searched for on *WorldCat* and also on *Amazon*, *eBay*, *Bol.com* and *Google Books*. Unfortunately, lack of accessibility resulted in the use of just a fraction of existing books.

3.3 Inventor's resources (SQ2)

The goal of the second sub question (*Which resources have been available for independent inventors since the early nineties?*) is to identify available resources throughout the years since the early nineties and get a notion on what was used back then and is described in Chapter 5. The research was conducted in an iterative fashion using a snowball approach. It is thought that this method leads to the most extensive overview possible within a short amount of time. The validity is assumed justified by the notion that actual (independent) inventors will likely deploy a similar method when searching for resources or tools. The software application *Scapple* was again employed for the visualisation of thoughts as well, which helped to structure the research. The workflow used to identify as many resources, that are realistic options, for independent inventors[7] consisted of an initial round of brainstorming, followed by reviews of academic and non-academic literature (similar to those used for sub question one), and online market observation. Resources and tools that were obvious were readily documented, while others were identified using the following steps. At first, as much information as possible was gathered in the literature and on the internet about the focal resource, with the goal to get an improved understanding of the specific terminology. Then, the found terminology was used to conduct a more accurate search on the focal research. On the basis of the found information, it was determined if the focal resource could serve any meaningful purpose for the independent inventor by reasoning how it would be employed in any of the found activities (sub question one)[9]. Lastly, it was determined if the focal resource is a realistic option for independent inventors by considering the cost price, required physical space, required labour, accessibility among other factors – concurrently doing the same regarding the early nineties, using dated literature.

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[7] Inventors whose primary aim is the invention itself and who do not search for and select cutting-edge resources for the sake of it.
[8] In this thesis, the Western world is defined as the collective of countries in the European Union, United States of America, Canada, Australia and New Zealand.
[9] Virtual and augmented reality techniques are examples of resources that have been excluded in this research as it was assumed that these techniques did not yet fulfil any purposeful meaning with respect to independent inventors in general at the time of writing.

3.4 Resources used today (SQ3)

The intention of the third sub question (*Which resources are used by independent inventors these days?*) is to get a veracious account on the use of resources these days and is described in Chapter 6. The aim is to get a notion on the perceived merits of the different resources. This research is explorative and the intention is to gain better insight in the use of resources, not to document a comprehensive or representative notion of the independent inventor community as a whole. Data that has been used stems from a set of over a hundred standardised, open-ended, interviews with independent inventors and people who have a related profession (e.g. inventor coach, patent attorney). These interviews have been published on the blog *IdeasUploaded.com* over the course of four years, between October 2010 and June 2014 (Roskell, n.d.). The information derived from the interviews is used to conclude how the identified resources are used and why (or why not). An answer on the sub question is given in Table 2 (page 17). And consists of a comparison of resources used in the early nineties (sub question two) and those used today, resulting in the identification of the alterations in resources. The used sample was drawn from this collection by screening interviews on the prerequisite that the interviewee was, at that moment, an active independent inventor with the intention to successfully commercialise their invention (both licensing and launching). Monetising success of the inventors was not taken into consideration because the inventors were at different stages of the process. Besides, success is not assumed to be essential for answering this sub question. The screening resulted in a non-probability sample, with a sample size of sixty-one interviews. The descriptive statistics of the sample are as follows. One person was interviewed twice, leaving a total of sixty independent inventors of whom thirty-seven are male and twenty-three are female. Forty-one interviewees were based in the USA at the time the interview took place, thirteen in England, three in Canada, one in Australia, one in Spain and one in The Netherlands. A table containing information about the interviews and the URLs can be found in Table 6 (Appendix B). The interviews were analysed (qualitative analysis) by coding (identifying) resource-related themes using both the interviews and the findings on the first two sub questions. This method was used, as it was assumed that it enabled for partially scanning the interviews (instead of full in-depth review), due to limited time available. The workflow sequence has been as follows (several iterations were made). At first, the web pages of the interviews were saved to PDF files, to enable the extraction of text (using both *Apple Automator* and *AppleScript*; features of the *Apple Macintosh* operating system). Second, the interviews, now converted to plain text, were analysed by using a web based text analysis software application called *Voyant Tools* (*voyant-tools.org*) to get an understanding of what terms are used and what information the text contains. The conclusion was quickly drawn that thorough examination was required because of a lack of consistency in both terminology and writing styles. Both *NVivo* (by *QSR International*) and *Microsoft Excel* were tested. The latter was chosen due to more flexibility. Third, the interviews were scanned by placing them in a spreadsheet, each sentence in a separate row, and consecutively ticking resource-related sentences. A brief summary of every interview was written on the basis of these ticked sentences for identifying the themes. Fourth, labelling the summaries on the basis of the themes, followed by scanning the interviews to identify keywords per each theme and marking relevant sentences. Fifth, data was collected per each term, using its identified set of keywords, by analysing the interview sentences on the basis of these keywords. An *AppleScript* was written to automate this searching process. Lastly, the collected data per each theme (either a resource, or a type of resources) was analysed and to conclude on how the focal resources were used, and why they were chosen.

3.5 Inventor performance (SQ4)

The fourth sub question (*What are the implications of digital resources for the performance of independent inventors?*) is documented in Chapter 7 and the aim is to get an understanding of the impact of the various digital resources (sub question three) on inventor performance. The analysis was conducted in accordance with the conceptual framework (Paragraph 2.2), one set of resources (sub question three) at a time. The common activities (sub question one) were used as guidance. The results of this analysis were synthesised by identifying the implications per each of the four factors by shifting the focus to the resources and away from the activities and subsequently documented. Again, the software application *Scapple* was used to visualise, and organise, the research.

3.6 Digital resources' effect on inventors (RQ)

The answer on the research question (*How are independent inventors affected by the digitalisation of resources, in the Western world?*) is described in Chapter 8. The conceptual framework (Paragraph 2.2) is used to describe the identified implications on the independent inventor, when digital resources are used in favour of conventional ones. The implications on each of the nine factors that make up the conceptual framework were analysed by synthesising the findings on the sub questions and other insights gathered during the research.

CHAPTER 4 COMMON ACTIVITIES OF THE INNOVATION PROCESS

4.1 Stages of the innovation process

This chapter describes common activities involved with the monetising process on the basis of different stages that make up the process. Although innovation processes are dynamic and context-dependent, some models are described in the literature such as: linear, iterative, cyclical and stage-gate (van der Voort & van Ormondt, 2011, pp. 29–33). Cooper's Stage-Gate® model (Cooper, 1990, 2008; Edgett, 2015) is a well-known example that is very often deployed as a project management tool within firms (Cooper, 2008; van der Voort & van Ormondt, 2011, p. 31). Smeilus and Pollard studied the independent inventor's new product development (NPD) process and found that the stage-gate model "offers the greatest value when developing the foundations of a conceptual model that explains how independent inventors develop their inventions" (2016, p. 3). Fieldwork resulted in a modified stage-gate model that applies to independent inventors opting to license their invention. The model describes five stages, namely: scoping; development and testing; build business case; pre-licensing and license agreement (2016, p. 12). An altered version of this division is used to better fit the context because Smeilus and Pollard's paper only covers licensing, not entrepreneurship. The determined stages are as follows: scoping, development and testing, business case, commercialisation by license and commercialisation by launch. Each stage is elucidated in the remainder of this chapter and identified common activities are mentioned. Though It should be minded that the innovation process of independent inventors, being more subject to uncertainties than their corporate counterparts, is rather unpredictable on both composition and sequential level. Yet, information on how to conduct an activity is often required, which suggests that the activity of *sourcing information* has a stake in the degree of success of the endeavour and is therefore analysed as well. The activities are summarised in Table 1 alongside their goals and ideal results or products. The latter relates to the performance indicator 'quality' (see Paragraph 2.2.3). It is emphasised that the process is iterative and some phases and activities should be executed partially sequential and partially concurrently (Cooper, 1990; Smeilus & Pollard, 2016).

4.2 Scoping

A trivial, but important activity is *idea registration* (often in the form of an inventor's notebook). A dated and witness-signed record of the idea could serve as supporting documentation for a patent examiner (Kennedy, Watkins, & Ball, 2012, p. 56), in case any dispute has arisen about who the actual ideator is. Smeilus and Pollard (2016) found that prior to the scoping stage, the inventor will assess the idea in a subjective way, before deciding to follow-through or abandon the idea. They found that inventors are mostly occupied with *prior art search* and *patent search* to determine if the invention is both novel and patentable. Prior art search refers to the search for similar products as the invention that have been published already, whereas patent search refers to already published, similar patents (World Intellectual Property Organization, 2016). In addition is *initial market research* necessary to determine market place merit (i.e. determine market size, potential and likely acceptance) (Cooper, 1990; Foreman & Welytok, 2009; Smeilus & Pollard, 2016). Technical merit should also be determined concurrently by *concept development* (Cooper, 1990; Koster, 2008; Smeilus & Pollard, 2016). Smeilus and Pollard (2016, p. 3) performed a review of sixty-six inventor biographies (both independent and dependent inventors) presented by the Lemelson-MIT programme of the Massachusetts Institute of Technology (MIT) and found that inventive ideas were typically captured by sketching conceptual designs.

4.3 Development and testing

Product development is an extensive process that is often divided in approximately ten steps, for example in the model described by Koster (2008). Merely steps that are distinctive concerning resources are included, starting with concept development. This activity is, however, already included in the scoping stage. This might be confusing, but it should be noted that both the innovation process and product development processes are, at least in this case, iterative. Next is *detail design* (including engineering) of the product together with *prototyping*. The prototype together with other obtained information can be used for *verification* of the invention to, assess if the design requirements are met (Cooper, 1990; Foreman & Welytok, 2009; Koster, 2008; Smeilus & Pollard, 2016).

4.4 Business case

4.4.1 Business plan

The business case stage covers activities used to conduct specific research and document concrete information that prove market potential, financial feasibility and possibility to protect the IP. Market research is conducted to prove market potential. There are two ways of market research, primary and secondary. *Secondary market research* refers to the use of data that is compiled by an external party. *Primary market research* makes use of data that is collected by the inventors themselves or on behalf of the inventors. Secondary research should always be carried out prior to primary research, because some information might already be available (Fahy & Jobber, 2012, p. 92). *Validation* of the business case is important to prove market potential (Cooper, 1990). Leach and Melicher (2012, pp. 40–42), and Foreman and Welytok (2009, p. 60) also emphasise the importance of *financial analysis*. Two decisive aspects of financial analysis are *pricing* and *funding* (Foreman & Welytok, 2009; Leach & Melicher, 2012).

4.4.2 Intellectual property protection

IP protection application is an important aspect for both launching and licensing an invention. IP can be protected either formally (e.g. patent, copyright, trademark) or informally (first to market, trade secrets) (Hall, Helmers, Rogers, & Sena, 2014; Leach & Melicher, 2012; Scherer, 2015). Smeilus and Pollard point out that the exchanged asset in licensing is the patent (2016, p. 12). Licensing an invention without formal IP protection is, however, not impossible with inter alia a 'take-it-or-leave-it contract' (King, 2003). Yet, Arrow argues that "there is a fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he has the information, but then he has in effect acquired it without cost." (1962, p. 615). Hence, licensing an unprotected invention is the odd exception, whereas launching an unprotected invention is not so much (Hall et al., 2014). Only formal IP protection is taken into account, since informal is not always applicable (contrary to formal), thus not a common task. Two branches of intellectual property exist, namely copyright and industrial property. This study is limited to two systems of industrial property: the patent system (inventions) and the industrial design system (aesthetics of inventions) since only tangible products are covered (World Intellectual Property Organization, 2016).

4.5 Commercialisation

4.5.1 Licensing (open innovation)

As elucidated in Chapter 2, an invention can be commercialised in two ways, either through open innovation by licensing the intellectual property (protection) or through entrepreneurship by launching the invention (Foreman & Welytok, 2009; Whalley, 1992). Foreman and Welytok describe the licensing trade-off as follows: "it is a way to profit from an invention while minimizing the personal risk and commitment", adding that the risk-return trade-off applies (2009, p. 149). In the case of licensing, two main activities are identified, namely *licensee search* (identifying and addressing potential licensees) and *pitching and presenting* the product to convince potential licensees of its merit (Foreman & Welytok, 2009).

4.5.2 Launching (entrepreneurship)

Launching an invention involves four main aspects: manufacturing, *distribution,* pitching and presenting, and *promotion*. The manufacturing of the product will most likely be outsourced to one or several companies (Foreman & Welytok, 2009, p. 50). It is indeed unlikely that individuals have the right manufacturing equipment in their possession. Therefore, the main focus of manufacturing is on finding a suitable manufacturing partner (*manufacturer search*), not on the actual production of physical goods. The product could be distributed either to retailers or (sold) directly to the customer (Fahy & Jobber, 2012, p. 285). Pitching and presenting is also part of launching a product. Whether the outlet has been chosen to be a crowdfunding platform (e.g. Kickstarter.com) or a local shop, the product has to be pitched to either the shop or the 'crowd' – or as Foreman and Welytok suggest, to the decision maker (2009, p. 138). Potential customers have to be made aware of the product's existence on the market to be able to actually generate sales. Promotion is the activity involved with creating this awareness (and persuade to buy) and many different ways to do so exist, including advertisements, sales promotion and personal selling (Boone & Kurtz, 2012, p. 499).

4.6 Process sequence

Independent inventors are resource-dependent (Docie, 2015; Greiner, 2014; Smeilus & Pollard, 2016; Udell, 1990), subsequently, resources predominantly determine the actual sequence of the process (not solely a model such as stage-gate). Nonetheless, handbooks on the subject (e.g. Docie, 2015; Foreman & Welytok, 2009; Greiner, 2014) show coherence with Smeilus and Pollard's modified stage-gate model (2016) that is based on case studies of actual independent inventors. This is however not very surprising, since authors of such handbooks are predominantly experience experts themselves. A lesson can be drawn from the pursued neatness of the process in the corporate world. Cooper's stage-gate model (1990) has been widely adopted by companies globally, but as he found out, often in a wrong fashion (Cooper, 2008). Many firms have implemented the model in a way that it rather represents a linear (and rigid) process, leaving too little space for the necessary iterations and feedback loops. Hence, in their efforts to gain full control of their innovation activities, the companies managed to create an ineffective, but neat, system. In other words, the process of inventing varies with each project, although some activities simply cannot be executed before another (e.g. licensing a patent obviously requires a patent) which can be modelled after (such as the modified stage-gate model). Iteration and feedback loops are considered vital by both scholars and experience experts (Cooper, 2008; Docie, 2015; Foreman & Welytok, 2009; Greiner, 2014; Smeilus & Pollard, 2016).

Table 1

Common activities, their goals and ideal results or products from the independent inventor's perspective

Activity	Goal	Ideal result or product
Sourcing information	Gathering useful and correct 'how-to' information	All necessary knowledge to successfully carry out the whole process
Idea registration	Creating a dated and witness-signed record of the idea to prove being the ideator	A dated and witness-signed record of the idea that is accepted by (legal) officials as authentic
Prior art search	Check if no similar product exists, or has existed	All relatable products, that are available or have been in the past, of every country checked on similarities
Patent search	Check if no similar patent already exists	All relatable patents, both active and expired, of every country checked on similarities
Initial market research	Determine market place merit ex ante	Information that proves market demand for the conceptualised solution to the presumptive problem
Concept development	Determine (preliminary) design and technical merit ex ante	Information that proves (technical) feasibility of the chosen conceptualised solution to the presumptive problem
Detail design	Creating a documented engineered design ready for production	Information required to manufacture a product that meets the design requirements of the invention
Prototyping	Creating mock-ups, working models, engineering prototypes etc.	A physical representation of the invention that can be used to assess various aspects of the invention (e.g. aesthetics, ergonomics, (technical) feasibility)
Verification	Check if the design meets the design requirements	Measurement or assessment results on the fulfilment of the design requirements
Secondary market research	Define the target market with externally obtained data	Information describing the presumptive target market as a whole
Primary market research	Define the target market using data collected on one's own behalf	Information describing the presumptive target market in more detail
Validation	Check if the presumptive target market exists	Sales figures that accurately prove market demand for the developed invention in the presumptive target market
Financial analysis	Creating overview and balancing the assets and cash flows	Accurate financial plan including cost estimation, cost control plan and cost budgeting plan
Pricing	Determining the market value of the invention	Information proving the chosen market value
Funding	Balancing the budget throughout the process	Agreements with investors, lenders, or an organic growth plan, or both that (combined) provide sufficient, risk-free, cash at any point throughout the process
IP protection application	Getting the intellectual property protected with (design) patents	One or more accurate and valid (design) patent applications that protect the intellectual property in the countries of choice
Licensee search	Finding an external party willing to license the intellectual property (protection) of the invention	One or more interested parties that will license (or purchase) the intellectual property (protection)
Pitching and presenting	Convince potential partners or persuade potential customers with visual aids (e.g. drawings, animations, prototypes)	External parties convinced of the added value of collaborating, or customers persuaded to buy the product
Manufacturer search	Finding a suitable company to manufacture the invention	One or more suitable parties that are willing to manufacture the invention
Distribution	Getting the invention in the hands of customers or retailers	One or more accessible outlets findable by every single member of the target market
Promotion	Making the target market aware of the product being on offer and persuade to buy	Customer awareness, among the complete target market, about the product and its distribution points and persuaded to buy one or more units

Note. It is emphasised that the ideal results or products are purely theoretical and, in nearly all cases, not feasible. Additionally, the sequence of activities is merely suggestive, as the actual sequence will likely be iterative and context-dependent.

CHAPTER 5 INDEPENDENT INVENTOR'S RESOURCES

5.1 Introduction

Independent inventors are, paradoxically, resource-dependent (Docie, 2015; Greiner, 2014; Smeilus & Pollard, 2016; Udell, 1990). This implies that the used resources affect the effectiveness and efficiency of the innovation process and therewith the chances of success. Hence, a resource-related improvement might be beneficial for the independent inventor's. In this chapter, relevant resources and their presence in the past approximately twenty-five years are described in order to see if the digital revolution has caused improvements that *could* have better equipped independent inventors[10]. Resources used in the early nineties are emphasised for this very purpose. The period of the early nineties is not arbitrarily chosen. Digital resources (such as computer-aided design) already existed and were readily employed in the corporate world. Reports of independent inventor surveys of that time, however, showed that these resources were out of reach of the individual (Amernick, 1991; Brown, Curlee, Elliott, & Franchuk, 1993; Mohawk Research Corp., 1989; Whalley, 1991, 1992; Wisconsin Innovation Service Center, 1991). The activities are grouped together based on their very nature, rather than assigned to the process' phases. The groups are as follows: intellectual property protection, market research, product development, financial planning and commercialisation. Sourcing information is dealt with in a separate paragraph. Two categories of resources are omitted: family and friends, and (unscrupulous) invention promotion firms. *Family and friends* are an obvious source of assistance for inventors, but are omitted because they cannot be obtained from the market – in the same manner as the other resources that is. *Invention promotion firms* are services that assist the inventor with every step of the process. Although some ethical invention promotion firms exist, a great deal of them are scams (Udell, 1990; United States Patent and Trademark Office, 2004)[11]. Moreover, will the promotion services benefit from the same digital advances as the inventors do and can be consulted for every activity. If this type of resource would be included, it results in the same note in every paragraph and is therefore omitted.

5.2 Sourcing information

The advent of the internet has had far-reaching influences on many aspects of life. Especially the young generations growing up in a world marked by the internet will likely be rendered helpless when cut off from the internet on many occasions. Yet, a world in which the library was the prime locus of sourcing information is not part of a remote past at all. Reports on independent inventing written during that time (Mohawk Research Corp., 1989; Whalley, 1992; Wisconsin Innovation Service Center, 1991) describe the use of books (libraries), magazines, catalogues, professionals (e.g. patent agents, engineers, manufacturer representatives), publications (whitepapers) and seminars of companies. Starting points to find the right references included inventor associations and certain government agencies (addressed by writing, telephone, facsimile or a visit). The Wisconsin Innovation Service Center strikingly stated that, "quick access to this information is expected to reduce an inventor's product development time, an increasingly critical issue as product life cycles grow ever shorter, as well as reduce frustration levels" (1991, p. 1). One attempt to do so was the introduction of computer searches (on a certain topic) carried out by librarians, commissioned by (paying) visitors (Mohawk Research Corp., 1989). The internet made this lead time to nearly diminish, but also introduced new (often less reliable) information sources such as *Wikipedia*. Furthermore, is the introduction of interactive guides for various purposes, such as writing a business plan (e.g. *Bizplan.com*, *LivePlan.com*, U.S. Small Business Administration), seen as a product of the digital revolution.

5.3 Intellectual property protection

While patent systems have seen changes (e.g. the American Inventors Protection Act of 1999), the application process itself has remained mostly untouched, other than a shift of locus to the internet. Nowadays patents can be filed through internet platforms (for instance at the United States Patent and Trademark Office and European Patent Office). Hence, patent agents (such as patent attorneys, patent engineers etc.) have remained the recommended professionals to find assistance with the process. Some activities inherent to patenting, prior art and patent search, are more significantly affected. Patents used to be searched in dedicated libraries (such as the Patent and Trademark Resources Centers in the USA) or at offices of patent organisations. Already in the beginning of the nineties, 'Automated Patent Systems' were

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[10] The availability of resource does not imply they are employed accordingly.

[11] The United States tried to end this practice with the American Inventors Protection Act of 1999. Yet, a quick Google search on "Scam" and "Davison" (an infamous example) shows that these inventor promotion firms are still active.

implemented (Amernick, 1991, p. 109). These systems were the ancestors of online patent databases of today such as *Google Patents*, *Espacenet* and *Patentscope*. Inventors can easily access such databases from anywhere on the world. Most of these databases can be used for free (e.g. *Google Patents*), which is a big contrast to the early nineties when copies of patents could be ordered at the United States Patent and Trademark Office (USPTO) for USD 1.50 each (Amernick, 1991, p. 109). The search for prior art has also been extended to the internet, in addition to retail outlets, magazines, catalogues and such. One benefit of the internet is the presence of archives (e.g. *Google News Archive*) that can be used to search for products that have already become obsolete – which still counts as prior art (European Patent Office, 2016). While physical (diary-like) notebooks remain valuable tools, an official virtual alternative named *i-Depot* (Benelux Office for Intellectual Property) does exist. This is however the only example found of a digital idea registration service. Yet, conventional (physical) notebooks are still advised (at least in the USA) because they can be more easily examined by judges, jury or both (Palovich, 2014).

5.4 Market research

5.4.1 Secondary research

Today, inventors and entrepreneurs with the required skills and knowledge can carry out effective market research without the need of big investments. In the early nineties, market research was predominantly conducted by professionals and was a time and energy consuming activity. Back then, data for secondary research was available from various sources including libraries, industry magazines, trade associations, government publications (for example from the US Small Business Administration office, or departments of commerce), securities brokers or marketing companies such as *The Nielsen Company* (Mohawk Research Corp., 1989; Pope, 1993). The internet has introduced more convenient ways of accessing data with online databases such as *Eurostat* (European statistics). It has also introduced a new source, that of online activity of the masses (e.g. *Google Trends*) and social media use. Both types of data provide insight in what is on people their minds. Asur and Huberman even found that social media is a good forecasting technique (Asur & Huberman, 2010).

5.4.2 Primary research

Primary research has to be carried out if the needed data does not exist, or is not accessible. The internet offers superb resources for observing consumers. Social media (e.g. *Twitter*, *Facebook*) is an obvious example, but major e-commerce platforms (e.g. *eBay*, *LightInTheBox*) often provide good information (e.g. reviews, number of times sold). Interviewing methods that were used include research through mail, facsimile and door to door. A state-of-the-art interviewing tool in 1993 was 'computer-assisted telephone interviewing', which enabled interviewers to directly process the given answers on the computer (Pope, 1993). Despite the innovation, performing interviews remained a very time-consuming process. In-depth interviews remain time-consuming, but the lead time of surveys has decreased significantly by the internet. Websites such as *SurveyMonkey* and *Google Forms* enable researchers to create surveys, send them online and conveniently collect the data. Focus groups are still organised (e.g. *Business Network International*), but can also be found digitally for example on web forums. Although body language cannot be read online and certain interaction is missing (Fahy & Jobber, 2012, p. 97), they can often be observed without actively taking part in the discussion. The computer has also significantly increased convenience of data analysis. Spreadsheet applications (e.g. *Microsoft Excel*) is an excellent tool for simple analysis. Statistics and mathematics software programs that can be used for more complex analysis of data (e.g. *SPSS*, *Stata*, *MATLAB*, *R*) are available in various price ranges (including open source, free, software). It should be noted that specialised skills are required and that some applications have a steep learning-curve. Analysing big amounts of data is, however, practically not feasible by hand (Pope, 1993).

5.4.3 Validation

Market testing is the most obvious way of validating an invention. Traditionally this meant offering the product for sale on a small scale locally, which therefore entails only a small geographic area. Internet enables for market testing on a global scale through e-commerce (Foreman & Welytok, 2009, p. 43). Greiner (2014) points out the value of crowdfunding platforms (e.g. *Kickstarter*, *Indiegogo*) as a way of market testing an invention. The biggest advantage of these platforms is that, in essence, only a good story supported by visual aids and a decent cost estimation (to determine market value) are necessary to launch a campaign (thus an option on a low budget). However, Greiner also adds that publishing the invention online before formal IP protection has been applied for (or granted) can have negative consequences (2014).

5.5 Product development

Both engineering and technical drawing tasks require thorough training. If the inventor does not possess the required skills, then the most obvious choice is to outsource the job to, for instance, engineering consultancies. The emergence of online freelance marketplaces (e.g. *Guru.com*, *Upwork.com*) provide an alternative to convent provide an alternative to the conventional business model for outsourcing the job. Foreman and Welytok (2009, p. 65) suggest to inform at universities if they have the possibility to assist with the work as an alternative. For the remainder of this paragraph it is assumed that the inventor does possess the required skills to effectively use the mentioned resources.

5.5.1 Detail design

In recent times, many worthwhile engineering tools have emerged. Spreadsheet software are very useful regarding the iterative nature of solving engineering problems. The internet contains many of such calculation sheets (e.g. *EngineeringToolBox.com*). *Autodesk ForceEffect* was a handy tool for free body diagram calculations (mechanics), but seems to have been retired by Autodesk. A worthy alternative has not yet surfaced at the time of writing. Designing the product (aesthetically) can also be digitalised. Sketching and drawing software such as *Adobe Sketch* or *CorelDRAW* are digital alternatives to paper. One of the biggest advantages include the convenience of undoing edits (easy adjustments) and a broad set of drawing tools. Ongoing development of graphic tablets (e.g. *Wacom Intuos*) and pen displays (e.g. *Wacom Cintiq*, *Apple iPad Pro*), result in incredible accuracy that comes close to drawing on paper. Traditional technical drawing on paper has completely been superseded by two-dimensional computer-aided design (2D CAD), such as *AutoCAD*. According to Breedveld is the biggest advantage of CAD to be found in time reduction when corrections are needed (2008, p. 3). Computer-aided design (CAD) software for electrical drawings and other types of drawings also exists (e.g. *AutoCAD Electrical*). More advanced CAD software include 3D modelling (e.g. *Autodesk Inventor*, *Dassault Systèmes SolidWorks*, *Siemens NX*). 2D drawings can be derived from a 3D model without the need for separate 2D CAD software in most 3D CAD software.

5.5.2 Prototyping

Conventional ways of making prototypes, with respect to inventors, include handicraft, (clay) sculpting or conventional machining. Outsourcing is the alternative and has been a common one given the required space, tools and materials that are not often at the inventor's disposal (Mohawk Research Corp., 1989; Whalley, 1991). These traditional methods have been joined by digital and rapid prototyping methods. Digital prototyping comprises the creating of a 3D model in for example 3D CAD software or 3D design software (e.g. *Autodesk 3ds Max*, *Trimble SketchUp*). Worth mentioning is the possibility of creating digital models by scanning objects in 3D (with the use of a 3D scanner). The 3D models can subsequently be printed, using additive manufacturing (3D printing), a well-known form of rapid prototyping. 3D printers are becoming increasingly accessible with starting prices of a few hundred dollars (ABS or PLA plastics) and only occupy minimal space. The company *Markforged* produces and markets noteworthy 3D printers. The *Mark Two* that prints composites (carbon fibre, glass fibre and Kevlar), offered for USD 13,5k (excl. vat). And the *Metal X* that prints metal, offered for less than USD 100k. Purchasing a 3D printer is not a necessity though. 'Sharing economy'-type websites such *Shapeways* and *3Dhubs* connect people and companies with 3D printers and other type of rapid prototyping tools, to people and companies who need something printed.

5.5.3 Verification

The inventor today has two options to verify a product, in this thesis defined as verifying that the designed product actually meets the design requirements. Either real world testing or virtual. Respectively by creating a work-like prototype (or engineering prototype) that serves as a proof of concept (Foreman & Welytok, 2009, p. 65), or by using simulation software. In case of testing the product's mechanics, is finite element analysis (FEA) a well-known simulation that is available as separate software (e.g. *COMSOL*) or add-ins of 3D CAD software. Given the extensive training necessary to master techniques such as FEA and similar, it is unlikely that many inventors will make use of it (except those with the right background). No other options were identified. Yet, it is expected that verification predominantly takes place by simply examining and testing the (final) prototype, and possibly by obtaining required markings (e.g. CE marking) through certified bodies.

5.6 Financial planning

A financial plan is part of the business plan and consists of financial statements and balances. The computer has made financial accounting a lot more convenient. Most noteworthy is spreadsheet software (e.g. *Microsoft Excel*), which is a very effective tool for creating and monitoring such statements and balances. A myriad of spreadsheet templates for this purpose are to be found on the internet. Such templates are seen as an enhancement of the resources, since it provides the inventor with reference material, to use as a guide.

5.6.1 Pricing

To balance the budget, it is important to find the market value of the product and attract sufficient funding. Three basic methods for setting a price exist: cost-based pricing, competitor-orientated pricing and market-led pricing (Fahy & Jobber, 2012, pp. 200–202). Upcoming is software that estimates manufacturing costs of products based on 3D CAD models (cost-based pricing). The software can be part of 3D CAD or product life cycle management (PLM) software (e.g. *SolidWorks Costing*), as standalone software (e.g. *aPriori*, *MicroEstimating*) or even as web based application (*custompartnet.com*) (Chang, 2013, p. 270; Ehlhardt, 2014). Market-led pricing analysis can be performed by monitoring similar products of competitors on web shops (e.g. *Amazon.com*) or paper catalogues. An alternative form of market-led pricing was identified by means of crowdsourcing, i.e. have a large group of people estimate the product's price to get an accurate indication of its value. The *Amazon Mechanical Turk* (*MTurk*) is a platform that is employed for this purpose.

5.6.2 Funding

Investments are likely necessary to develop and commercialise an invention. Conventional sources of funding include family and friends, government grants, business angels, venture capitalists, leveraging purchase orders to pay production costs and the inventor's own money (bootstrapping) (Foreman & Welytok, 2009). An addition brought about by the digitalisation is crowdfunding (e.g. *Kickstarter.com*, *Indiegogo.com*), which has become renown in recent times. Crowdfunding can be categorised as seed capital and is in essence a directed form of leveraging purchase orders to pay production costs. Hence, crowdfunding is different in the sense that it greatly reduces pecuniary risk for the inventor.

5.7 Commercialisation

5.7.1 Licensee search

Handbooks on inventing describe the process of seeking licensees, not surprisingly, as identifying potential licensees based on thorough market research and subsequently contacting the found companies (Docie, 2015; Florida International University, 2013; Foreman & Welytok, 2009). Yet, this description leads to the assumption that networking platforms, such as trade fairs, are valuable tools for prospective licensors. The internet has introduced new ways of getting in touch with companies for inventors seeking licensing deals. In light of the Open Innovation Model (OIM) have some large corporate companies dedicated web pages for (IP protected) idea submission that inventors can use (e.g. *3M*, *Procter & Gamble*, *BMW*, *Nike*). This can be considered an alternative to cold calling the company. And online patent and invention marketplaces can be considered the digital variant of trade fairs. Examples of patent marketplaces include *IdeaConnection.com* and *PatentAuction.com*.

5.7.2 Pitching and presenting

Whether the invention has to be pitched to potential business partners, or presented to potential customers, the purpose remains the same: to convince. Visual aids (e.g. graphs, sketches, animations, prototypes) are, obviously, great tools to appeal to the audience's imagination. Different mediums to present the visuals are, at this point in time, assumed less relevant (virtual and augmented reality are promising techniques, but not yet effectively deployable). Therefore, the focus in this study is on the tools and resources to create these visual aids (the information that is transferred). The characteristics of the visual aids that can be created today are clearly distinctive to those of the past, when line drawings were the common form of visuals and photographs an expensive alternative (Pope, 1993, p. 124). Software that is available today enable inventors to create (or render) comprehensible pictures (e.g. graphic editing or 3D modelling software). Videos (animations) are very suitable to clearly and comprehensibly explain the workings of the invention. Such animations can be made by using a 3D model (3D CAD software or 3D modelling software) or without (in a similar fashion as animated sitcoms), using applications such as *Synfig Studios*. Outsourcing this work to e.g. an animation studio is of course a possibility for inventor who lack the required skills. Whereas prototypes have always been valuable aids, enable rapid prototyping techniques for (quality) prototypes in much earlier stages than independent inventors ever could.

5.7.3 Manufacturer search

The internet is full of directories of manufacturers (e.g. *Thomasnet.com*, *Alibaba.com*, *MakersRow.com*, *EdisonNation.com*) (Foreman & Welytok, 2009; Greiner, 2014). Registries could be found at libraries, prior to the internet (Wisconsin Innovation Service Center, 1991). The computer has made searching for potential partners a less time-consuming task, while the internet has extended the geographical reach, enabling for global sourcing. For instance, websites such as *Alibaba.com* could be used to get in touch with Chinese manufacturers.

5.7.4 Distribution and promotion

A complete new way of retail, e-commerce, that inventors might benefit from is brought about by internet. Inventors today can distribute their products online either via a purpose-built web shop (e.g. with the help of *Shopify.com*) or as a third-party supplier of an existing web shop (e.g. *Amazon.com*, *eBay.com*, *Bol.com*). A third option of online retail is distribution through crowdfunding (e.g. *Kickstarter.com*). Foreman and Welytok argue that becoming a third-party supplier is preferred above creating one's own web shop because of the lack of existing customers in the latter (2009, p. 135). Conventional distribution channels include (local) offline retail and trade shows. This way of selling a product has the advantage that the product could be demonstrated or tested (hands-on) by potential customers (Foreman & Welytok, 2009; Greiner, 2014). Mail-order catalogues are, in a sense, the predecessors of e-commerce platforms like *Amazon*. Brown et al. argue that these catalogues are a valuable alternative to retail outlets for enabling large-scale sales by independent inventors. They also emphasise the large-scale visibility amongst interested clientele (1993).

Similarly, are home shopping channels (and direct response television, DRTV) good ways for both promoting and distributing an invention, due to the large-scale visibility. Foreman and Welytok argue that home shopping channels are a boost for inventors who cannot (yet) pay for airtime on 'mainstream' television for demonstrating the product, as airtime is free on these shopping channels (2009, p. 133). Hence, whereas advertising on mainstream (national) television or radio are highly effective ways of promotion, they are too expensive to consider them as a popular promotion tool for independent inventors. Less costly means for promotion include placing advertisements in, inter alia, (local) periodicals, newspapers and magazines. Promoting at trade shows was (and still is) another viable option (Brown et al., 1993). One interviewee of a 1991 study stated using testimonials from well-known specialist (secured through advertising in professional journals) as a means of promotion (Whalley, 1991). New are the digital marketing methods include advertising on websites (e.g. *Google AdWords*), promoting through social media and search engine marketing (SEM).

CHAPTER 6 **RESOURCES USED IN RECENT TIMES**

6.1 Introduction

In this chapter, empirical information is used to get a veracious insight in the perceived merit of the various resources. To do so, sixty-one interviews with independent inventors (Roskell, n.d.) have been reviewed to get a notion on how resources are employed and on what grounds they were selected (or not). The explorative character of this research is emphasised. The findings, together with those of the two previous sub questions are summarised in Table 2 on page 27, which describes the alterations per each activity in terms of digital resources. Interview citations are marked by the number of the interview in between square brackets (e.g. [5]). Table 6 (Appendix B) shows the details of the cited interview, according to the interview number.

6.2 Digital resources

6.2.1 Internet

The internet has clearly become an integrated part of the innovation process and its value is evident. One inventor stated that "having access to so much information was life-changing" [51]. However, the abundance of information also comes with a downside. One inventor argued that there is no way to measure accuracy or validity of information [58]. Internet as an information source is, in one way or another, fully integrated in the innovation process of inventors. The internet serves either as an information source or is deployed as an instrument. Nine inventors mentioned the use of internet for prior art search (whether or not complemented with store visits). One inventor used *Google Image Search* together with *Google Patents* for this purpose [2, 34]. Others used various online patent databases (such as USPTO) for this reason. Eight used the internet to find a manufacturer, of whom four found a Chinese manufacturer through *Alibaba.com*. Another two used freelance marketplaces to hire a professional, one used *Elance.com* (today called *Upwork.com*) [56] and one *Craigslist.com* [8]. Yet another found a mentor by randomly contacting the person via the internet [28]. Internet as an instrument has also integrated in the landscape of independent inventing. For example, by enabling worldwide (video)calls at low cost or even without charge (e.g. *Skype*). One interviewee communicated with a Chinese manufacturer with the help of email, *Google Translate* and *Skype* [45], while another teamed up with a partner through the internet [10]. The increase of convenience is clearly present, as geographic location has become rather irrelevant. One interviewee stated to have applied for a (foreign) provisional patent online [60]. Nearly all interviewees mentioned having a website containing information about the invention (and the majority included a web shop). Contrary to traditional marketing does a website require the least amount of investment (in terms of both money and time). The only thing left, once the website has been set up is to generate 'traffic' (with the use of e.g. social media, search engine optimisation, traditional marketing). Yet, one interviewee found out that even without efforts to generate traffic people will reach the web page [23]. Internet as a means of market research was only mentioned a few times. One interviewee actually set up a website with the goal to find a presumptive market [40]. And another found favourable talks about the invention on a range of online forums [12]. Internet was, however, often employed for marketing ends. Popular resources include *Google AdWords*, *Facebook Ads*, search engine optimisation (SEO) and social media (the majority makes use of one or more techniques). One of the unique aspects of digital marketing is that the only boundaries that limit the reach are language barriers – and (governmental) censorships.

6.2.2 Social media

Social media is a very popular resource (mostly for promotion ends). Platforms that are often used are *Facebook*, *Twitter*, *LinkedIn*, *YouTube* and weblogs (blogs). Four major benefits of social media have been identified. First of all, social media is a very suitable promotion tool in case of a low budget [22, 25, 30, 45, 48]. Second, the geographic location of the inventor is irrelevant, the only requirement is an internet connection and suitable device. For example, one inventor who lives in a remote place in Spain is still able to promote by using *Facebook* [37]. Third, video hosting services such as *YouTube* or *Vimeo* enable inventors to easily share explanatory or promotional videos [46]. The benefits compared to the conventional methods for sharing videos (e.g. broadcasting on television) are evident. And last, blogs are often used for product reviews [21, 25, 27, 42]. The number of blogs and vlogs (video weblogs) is huge these days. Bloggers are very approachable and willing to review products, in contrast to traditional media. On the one hand because for the majority it is merely a pastime. And on the other hand, because it could result in an increase of visitors or viewers (and revenue subsequently) – if the target audience of the blog is the same as the target market.

6.2.3 E-commerce

E-commerce provides inventors with an alternative commercialisation route that makes them more self-reliant. The benefits of e-commerce are significant in more than one way. The biggest advantage is that the costs of selling a product online are minimal, thereby serving as a way to steadily build up sales (funding by organic growth) [6, 17, 19, 38, 47]. Hence, not only a cash flow is generated, but, in case of sales, it also proves the existence of a market for the product [17, 47]. As a bonus, high margins can be realised [14, 38]. Not only are the required investments minimal, the inventor is not necessarily dependent on other parties for setting up sales, because the only necessity is a web shop [12, 23, 38]. With the emergence of website and web shop building software no specialised skills (e.g. programming) are required anymore. Moreover, the ease of operating a web shop is tremendous (especially in combination with online banking). These so-called e-fulfilment activities (everything from the client's order to the actual delivery) can be outsourced as well. One last advantage of e-commerce is the possibility to provide information along with the product. In general, in case of offline retailing the only space available for promotion, explanation and such is the packaging. A website, however, can also contain explanatory videos, product reviews, list of specification and so on [13, 47]. Offline retail parties are not fond of taking risk as multiple interviewees described, which inevitably means that getting an invention on store shelves is very challenging [14, 18, 20, 23, 42, 54]. Major retailers could be persuaded, according to the interviewees, with proof of market demand [18, 27], running (national) marketing campaigns [23] or simply pecuniary back up [14]. In short, it can be stated that e-commerce better enables inventors to prove market demand and increases their chances of successful market entry.

6.2.4 Crowdsourcing

Crowdfunding shares benefits with e-commerce and is a popular platform among the interviewees for launching the invention. Crowdfunding also enables organic growth, similar to e-commerce, and is an appropriate tool for market testing [58]. The difference with e-commerce is that not a single investment in production has to be made before any units are sold. Thus, if the funding goal is not met, no investments for the pilot product are lost. Crowdfunding is therefore especially popular for getting funds for the initial production batch (e.g. for tooling) [10, 31, 58, 60]. Another beneficial feature is the possibility to share comments on crowdfunding platforms. One interviewee invited readers to share feedback on his invention's *Indiegogo* page [60]. Besides crowdfunding, the crowd was also addressed for outsourcing parts of the process, as one interviewee had her idea developed by the community of the website *Genius Crowds* [52]. The right to exist of co-creation websites such as *Genius Crowds*, however, has not yet been proven indecisively. For example, the website was shut down in 2013, just three years after its launch, whereas another co-creation platform, *Quirky.com*, went bankrupt after six years of operation (but was relaunched half a year later).

6.2.5 CAD and rapid prototyping

The digital resources for product development that are often made use of are computer-aided design and rapid prototyping, additive manufacturing (3D printing) in particular. These resources are more likely to be used within the development and testing stage, than within the scoping stage (as defined in Chapter 4). The two mentioned tools affect the course of action to a great extent. First of all, a digital model can be used for multiple purposes. A single model can be used to create, inter alia, presentation material, animations, technical drawings and rapid prototyping. One interviewee only needed drawings for tolerances, but used the 3D CAD file for everything else [13]. The centrality of information (in essence, only one file is needed) is not only convenient but also prevents mistakes from happening that are likely when information is stored decentral. It also enables tele-collaboration as there is, in principle, no need for collaborators to meet in person anymore (complemented by other digital tools such as *Skype*) [10]. A digital model is also a very comprehensive way to present the invention, especially in the case of a digital prototype (a digital model that mimics the actual product in form and function). In addition, high quality pictures and animations can be rendered from the model in an early stage with relatively little effort in comparison to conventional methods – or even physical when a 3D print is made. One inventor had 3D renderings made for a first focus group and survey [30]. Another had a rough prototype made to shoot a promotion video [58]. With rapid prototyping, forms and shapes can be produced that otherwise require techniques such as injection moulding and is in comparison very cost-effective and time efficient. Now, representative (working) prototypes can be made quickly and inexpensive [40, 49]. One interviewee, who is a medical doctor by profession, used a prototype for testing, that was made with rapid prototyping (stereo lithography). The test results were subsequently published in a medical academic journal [40]. The threshold of required skills is decreasing with software such as *Trimble SketchUp* (formerly *Google SketchUp*), whereas professional 3D CAD software remains specialised work. One inventor points out that CAD software is, however, useable for every person willing to learn with the presences of free software (e.g. *SketchUp*) and classes for a small fee [45].

6.3 Conventional resources

6.3.1 Product development

Conventional resources for drawing and prototyping were usually used before digital ones are employed. Initial drawings and prototypes are often made by hand during the onset of the scoping stage, according to the interviews. The interviewees were also asked about the first steps they took after they got the idea. The main activities included prior art search, sketching (or drawing) the idea or start making a prototype. A few used CAD software quite early in this process, while ordinary sketching was most often mentioned. A pen and paper (or other types of drawing materials) seem to be the obvious choice for initial documentation of an idea. After all, such ideas show up rather impromptu (the eureka moment). One inventor, for instance, actually began sketching on a napkin [11]. Handicraft was the common choice for prototyping. A great deal of inventors repeated the saying that 'necessity is the mother of invention' [9, 15, 21, 22, 35, 39, 43] and an even greater group also acted upon it. Some initial prototypes were not even regarded to as an actual prototype, but rather as a homemade solution to the inventor's perceived problem [46, 48, 54]. These initial prototypes were predominantly made by handicraft and with materials that were either at their disposal or shopped for. One interviewee, for example, used the back plate of a *Harley Davidson's* speedometer together with phone cases to create a case with integrated bottle opener [49]. Others used an empty toilet paper roll to create a new type of hair clip [20]. All in all, the conclusion is drawn that these conventional methods (conventional sketching and prototyping by handicraft) are still the obvious choice because it serves as a rather natural continuation of the initial thought process, before the next steps are carefully planned. Three interviewees mentioned the used of an inventor notebook during development (online idea registration was not mentioned at all) [9, 24, 53]. No conclusions are drawn however, because only one such service was found (see Paragraph 5.3). The choice for physical notebooks might also be prompted by the advice to do so.

6.3.2 Books

While the internet has likely become the number one information source, more traditional sources remain prevalent as well. In the case of inventors: books and social encounters. Although inventors are wary of talking too much about their invention, regular chats with acquaintances or experts often have big influence on the course of action that they follow. The abundance of information on the internet is a downside, as aforementioned. While search engines such as *Google* might ease this in some way, critical thinking remains invaluable. A book is more comprehensible and contains more of a sequence (assuming it is a qualitative good book), compared to the internet. Most of the inventors that mentioned the use of one or more books included a book on patenting [40, 55, 58, 59]. This might not be a coincidence since the patenting process was often referred to as daunting. One inventor said, "I know its [*sic*] considered taboo to attempt to learn about patents but my inquiring mind wanted to know what was so terrifying" [59]. The internet provides a way to verify the quality of a book with the 'wisdom of the crowd' (i.e. book reviews). Hence, it is argued that a recommended book provides the inventor with more inner peace than the internet, in general, will.

6.3.3 Offline retail

The ultimate goal for most interviewees was to get their product on the shelves at major retailers. Its attractiveness is based on the massive customer bases, dispersed outlets and accompanied web shops (if any). Some inventors went to retail outlets in search of prior art [16, 27, 53, 55]. When envisaging an outlet of a major retailer and its online store, it could be reasoned that the former is more suitable for browsing products, while the latter for searching. Store personnel might also form a good source of information. Either way, prior art search should be as exhaustive as possible, thus outlets must be regarded to as complementary. Small (local) retailers were also used for market testing [7, 27]. The benefit of offline retail is the social interaction with customers and retail partners, which might lead to new insights. Some interviewees actually went to shops to pass out samples and received valuable feedback [28, 32].

6.3.4 Trade fairs

Trade fairs are another place where social interaction leads to advancements of the inventor's progress. Having many players of a certain industry packed in one venue enables inventors to network with potential manufacturers, distributors and other partners [12, 19, 23, 41, 42, 56]. Some attended trade fairs (and similar venues) in search of potential licensees [11, 19, 56], or to promote their invention [1, 7, 10, 21, 25, 43, 53, 54], in search of feedback [4] or to directly sell the product [25]. At some conventions are invention contests organised. Two interviewees mentioned having entered such a contest, and winning an award [4, 31].

6.3.5 Traditional marketing

Traditional marketing is, next to trade fairs and digital marketing, frequently made use of. Television is considered to be one of the most effective mediums to promote an invention [23, 44, 57], but also a very expensive one [53, 57]. Some inventors arranged cameo appearances or getting the invention on a show [25, 44, 45, 50], besides regular commercials [23]. Television shopping channels were also considered to be used [13, 61]. One interviewee had a striking reasoning behind his preference for promotion via television: while referring to the US he stated, "we are still a nation of couch potatoes" [44]. In other words, the television is still a very popular medium and commercials will easily reach the target audience. Radio, another broadcast marketing outlet, was only mentioned once. One inventor was interviewed on the radio [5]. Print marketing has not become obsolete with the advent of digital marketing. On the contrary, niche magazines in particular are seen as a very valuable medium. Some placed advertisements in niche magazines [12, 21, 43], while others hoped to have their invention reviewed by sending samples to the magazines [18, 27, 28]. Free media coverage is also aimed at [13, 43], by sending samples (for review) to newspapers [28]. Referral marketing (word of mouth) has been mentioned as a highly effective method for generating sales [44, 45, 49, 53, 61] and is particularly useful for low budgets [22, 27, 45, 48]. Although direct mail was mentioned once [14], it seems to have lost its right to exist in favour of digital marketing.

Table 2

Alterations of used resources between early nineties and today

Activity	Resources used in the early nineties	Resources used today	Alterations
Sourcing information	Books; publications (magazines, catalogues, whitepapers etc.); authorities (by writing, telephone, facsimile or visiting)	Internet, books and authorities	Internet has become prime way of accessing information
Idea registration	Use of physical inventor's notebooks or lab journals	*No changes*	*None (physical notebooks are still advised)*
Prior art search	Publications such as magazines and catalogues, and in offline retail outlets	*Similar* plus by the internet	Internet forms an additional source of information
Patent search	(Dedicated) libraries and patent agency offices	Online databases with search engines	Internet forms an additional source of information
Initial market research	*Insufficient information found to draw conclusions*		
Concept development	Traditional drawing and sketching (on paper), and (initial) prototyping by handicraft	*No changes*	*None*
Detail design	(*Outsource*), traditional (technical) drawing and sketching (on paper)	(*Outsource*), computer-aided design	CAD has seemingly replaced traditional methods
Prototyping	*Mainly outsourced to professionals*	*Similar* plus rapid prototyping	Rapid prototyping (including CAD) enables in-house production of prototypes
Verification	With the use of prototypes	*No changes*	*None*
Secondary market research	*Insufficient information found to draw conclusions*		
Primary market research	Focus groups and (group) interviews through mail, telephone, door to door, facsimile, local retail and trade fairs	Focus groups (including online discussion forums) and (group) interviews through internet, telephone, local retail and trade fairs	Internet and social media form additional sources of information and enhances communication, data collection and analysis efficiency
Validation	Market testing at (local) offline retail and trade fairs	*Similar* plus market testing through e-commerce and crowdfunding	E-commerce and crowdfunding have become prime market testing methods and enhanced the inventor's possibilities
Financial analysis	*Insufficient information found to draw conclusions*		
Pricing	*Insufficient information found to draw conclusions*		
Funding	Inter alia family funds, friends and family, (mortgage) loans, government grants, local network, (informal) investors	*Similar* plus e-commerce (organic growth) and crowdfunding	E-commerce and crowdfunding have become an effective alternative
IP protection application	*Mainly outsourced to professionals*	*Similar* plus filing (foreign) provisional patents online	Internet enables for (convenient) cross-border IPP application
Pitching and presenting	(Line) drawings (and to a lower degree photographs) and prototypes	Virtual (interactive) 3D models, rendered pictures and animations, and prototypes (by rapid prototyping)	CAD and rapid prototyping have become an important tool for creating visual aids and prototypes.
Licensee search	Mainly by attending trade fairs and cold calling	*No changes*	*None*
Manufacturer search	(Offline) registries in e.g. libraries	Online registries	Internet seemingly replaced offline registries and extended the geographical reach
Distribution	Offline retail, trade fairs, (mail-order) catalogues and television shopping channels	E-commerce, crowdfunding, offline retail, trade fairs, television shopping channels	E-commerce and crowdfunding have become the prime distribution channel
Promotion	Broadcast marketing (television and radio), print marketing (advertising), trade fairs and referral marketing (word of mouth)	*Similar* plus digital marketing (social media, blog reviews, online advertising and SEO)	Internet and social media form additional (cost-effective) promotion channels

Note. The first column ('Activity') is based on Chapter 4. The second column ('Resources used in the early nineties') is based on Chapter 5 (or obviousness) and describes resources that were either used, or likely used in that period. Outsourcing is, per definition, not a resource, but is included in some cases to form a rather complete notion (formatted in italic). Early-stage digitalised resources are excluded (e.g. 'automated patent systems'). The third column ('Resources used today') describes resources used by inventors today on the basis of the interviews (analysed in Chapter 6). The last column ('Alterations') briefly summarises the digital resources (if any) that have affected the activity in consideration (and in what way).

CHAPTER 7 THE IMPACT ON INVENTOR PERFORMANCE

7.1 Introduction

It may be clear that the digital resources have a great impact on inventing activities. One interviewee [54] notably stated that "there are so many resources at your fingertips these days, there is no excuse to sit around with a brilliant idea." Six digital resources were found to be actually employed, and appreciated, by independent inventors in Chapter 6: internet, social media, e-commerce, crowdfunding, CAD and rapid prototyping. This chapter describes the reasoned impact of these resources on the performance of independent inventors by using the conceptual framework (Paragraph 2.2). Each one of the following paragraphs describes one of the four factors (scope, cost, time and quality). The results are summarised in Table 3 (page 30).

7.2 Scope

Digital resources enable inventors to carry out activities that would have otherwise been outsourced. Four activities were identified at which the independent inventor gains more autonomy. The first activity is patent search. Online patent databases and search engines enable inventors to carry out a more comprehensive (preliminary) patent search than what was previously possible, with requiring specialised skills. This results in less dependence on patent agents. The second activity is prototyping. Prototypes with complex shapes can now be created in-house with rapid prototyping techniques, provided the design suits the technique. The most obvious alternative would be outsourcing to injection moulding companies. The merit of rapid prototyping, and 3D printers in particular, is that the workflow is comparable to outsourcing, since both need a 3D model file only (apart from setup proceedings). The third activity is distribution (for validation). E-commerce (and crowdfunding) enable for effective, global market testing endeavours. Hence, cross-border distribution can be taken on by inventors in a convenient way that is not possible with merely conventional resources (resulting in the need to outsource). The scope is positively affected in terms of becoming more autonomous, since no prior consent of external parties is needed to use (valuable) shelf space in retail outlets. The last activity is funding, though less significant than the previous three. E-commerce (and crowdfunding) enables inventors to autonomously sell their invention as early in the process as wished (or is wise). If the commercialisation turns out successful and profits are generated, the possibility arises to make the project (partially) self-funding by means of organic growth.

7.3 Cost

Four ways that digital resources lead to lower budgets are identified. The first is builds upon the just mentioned increased chances to realise funding by organic growth through e-commerce or crowdfunding. No interest has to be paid over these funds, which is therefore cheaper than borrowing money. The second way is also of minor importance and relates to trivial expenses. The internet contains an endless amount of information, of which the biggest part can be accessed for free. One example are patents that can be downloaded without charge today, while in the past photocopies had to be bought. Besides, since geographic location becomes irrelevant and remotely stored information ca be accessed from everywhere in the world, less travel is needed. Hence, travel expenses could also be declined. Other trivial expenses that can be reduced include, for instance, free video calling with foreign based partners (saving on telephone fees). A third way is related to the flexibility of prototyping (not manufacturing). When an inventor has a rapid prototyping machinery, all different kind of design can be printed, with only having to buy material (such as filament for 3D printers). This is in sharp contrast with the costs involved with e.g. injection moulding, as the different designs require separate moulds to be made. The last cost-reduction way is related to promotion via internet (digital marketing). Internet has brought about a number of new promotion channels (e.g. social media) that, compared to conventional methods, can be deployed on low-budgets, yet without regional limitations (an advertising campaign in a local weekly suits low-budgets too, but is obviously local). Based on the interviews it can be concluded that inventors value digital marketing for these reasons.

7.4 Time

Four sources of time savings have been identified. The first source of time saving relates to the reduction of travelling that was argued to be a cost-effective aspect of the internet, but is of course also time-effective. An enquiry can be answered within minutes using the internet, as the instant nature of things reduce lead times. Moreover, search engines are great tools that increase the efficiency of the search (although the actual results depend on critical thinking and reading comprehension skills). The same enquiry answered without the use of digital resources implies the need to travel to libraries and such, therewith adding travel time. But also having to manually searching, or browsing, heaps of information which leads to an increase of lead time. The second source of time saving is related to the benefit of e-commerce (and crowdfunding) that no other parties have to be convinced in order to start offering a product. It was found in the interviews that such endeavours can quickly become very time-consuming. The third and fourth sources are related to CAD and rapid prototyping. One of the main benefits of CAD is its multipurpose use and the fact that all output revolves around one central set of data: the 3D model. The implication is twofold. The third source of time saving is derived from the fact that by using CAD, the product has to be modelled only once and many other deliverables (e.g. visual aids, prototypes) can be created relatively effortlessly compared to conventional methods (given the same quality of the end products). The fourth and last source stems from the interlinkage of files (of the deliverables) through the 3D model. If the model has to be adjusted it only takes the work dealing with the 3D model. All deliverables could be updated automatically (of course dependable on the used software package). Complex animations can be re-rendered and prototypes reprinted for instance.

7.5 Quality

Digital resources also affect the quality of the results and products of the various activities. In Paragraph 2.2.3, quality has been defined as the degree to which the requirements of the result or product of the activity are fulfilled. The requirements are fully met when the result or product is as described in the last column of Table 1 (page 17), that contains ideal results. Hence, the amount of information accessible to inventors has become practically infinite with the advent of internet. In theory, inventors could benefit from this in the sense that it enhances the attainable degree of quality of multiple activities. The internet provides access to data, regardless of location of storage or origin (with the odd exception, e.g. due to political firewalls), including archival data and patent data. This development enhances sourcing information in general, simply because more data is available. More specifically is the quality of both prior art and patent search improved, by having access to all marketed products (e-commerce), including ones that have become obsolete (archives), and to the patent databases of presumably all countries that also include expired patents. Furthermore, is the quality of manufacturer search improved, as global sourcing has now become feasible for inventors. This implies that the inventor, potentially, gains access to better suitable manufacturers than those they could find locally without using internet. The mentioned positive effects on the quality are, however, moderated by the inventor's skills concerning critical thinking and reading comprehension. The enquirer has to be able to distinguish false information from real and be able to comprehend an excessive amount of information in order to derive just one unambiguous answer on the enquiry. Hence, to capture the positive effects of the internet as an information source, one has to master the skills critical thinking and reading comprehension. However, it was argued in Paragraph 6.3 that books are a worthy alternative for when one cannot succeed using the internet. Internet in the form of social media also contributes to the quality of primary market research without increasing the budget or postponing the scheduled time of completion. The irrelevance of geographic location and global reach means that one could better control the local bias when selecting samples. The aforementioned characteristics could also result in a higher quality of promotion efforts, since the target audience can be better more accurately addressed. An additional benefit is that more elucidative information (e.g. animations) can be included when promoting online compared to alternatives (such as advertisements in local magazines) on the same budget. The global reach also leads to improvements in distribution and validation. Distribution because e-commerce (and crowdfunding) enables to better serve the global target market as it can be exploited. And accordingly, validation because this also implies that full-scale market testing is possible, potentially leading to more accurate and valid results. E-commerce and crowdfunding also potentially improves the effectiveness of product offers. Much more elucidative information (including all sorts of virtual visuals) can be included with the product offer than would be possible for retail displays and packages. Another merit of crowdfunding is that it reduces risk in terms of funding (the defined ideal result includes the lack of risk) by enabling the inventor to virtually market test the invention. With CAD and rapid prototyping, one could create much more elucidative visuals than is possible with conventional methods (such as photography) on a lower budget, advanced scheduled time of completion, or both. Examples included photo-realistic renders, mock-ups and exploded-view animations that could unambiguously show mechanisms and such. These products can be used as visual aids to support pitches or presentations or enhance packaging. Yet, the actual positive effects on quality are fully dependable on the inventor's skills of the used software. It is expected that it will become increasingly doable for inventors to acquire sufficient skills with time. On the one hand because some 3D modelling packages are getting more focused on the novice user. And on the other hand, given the ample opportunities to improve these skills by means of accessible (online) courses and tutorials.

Table 3

Reasoned moderating effect of digital resources on inventor performance (on the basis of the inventor performance model)

Activity		Scope		Cost		Time		Quality
Sourcing information	•	*Not applicable*	+	Reduction of trivial expenses (travel, hardcopies) and more free content	+	Reduction of travel and lead time through online sourcing and using search engines	~	More extensive search possible due to more sources (moderated by critical thinking and reading comprehension skills)
Prior art search	•	*Not applicable*	+	Reduction of trivial expenses (travel, hardcopies)	+	Reduction of travel and lead time through online sourcing and using search engines	~	More extensive search with inclusion of archival and foreign data possible (moderated by critical thinking and reading comprehension skills)
Patent search	+	Online patent databases and search engines enable for extensive patent searches	+	Reduction of trivial expenses (travel, hardcopies)	+	Reduction of travel and lead time through online sourcing and using search engines	~	More extensive search with inclusion of archival and foreign data possible (moderated by critical thinking and reading comprehension skills)
Detail design	•	*Not applicable*	•	*Not applicable*	+	Multipurpose use and interlinkage of deliverables	•	*Not applicable*
Prototyping	+	Rapid prototyping enables for more variation in prototypes in terms of shape at an earlier stage	+	Lower setup costs compared to injection moulding	+	Reduction of travel and lead time through in-house prototyping instead of outsourcing	•	*Not applicable*
Primary market research	•	*Not applicable*	+	Reduction of trivial expenses (e.g. travel) by using online tools	+	Reduction of lead time by researching online	+	Local bias can be controlled more effectively due to boundless global reach
Validation	+	E-commerce enables for effective and autonomous (global) market testing	•	*Not applicable*	+	No parties have to be persuaded to provide access to shelf space	+	Increased validity and accuracy through full-scale (global) market testing
Funding	+	More chances of realising organic growth using e-commerce as soon as possible	+	Indirectly by organic growth (if achieved through e-commerce)	•	*Not applicable*	+	Reduction of pecuniary risk through crowdfunding
IP protection application	•	*Not applicable*	+	Reduction of travel expenses by filing (foreign) patents online	+	Reduction of travel time by filing (foreign) patents online	•	*Not applicable*
Pitching and presenting	•	*Not applicable*	•	*Not applicable*	+	3D model software enables for quick creation of visuals (multipurpose use and interlinkage of deliverables)	~	More professional and effective results (moderated by CAD related skills)
Manufacturer search	•	*Not applicable*	•	*Not applicable*	+	Reduction of travel and lead time through online search	~	Other, potentially more suitable, manufacturers than locals can be sourced from (moderated by critical thinking and reading comprehension skills)
Distribution	+	E-commerce enables for effective and autonomous (global) distribution	•	*Not applicable*	+	No parties have to be persuaded to provide access to shelf space	+	Bigger target market (geographically) possible
Promotion	•	*Not applicable*	+	Digital marketing is relatively cheap	•	*Not applicable*	+	Target audience can more accurately be addressed and inclusion of more elucidative information with offer

Note. + denotes a positive effect; ~ denotes a moderated positive effect; and • denotes that the constraint is not applicable to the activity. Some activities that are found in Chapter 1 are omitted due to insufficient information found in the data (Chapter 6) to draw conclusions concerning actual employment of the related tools (initial market research, secondary market research, financial analysis and pricing). The activities idea registration, concept development, verification and licensee search were found to not be (substantially) altered by digital resources (Chapter 6) and are therefore omitted as well.

CHAPTER 8 CONCLUSION AND DISCUSSION

8.1 Conclusion

In this thesis, the effect of the digitalisation of resources on independent inventors has been examined. The implications of the following six resources are analysed using the conceptual framework (Paragraph2.2): internet, social media, e-commerce, crowdfunding, computer-aided design and rapid prototyping. *Inventor qualities*. Two implications related to soft qualities were identified. It was found that the information overload caused by the internet requires substantial levels of the skills critical thinking and reading comprehension. One implications related hard qualities was identified. To make effective use of the advantages of 3D modelling software, the inventor (obviously) needs to possess sufficient CAD software related skills. *Resources*. At first, four identified implications related to resource availability. It was found that some digital resources are more cost-effective than conventional alternatives, thus decreasing the required amount of financial resources. Required physical space is also significantly reduced, since many activities are now carried out virtually (on the computer), or require just a fraction of space (e.g. using a desktop 3D printer instead of an injection moulder). Keeping up a (high-quality) personal network requires less effort using social media (e.g. *LinkedIn*). Furthermore, the innovation system of which the inventor is part of is also active online (e.g. inventor related websites, weblogs, forums), facilitating continuous and more collaboration. Second, two identified implications related to resource acquirement capability. Digital resources introduce new funding sources, crowdfunding and potentially early-stage organic growth through e-commerce. Additionally, transaction costs (search and selection costs in particular) are better manageable. The internet enables individuals to source globally (e.g. manufacturers), while instant communication and translation services lead to more efficient and effective collaboration efforts. One identified implication relates to both resource acquirement capability and the mode of resource acquirement. It is argued that the willingness of the (introverted) inventor to acquire resources by social exchange is positively affected by the increased autonomy and anonymity of operating online from home – based on the assumption that operating online requires less or different social skills than real world social encounters. *Inventor performance*. Digital resources, internet in particular, enable for global sourcing and global exploitation of the invention single-handedly, from the comfort of one's own home. Hence, digital resources increase the autonomy of independent inventors, consequentially improving flexibility with respect to scheduling activities of the process. Additionally, lead time is reduced by, inter alia, new time-saving features (e.g. online search engines), and through the centrality and interlinkage of 3D model related information. The irrelevance of geographic location and global reach of the internet results in a significant reduction of both travel expenses and time. As aforementioned, digital resources are more cost-effective than conventional alternatives (e.g. promotion through social media). Furthermore, the inventor's efficacy is improved due to having more and possibly better information at their disposal. The irrelevance of geographical location also leads to the ability to exploit a bigger target market and better control on local bias concerning market research. Lastly, new features of digital tools enable for improved results and product, such as the quality of visual aids using CAD. All in all, as was to be expected, it was found that digital resources have a positive effect on independent inventors, as it (potentially) leads to an increase in autonomy, while at the same time improving their efficacy, all on a lower budget and within a tighter schedule.

8.2 Limitations

The first limitation is related to the methodology of mapping resources. During the research, in particular at sub question two (resources), it became apparent that ambiguous terminology and overlapping functionality of different tools often restrained progress. It should be noted that inefficiencies during the process were also attributable to lacking experience with academic research. For instance, the Wikipedia page on 'computer-aided tools' (CA_X) lists twenty-eight different tools, of which twelve start with 'computer-aided' ("Computer-aided technologies," 2017). Many of these tools have overlapping functionalities or are referred to by different names among scholars (and also in the non-academic literature), which led to difficulties categorising the tools. The consequence was that the study was approached rather pragmatically using the snowball method and was focused on popular and accessible resources. This approach was assumed the right method given the limited timeframe. And was justified by defining the research scope in such way that only popular and accessible resources were dealt with (see Paragraphs 3.1 and 3.3). In spite of any valuable insights gathered, the research is fairly superficial. It is expected that a structured and thorough approach (including niche, cutting-edge and unsought after resources and tools) leads to more interesting insights and the possibility to make predictions about the future. The second consequential limitation relates to empirical data used to answer the third sub question. The used dataset was picked in favour of conducting new interviews or a survey with respect to the limited timeframe. The motivation is twofold. On the one hand because the dataset contains a non-probability sample (presumably through accidental sampling) and on the other hand because the interviews are standardised, but open-ended, which simplifies the analysis. Sixty-one interviews remained after filtering out the unusable ones. Yet, the interviewer does not seem to have focused on the employment of resources, but on the innovation process as a whole. Despite the sample size (n = 61), some resources were not discussed at all (e.g. financing tools) which is considered a shortcoming of the used data. Thus, it is reasoned that (similar) interviews constructed with this study in mind and a similar non-probability sample would lead to improved results. The last implication concerns ongoing developments altering the state of the art of tools and resources used by independent inventors at a high pace. With new technologies entering the (consumer) market such as virtual and augmented reality at the time of writing, it is expected that the findings of this research remain tenable for not more than five years.

8.3 Suggestions for future research

While the findings of this thesis are fairly self-evident, the results are worthwhile considering the derived implications. The purpose of this research focused on the layperson and the budding inventor, in other words, people who do not (yet) have extensive knowledge about the inventing process and related resources. Therefore, the activities, processes and resources addressed in this thesis are likely eye-openers for this group – whereas, assumed petty topics for expert inventors and scholars alike. On another note, it is argued in the limitations that the timeframe (perhaps combined with inadequate academic skills) did not allow for conducting a comprehensive and structured research. And that a (small) misalignment between the used dataset and research likely resulted in missing out on some very interesting findings. Thus, it is hypothesised that a similar, but comprehensive research leads to more significant and interesting findings. Provided that a better aligned dataset is used, and all resources including obsolete and cutting-edge are dealt with to the best extent possible.

8.4 Implications

This thesis contributes to the body of knowledge about independent inventors, by providing (confirmative) insights in the effect that the digitalisation of resources has on independent inventors in terms of inventor qualities and performance. The study distinguishes itself by focusing on laypersons and budding inventors in favour of seasoned inventors. Another contribution is the provided conceptual framework that depicts the relation between inventor qualities, resources and inventor performance. Scholars unfamiliar with the topic can use this thesis to get a quick overview about the subject independent inventors. Furthermore, the findings can be used by organisations that assist these inventors to design comprehensible reference material or courses on independent inventing. Companies engaged with open innovation can use the findings to further development of co-creation platforms. One obvious practical implication for (independent) inventors is that they are advised to get familiar with the six digital resources found. But also, to get insight in one's own skills concerning critical thinking and reading comprehension to better estimate the prospects of success of relevant endeavours and decide upon using the internet or to search for a good book for certain enquiries. Besides, it is recommended to develop one's CAD related skills. Tutorials, courses and various CAD software packages are very accessible in terms of cost price and usability. Thus, it is hypothesised that the benefits outweigh the burden. Also, digital resources enable inventors to carry out a monetising process at home concerning inventions that can be produced using additive manufacturing (in theory), without the need of substantial budgets. This implies that it becomes easier to conveniently 'simulate' the innovation process, without being subject to any financial risk or having to start to networking. All in all, it is hypothesised that digital resources increase the approachability of the inventing process significantly. If the findings of this thesis are accurate and valid, the only thing left to initiate an explosion of innovative activity is informing all the people with great ideas about the approachability of inventing.

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APPENDIX A **ADDITIONAL DATA**

Table 4

Difficulties and obstacles faced by independent inventors in 1992

Invention development		Invention monetising		Innovation process	
Access to raw material	32%	Poor marketing skills	41%	Lack of capital	71%
Access to necessary equipment	34%	Manufacturing too costly for market	22%	Marketing	61%
Acquiring the technical skills to build model	26%	Problems associated with scaling-up	18%	Lack of knowledge	35%
Knowledge of, or access to, a model-builder	33%	Manufacturers not interested in products	32%	Lack of facilities	27%
Finance for building a model	43%	Lack of funds to prove potential	52%	No opportunity to consult with others	13%

Note. The percentages represent the percentage of inventors (n = 1043) who did experience the respective difficulty or obstacle. Adapted from "Survey of independent inventors: An overview," by P. Whalley, 1992, pp. 28-30.

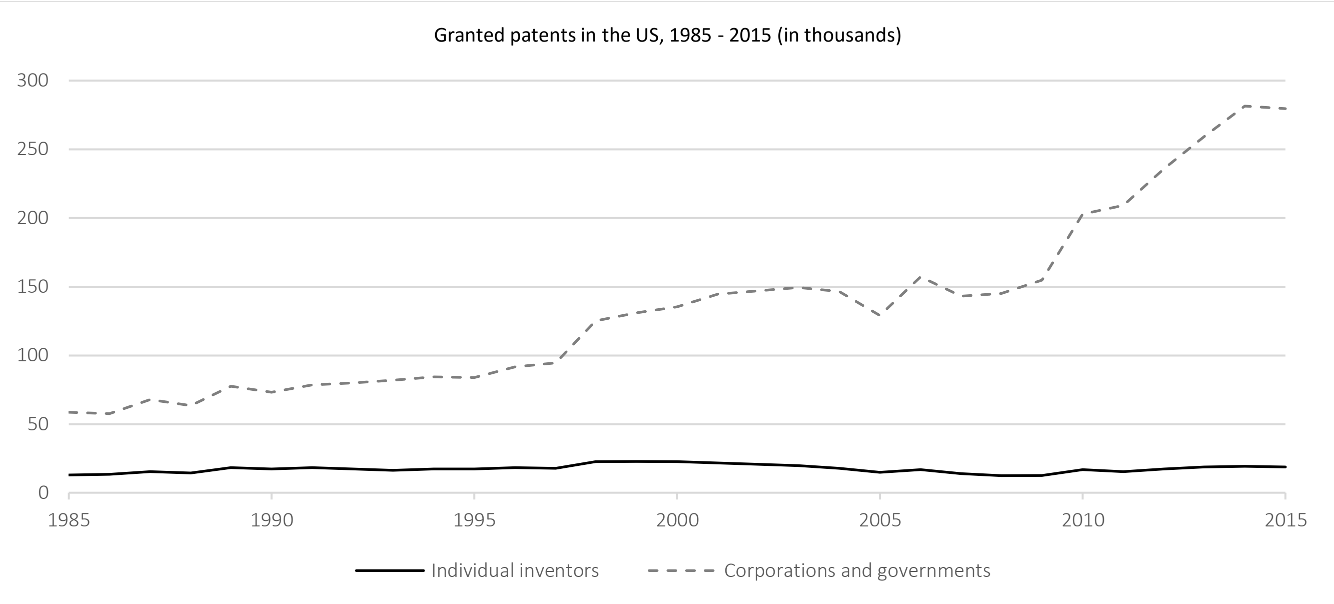

Figure 3. Number of US patents granted as distributed by year of grant, 1985 - 2015. The patents origin includes both US and foreign inventors. Adapted from "Extended Year Set - All Technologies (Utility Patents) Report" by Patent Technology Monitoring Team, 2015, United States Patent and Trademark Organization. https://www.uspto.gov/web/offices/ac/ido/oeip/taf/h_at.htm - PartA1_1b

Table 5

Top 20 US patent classification system classes by number of independent inventor patents, 1995 - 2015

Class	Class Title	Patents	Class	Class Title	Patents
D06	Furnishings	10631	**606**	Surgery	5561
D08	Tools and hardware	8020	**482**	Exercise devices	5538
52	Static structures (e.g. buildings)	7979	**248**	Supports	5319
280	Land vehicles	7589	**424**	Drug, bio-affecting and body treating compositions	5218
D21	Games, toys, and sports goods	7461	**D03**	Travel goods and personal belongings	5076
340	Communications: electrical	6738	**600**	Surgery	4860
D07	Equipment for preparing or serving food or drink not elsewhere specified	6422	**2**	Apparel	4797
473	Games using tangible projectile	6371	**D02**	Apparel and haberdashery	4785
362	Illumination	6069	**604**	Surgery	4654
D12	Transportation	5725	**210**	Liquid purification or separation	4447

Note. The patent counts are based on the original patent classification. Adapted from "Patent Counts By Class By Year - Independent Inventors" by Patent Technology Monitoring Team, 2015, United States Patent and Trademark Organization. https://www.uspto.gov/web/offices/ac/ido/oeip/taf/cbcby_in.htm - PartA1

APPENDIX B **INTERVIEW DATA**

Table 6

Details of analysed interviews, derived from IdeasUploaded.com

№	Date	Interviewee	Gender	Country	URL (following http://ideasuploaded.com/)
1	2010-10-25	Claire Mitchell	Female	England	2010/10/25/interview-with-baby-products-inventor-claire-mitchell-from-chillipeeps/
2	2010-10-29	Jason Garcia	Male	USA	2010/10/29/interview-with-game-inventor-jason-garcia/
3	2010-11-03	Bill Ward	Male	USA	2010/11/03/interview-with-toy-inventor-bill-ward/
4	2010-11-10	Johnny Smith	Male	USA	2010/11/10/interview-with-hammer-bumper-inventor-johnny-smith/
5	2010-11-17	Ian Davies	Male	England	2010/11/17/interview-with-plugster-inventor-ian-davies/
6	2010-11-24	Lucas Jordan	Male	USA	2010/11/24/interview-with-pad-bracket-inventor-lucas-jordan/
7	2010-12-08	Philip Annets	Male	England	2010/12/08/interview-with-whirred-play-game-inventor-philip-annets/
8	2010-12-29	Norm Yerke	Male	USA	2010/12/29/interview-with-aircut-inventor-norm-yerke/
9	2011-01-05	Nandu Marketkar	Male	USA	2011/01/05/interview-with-nandu-marketkar-serial-electronics-inventor/
10	2011-01-19	Bernie Graham	Male	Canada	2011/01/19/interview-with-padpivot-and-vacpan-inventor-bernie-graham/
11	2011-01-26	Trevor Theriault	Male	Canada	2011/01/26/interview-with-trevor-theriault-inventor-of-the-divers-communication-torch-dct/
12	2011-02-02	Audrey Buck	Female	England	2011/02/02/interview-with-audrey-buck-inventor-of-easy-blackout-blinds/
13	2011-02-09	Dorota Shortell	Female	USA	2011/02/09/interview-with-dorota-shortell-inventor-of-the-zipnhang/
14	2011-02-23	Ken Mencel	Male	USA	2011/02/23/interview-with-ken-mencel-inventor-of-the-ski-hugger/
15	2011-03-09	Nancy Tedeschi	Female	USA	2011/03/09/interview-with-nancy-tedeschi-inventor-of-the-snap-it-screw-for-fixing-glasses/
16	2011-03-16	Ron Weingartner	Male	USA	2011/03/16/interview-with-ron-weingartner-toy-inventor-and-co-author-of-the-toy-and-game-inventors-handbook/
17	2011-03-23	Jill Drew	Female	USA	2011/03/23/interview-with-inventor-and-nurse-jill-drew-about-her-invention-the-nono-sleeve/
18	2011-03-30	Tangela Walker-Craft	Female	USA	2011/03/30/interview-with-tangela-walker-craft-inventor-of-the-gopillow-which-makes-feeding-babies-more-comfortable/
19	2011-04-13	Scott Thieman	Male	USA	2011/04/13/interview-with-scott-thieman-inventor-of-holey-rail-a-storage-system-for-garages/
20	2011-04-20	Lindsey Walker	Female	England	2012/02/17/interview-with-the-inventors-of-the-linziclip-hair-accessory/
21	2011-05-04	Jill Leech	Female	USA	2011/05/04/interview-with-jill-leech-inventor-of-the-potty-tots-training-program/
22	2011-06-15	Kathleen Parisi	Female	USA	2011/06/15/interview-with-kathleen-parisi-co-inventor-of-lock-a-bye-bags/
23	2011-07-01	Nicolas Stanco	Male	USA	2011/07/01/an-inventor-interview-with-nicolas-stanco-inventor-of-the-tacorack/
24	2011-07-06	David Prokop	Male	USA	2011/07/06/interview-with-david-prokop-inventor-of-the-gel-filled-mousepad-and-smart-keyboard/
25	2011-07-15	Wayne Lifshitz	Male	USA	2011/07/15/interview-with-inventor-wayne-lifshitz-about-his-invention-the-piggy-back-rider/
26	2011-07-20	Delia Strand	Female	England	2011/07/20/interview-with-inventor-delia-strand-who-used-angel-investment-to-fund-her-invention/
27	2011-07-29	Mia Hunter	Female	USA	2011/07/29/interview-with-mum-inventor-mia-hunter-about-her-invention-the-funspunge/
28	2011-08-03	Stuart Walsh	Male	England	2011/08/03/interview-with-stuart-walsh-inventor-of-the-gripeeze-sports-glove/
29	2011-08-12	Eduardo Talbert	Male	USA	2011/08/12/an-interview-with-eduardo-talbert-co-inventor-of-ninadog-a-portable-hydration-system-for-pets/

№	Date	Interviewee	Gender	Country	URL (following http://ideasuploaded.com/)
30	2011-08-17	Patrick Kinnamon	Male	USA	2011/08/17/interview-with-patrick-kinnamon-inventor-of-the-swaggerdoodle-collage-frame/
31	2011-08-25	Alejandro Lacreu	Male	USA	2011/08/25/interview-with-inventor-alejandro-daniel-lacreu-about-his-bike-invention-flipphandle/
32	2011-10-07	Hally Norton	Female	USA	2011/10/07/interview-about-hally-norton-the-inventor-of-the-original-cosmo-finger-guard/
33	2011-10-14	Anthony Migyanka	Male	USA	2011/10/14/interview-with-anthony-migyanka-inventor-of-clleen-self-powered-water-treatment-system/
34	2011-10-19	Jason Garcia	Male	USA	2011/10/19/interview-with-jason-garcia-about-his-second-successful-invention/
35	2011-11-29	Tony Hemmings	Male	England	2011/11/29/interview-with-tony-hemmings-inventor-of-the-swan-neck-left-handed-pen/
36	2012-01-13	Jarno Smeets	Male	Netherlands	2012/01/13/inventor-jarno-smeets-talks-flying-with-human-bird-wings/
37	2012-02-03	Yvonne Jane	Female	Spain	2012/02/03/yvonne-jane-wright-talks-creating-ecobears/
38	2012-02-09	Peter Greedy	Male	England	2012/02/09/interview-with-inventor-peter-greedy-about-his-invention-greeper-laces/
39	2012-03-13	Lydia delRossi	Female	USA	2012/03/13/interview-with-inventor-lydia-delrossi-about-her-invention-stepnsoak/
40	2012-03-21	Amy Baxter	Female	USA	2012/03/21/interview-with-inventor-amy-baxter-about-her-invention-buzzy-for-shots/
41	2012-04-05	Bryce Taylor	Male	USA	https://ideasuploaded.com/2012/04/05/interview-with-bryce-taylor-who-invented-the-halo-trainer/
42	2012-04-12	Sandra Frawley	Female	USA	2012/04/12/interview-with-sandra-frawley-about-her-invention-seatpak/
43	2012-04-20	Tobi Kosanke	Female	USA	2012/04/20/interview-with-tobi-kosanke-about-her-inventions-which-help-animals/
44	2012-05-01	Russ Cohn	Male	USA	2012/05/01/interview-with-russ-cohn-inventor-of-naturemill-automatic-compost-bin/
45	2012-05-17	Lisa Illman	Female	USA	2012/05/17/interview-with-lisa-illman-about-her-invention-kritter-kondo/
46	2012-05-23	Katherine Wolfe	Female	USA	2012/05/23/the-invention-of-thumbby-an-interview-with-the-inventor-katherine-wolfe/
47	2012-06-21	Jack Dell'Accio	Male	Canada	2012/06/21/interview-with-jack-dellaccio-inventor-of-natural-memory-foam/
48	2012-07-06	Rebecca Rabson	Female	USA	2012/07/06/interview-with-rebecca-rabson-about-her-invention-smartseat-chair-protector/
49	2012-07-13	Westin Lord	Male	USA	2012/07/13/interview-with-westin-lord-inventor-of-the-ipopper-iphone-accessory/
50	2012-08-03	Rico Elmore	Male	USA	2012/08/03/interview-with-rico-elmore-the-inventor-of-fatheadz-eyewear/
51	2012-09-21	Sally Guyer	Female	England	2012/09/21/interview-with-sally-guyer-creator-of-cambridge-raincoats-fashion-rainwear-for-bicycles/
52	2012-10-11	Carla Leming	Female	USA	2012/10/11/interview-with-carla-leming-inventor-of-the-speed-bather-for-dogs/
53	2012-10-31	Terron Sommerville	Male	USA	2012/10/31/terron-sommerville-shares-his-story-of-inventing-the-power-tablet-charger/
54	2012-11-22	Rick Hopper	Male	USA	2012/11/22/interview-with-inventor-rick-hopper-creator-of-readarest-for-reading-glasses-wearers/
55	2012-12-11	Matt Butler	Male	USA	2012/12/11/interview-with-matt-butler-about-his-invention-a-game-called-rollors/
56	2013-02-19	Lucy Mitchell	Female	England	2013/02/19/inventor-lucy-mitchell-talks-about-her-invention-the-magneclip/
57	2013-03-08	George Wood	Male	USA	2013/03/08/interview-with-george-wood-the-inventor-of-freeze-n-go/
58	2013-05-13	Adrian Hayward	Male	England	2013/05/13/interview-with-adrian-hayward-inventor-of-pick-tack-for-guitar-players/
59	2013-07-26	Shawn Moye	Male	USA	2013/07/26/interview-with-inventor-shawn-moye-about-the-electronic-basketball-shooting-coach/
60	2013-08-09	Jim Tryfon	Male	Australia	2013/08/09/interview-with-inventor-jim-tryfon-creator-of-the-zeus-multi-tool/
61	2014-06-18	David Sykes	Male	England	2014/06/18/an-interview-with-david-sykes-about-his-invention-the-multitask-joist-hanger/