

**MONETARY VALUE ESTIMATION  
MODEL FOR PATENT AND  
PATENT APPLICATION**

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## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENT</b> .....	<b>2</b>
<b>ABBREVIATIONS</b> .....	<b>5</b>
<b>ABSTRACT</b> .....	<b>6</b>
<b>1. BACKGROUND</b> .....	<b>7</b>
1.1 PROJECT.....	8
1.2 THE COMPANY: BIOKAPITAL AS .....	8
<b>2. INTRODUCTION</b> .....	<b>10</b>
2.1 PATENTING PROCESS .....	10
2.1.1 <i>Disclosure of Invention</i> .....	10
2.1.2 <i>Patentability Search</i> .....	11
2.1.3 <i>Application and Publication</i> .....	12
2.1.4 <i>Substantive Examination: Patent Pending</i> .....	12
2.1.5 <i>Decision</i> .....	13
2.2 WHAT VALUE OF A PATENT MEANS .....	13
2.3 WHY ESTIMATING VALUE OF AN PATENT .....	14
2.4 THE LITERATURE ON PATENT VALUE .....	16
2.4.1 <i>Patenting Process and Value Determinants of Patent</i> .....	16
2.5 MAIN VALUE DETERMINANTS OF PATENT .....	18
2.5.1 <i>Lifetime</i> .....	18
2.5.2 <i>Novelty and Inventive activity</i> .....	19
2.5.3 <i>Difficulty to invent around (infrangibility)</i> .....	20
2.5.4 <i>Breadth of a patent</i> .....	20
2.5.5 <i>Portfolio Position</i> .....	21
2.5.6 <i>Market Size (market value) and Status of Commercialization &amp; Production</i> .....	21
2.5.7 <i>Geographical Coverage (patent family)</i> .....	22
2.5.8 <i>Difficulty of Proving Infringement</i> .....	22
2.6 HOW DO COMPANIES VALUATE THEIR PATENTS.....	22
2.6.1 <i>Quantitative Evaluation Methods</i> .....	23
2.6.2 <i>Qualitative evaluation methods</i> .....	29
2.7 ESTIMATION OF PATENT VALUE BY IPSCORE® 2.2.....	31
2.8 NEED FOR A QUICK METHOD TO VALUATE PATENT .....	33
2.8.1 <i>Aim of Project</i> .....	34
<b>3. MATERIALS AND METHODS</b> .....	<b>35</b>
3.1 PROGRESS OF THE THESIS WORK .....	35
3.2 QUESTIONNAIRE.....	36
3.3 FORMULA FOR PATENT VALUATION .....	38

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3.4	SURVEY METHOD .....	41
3.4.1	<i>Trial Survey</i> .....	43
3.5	MARKETING OF THE QUESTIONNAIRE .....	44
<b>4.</b>	<b>RESULTS.....</b>	<b>45</b>
4.1	RESPONDENTS TO THE QUESTIONNAIRE .....	45
4.2	EVALUATION OF THE RESULTS .....	45
4.2.1	<i>Calculation of Scores for Each Choice (Answer) of each Question</i> .....	47
4.2.2	<i>Scoring the Results from each Participant</i> .....	47
4.2.3	<i>Calculation of the Coefficient</i> .....	48
4.2.4	<i>Summary of the results</i> .....	50
<b>5.</b>	<b>DISCUSSION.....</b>	<b>51</b>
<b>6.</b>	<b>CONCLUSION .....</b>	<b>55</b>
<b>7.</b>	<b>REFERENCES .....</b>	<b>56</b>
	<b>APPENDICES.....</b>	<b>60</b>
	<b>APPENDIX 1 .....</b>	<b>60</b>
	<b>APPENDIX 2 .....</b>	<b>68</b>
	<b>APPENDIX 3 .....</b>	<b>70</b>

## Abbreviations

EPO	European Patent Office
FPV	Fatih's Patent Valuator
FF	Fatih's Formula
IAS38	International Accounting Standard No 38
IP	Intellectual Property
IPR	Intellectual Property Rights
MVP	Monetary Value of Patent
S	Score for Each Individual Answer to the Questionnaire
SME	Small and Medium Enterprises
USPTO	United States Patent and Trademark Office
OECD	Organisation for Economic Co-operation and Development

## **Abstract**

This study aims to contribute to estimating economic value of a patent/patent application for Biotechnology companies. To be able to perform a solid portfolio management of patents and patent applications, it is necessary to obtain an approximate economic value of patent/project in question. In this manner, this study seeks to answer the questions of how the value evolves throughout the filing process, what the value determinants of a patent are and how they affect the value of patent/patent application during filing process. After selecting major value determinants of innovation/patent by observing the interaction between the value determinants and patenting process, a questionnaire was prepared and a survey was carried out with participation of biotechnology companies. Based on the responses to the questionnaire, a proper mathematical model was attempted to be developed in order to use for further estimations on patent value.

**Keywords:** Intellectual property; Patent; Patent portfolio; value of patent; value determinant of patent

## 1. Background

Intellectual property (IP) is a term referring to a number of different types of innovations of the mind; intellectual properties can be protected in accordance with their forms in different ways (Raysman, 1999). There are several forms of intellectual property rights (IPR) such as trademarks, trade secrets, industrial design rights, utility model, patents and copyrights. The most common and potent form of IPR is patent. Patent is the right to exclude the other parties from making, using, or selling the invention or technology as defined in the claims of the patent during its lifetime. After a patent is granted by the patent office, lifetime of the patent is around 20 years (Zimmerer et al., 2008).

Patent provides financial incentive to innovative companies. In this way, technology producing companies are encouraged for further research and development. For instance, if pharmaceutical industry is considered, patent of an effective medication can generate high income to the patent owner (van Triest and Vis, 2007). Intellectual property in the form of patentable technology, legally protectable designs and trademarks, and copyrights have increasingly become the most important assets, not only for many of the world's largest companies, but also for small and medium enterprises (SMEs) (EPO, 2009). In this sense, patents can be viewed not only as a legal document protecting a technical solution to a problem, but as a basis for commercial opportunities – an option (Office, 2010).

Since biotechnology is a highly innovative field, the most preferred way of protecting the technology has become patents held by biotechnology companies. The number of patents granted in biotechnology ascended 15% a year at the United States Patent and Trademark Office (USPTO) from 1990 to 2000, and 10.5% at the EPO, against a 5% a year overall increase in patents (OECD, 2002).

Patent takes place at the centre of the competitive strategy for the companies which are commercializing wide variety of technologies and innovation. Ideas or innovations of biotechnology companies might often be their only assets. Intellectual property rights are often the company's biggest asset. Intellectual property rights have also higher value than the company's physical assets in general (Krohn, 2010). Thus, patent is a key factor in order to

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obtain funding and commercial success for further development for biotechnology companies (Philpott and Jolly, 2004).

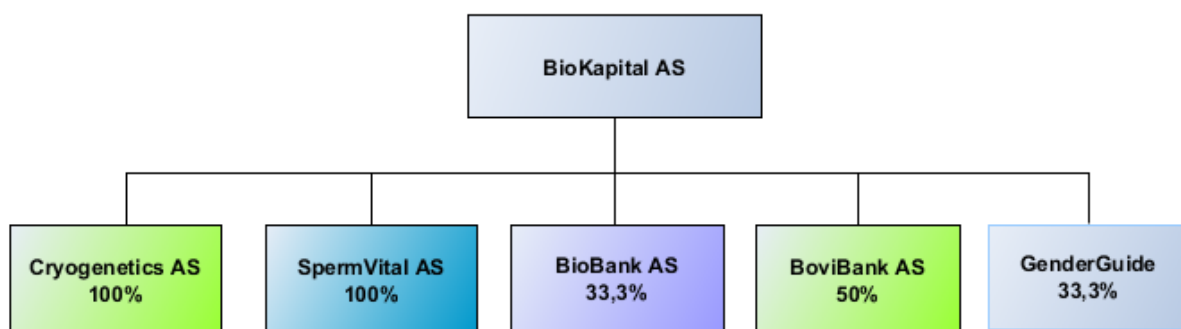
## 1.1 Project

This project covers a 60-credit thesis work of Hedmark University College Master program in Commercial and Applied Biotechnology – Commercialization of Biotechnology, 2011. The research has been conducted upon assignment from BioKapital AS at the Hamar Biohus. BioKapital AS has needed to optimize its patent portfolio and to find out what procedures should have been enforced in order to maximize commercial value of their patent portfolio.

This dissertation covers a new approach to estimation of monetary value of core business patent and patent applications for biotechnology companies, especially for BioKapital AS, in different aspects. In this manner, significance of patent value and patent value determinants are in question.

## 1.2 The Company: BioKapital AS

BioKapital AS is the holding company of BoviBank AS, SpermVital AS, Cryogenetics AS, GenderGuide AS and BioBank AS. BioKapital has whole shares of Cryogenetics and SpermVital. As half of BoviBank's share belongs to BioKapital; 33.3 percentages of BioBank's and GenderGuide's shares are owned by BioKapital as well. Figure 1 shows share distribution of BioKapital AS.



*Figure 1. Illustration of the current ownership structure of BioKapital AS.*



Main goal of BioKapital is to increase commercial value of a selected portfolio of the daughter companies to the greatest degree. They are planning to achieve this goal through active ownership, capital providing for successful growth, senior research and development expertise, commercialization, IP management and relevant industrial experience. The daughter companies are focusing on the global agriculture and aquaculture industries. Their main fields of expertise are; artificial insemination (AI) and fertilization, gender selection, gene interaction, storing biological material and data, and the portfolio that will be developed on these basis. The aim of the portfolio companies is to enhance effectiveness in food value chains by implementing novel biotechnological methods (2011a).

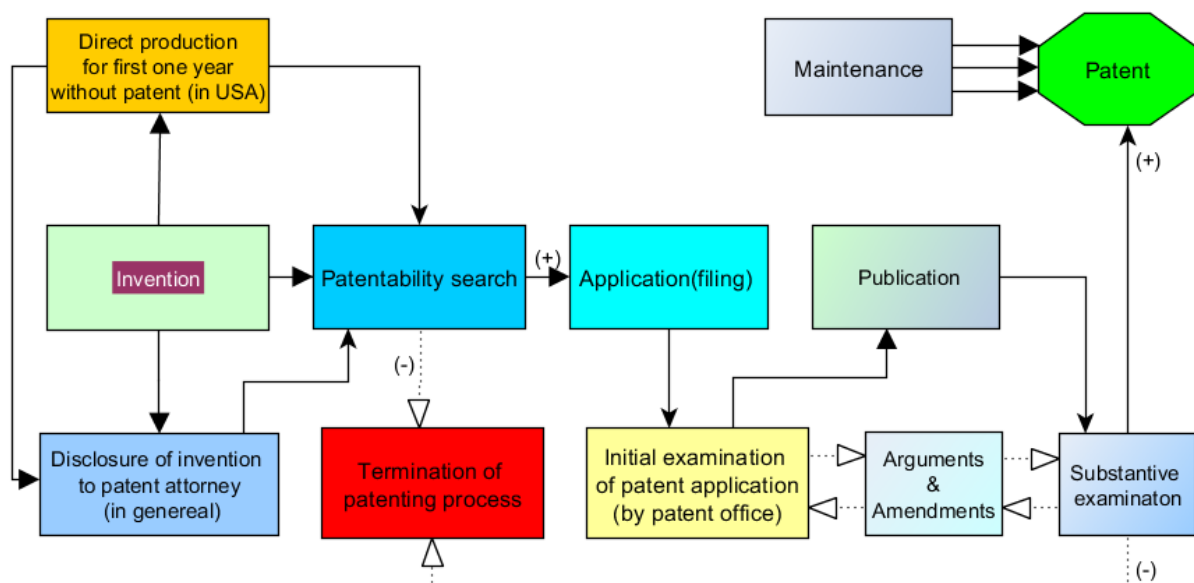
BioKapital has also international activities such as SpermVital AS - Geno Italy srl collaboration. In the end of 2009, Geno Italy srl started selling SpermVital's semen to Italian dairy farmers. SpermVital semen is a revolutionary new technology and is the final product of nearly a decade of research. SpermVital has had aimed to immobilize or "arrest" the sperm cell to save energy of sperm cells in order to ensure the sperm cells to survive for a longer period of time after insemination. For dairy farmer this application makes timing of insemination less critical and increases the chances of cow getting pregnant. The SpermVital process successfully combines immobilization with conventional cryopreservation techniques, so that SpermVital semen is stored, distributed and inseminated like conventional semen (AS, 2011).

Patent application of SpermVital semen was published on 10 January 2008 and patenting SpermVital semen obviously encouraged BioKapital to do international business strengthening the patent portfolio. Estimating value of patent helps BioKapital and BioKapital's portfolio companies to remove uncertainties through patent filing process and to better managing the portfolio.

## 2. Introduction

### 2.1 Patenting Process

To be able to estimate economic value of a patent, it is required to understand how patenting process is conducted. Overview of the typical process of patenting an invention is showed in Figure 2.



**Figure 2.** The figure summarizes a typical patenting process. In general, it starts with disclosure of invention to a patent attorney and then patentability search is carried out by industry professionals or inventor. According to the search results, patent application is submitted to the patent office (e.g. EPO, USPTO) or patenting process is terminated. After initial examination of the application at patent office, application is published. After patent is publicized, invention is granted with patent; as long as the substantive examination is completed without any crucial objection. During the examination steps, necessary arguments and amendments may be carried out between patent office and inventor/attorney. Maintenance fees are paid at particular terms during patent lifetime. There is a nine months opposition period after patent is granted for competitors. Opposition is the last chance to attack a European patent as a single entity in a single forum. Later, the patent can only be opposed in national courts (Office., 2007).

#### 2.1.1 Disclosure of Invention

In general, patenting process starts with inventor's disclosure of the prior art to a patent attorney (EPO recommends inventors to recruit a patent attorney to avoid costly mistakes

through application process) or a company which can be interested in the invention. In this step, if inventors think that their invention can be defended, then they should prepare a disclosure document of the invention in written form (non-disclosure agreement to prevent possible infringement of invention). Briefly, the disclosure document (a non-disclosure agreement) contains statement of invention (statement of prior art), drawings, name of inventor (s) and list of important dates related to the invention (2011b). In other words, disclosure document should answer some basic questions such as what is the invention, how can it be used, how does it work and etc. There can be some drawings in the disclosure or descriptions if it is a new method or developed version of a previous invention. Moreover, it is important to have a detailed documentation of the work such as laboratory reports in addition to references to the drawings before disclosure of invention. The disclosure should be dated and signed by inventors and two more individuals as witnesses other than inventor or co-inventors, witnesses should be able to understand the basics of the technology (Colitz, 1995).

Apparently, inventor's disclosure is one of the solid steps for monitoring how the value increases since the patent attorney may contribute to estimating value of the patent by opining on invention (Macdonald and Lefang) .

### **2.1.2 Patentability Search**

To determine patentability of a technology, inventions are evaluated in light of existing prior art (Atal and Bar, 2010). Patentability search is useful before preparing and filing a patent application. The search results help determine whether to pursue protection and may indicate what issues could arise during examination of the application. After disclosing the invention to a patent attorney, comprehensive search is done by industry professionals (Hunt et al., 2007). Patentability search is mainly based on claims of the invention for novelty. In the end of patentability search results are reported to gives an initial opinion on the patentability of the invention and to help better reconstruction of the claims. Hereby it is aimed to achieve the broadest protection without stepping on the known prior art (Foglia, 2007). According to the patentability search results, patent application is prepared and submitted to the patent office. Therefore, patentability search of invention has also a crucial effect on patent value.

### **2.1.3 Application and Publication**

Inventors usually apply to the United States Patent Office (USPTO) or European Patent Office (EPO) to patent their invention. When the patent application is received, an initial examination is carried out by the patent office. In case of any mistake in the application, applicant makes correction and resubmits the document. Patent application is filed with a filing date. For EPO, eighteen months after filing patent application, inventor's patent application is published (Aoki and Spiegel, 2009).

Inventor's application can be seen by other people around the world in patent databases. This publication acts as prior art against other inventors or companies for similar invention (Office., 2007). The period after the filing process is called "patent pending". This is warning for excluding the competitors and attracting potential investors. For example, most of the pharmaceutical companies try to have license of novel medicines before patent of the medicine is granted. Because pharmaceutical companies need a new product every three to five years in order to maintain growth. This need is often met by licensing a product from a competitor (Fitzgerald, 1992). As a part of the thesis, it is assumed that patent value would increase with publication process in case of acquisition offers from the competitors.

### **2.1.4 Substantive Examination: Patent Pending**

After filing of the patent application at a relevant patent office, when the examiners check the application to determine its patentability, they must see that the invention is useful, non-obvious and novel (Colitz, 1995). Duration of the examination is a critical period not only for owner of patent/invention but also the market, because a pending patent produces uncertainty for all the parties in relevant market. Patent pendency may distort rival firms' investment decisions since it is a signal to rival firms. In other words, competitors get aware space of a specific technology may already be owned. Definitely, the strength of this signal depends on the probability of being granted (Palangkaraya et al., 2008). In this manner, 'patent pending' has a relative effect on patent valuation.

### 2.1.5 Decision

Apparently, the most important value determinant stage of patenting process is decision on granting patent. If the patent application fulfils the requirements of patent office and all charges have been paid, patent examiners decide to grant patent under examination. Granting process takes on average 4.2 years from date of filing the application for a European patent (Harhoff and Reitzig, 2004). After a patent is published in relevant patent bulletin, maintenance fees are paid at particular intervals to keep patent in force (Colitz, 1995). Last process of the granting stage is opposition period. This period is nine months after publication of the mention showing that a European patent has been granted. Anyone can give the EPO notice of opposition to the patent, except for the proprietor (European patent office, 2009). If the opposition period ends without any opposition, invention completely becomes an asset of the inventor. Thus, invention can be driven into market safely with less risk and more value.

## 2.2 What Value of a Patent Means

The value of a patent is the future commercial utility of patented invention. A patent value is derived taking into account all necessary economic and technical aspects and risks. Patent value is that how much money can be earned on patented invention out of the cost (Office, 2010). In that case, there are three concepts which should be defined to better understand notion of patent value; value (individual utility), price (exchange value) and cost. These three notions can be explained with an example; For instance, cost for a bottle of water can be 0, 2€ and the price for a bottle of water probably vary between 0, 3€ and 2€. Whilst a customer may buy a bottle of water paying 0, 3€ from super market, the customer may pay 2€ for the same bottle of water in a gourmet restaurant. As to notion of value (individual utility), a bottle of water may even be priceless, if the customer in the middle of a desert. Therefore, value of something depends very much on the situation where the asset is used and who is using the asset. For example, value of a bottle of water is absolutely different for a man and for a camel (Schaaf, 2009). In general, those three main concepts are taken into account for patent valuation.

## 2.3 Why Estimating Value of an Patent

For some decades, patent and statistics about patent evaluation have been under close examination by economists and policy-makers (Harhoff et al., 2003). In addition, technology transfer institutes, banks and venture capitalists have been interested in value of a patent beside the patent owners themselves (Office, 2011). In this chapter, reasons for estimating value of a patent are explained.

Patent is an intellectual property as pointed out in the previous sections. In the last 15 years there has been a remarkable increase in the number of companies that have become leaders through the effective creation, extraction and leveraging of their IP through efficient IP management. Yet, the role of IP in business has not sufficiently understood in most cases. Small and medium enterprises, the building blocks of many developed economies have failed to quickly realise the potential of IP management in increasing their competitiveness (EPO, 2009). Thus, many governments have taken a stand in the promotion of such IP management business practises.

The primary reason for such promotion is to maximise its value and therefore the value of the owner organisation through optimum management decisions. There are various situations where valuation is needed, and some examples are given below.

*Company valuation (transactions, joint ventures, mergers and acquisitions, bankruptcy)*

IP is an essential component of company value. A precise IP valuation is required for acquiring or selling a company, setting up joint ventures, and executing mergers and acquisitions. In such transactions, each party will need to know the value of purchased and sold IP assets as part of the company. In case of company's bankruptcy or reorganisation, assessment of the company's value is required, and this must include the value of IP assets and the assessment of the impact of proposed reorganisation plans (EPO, 2009).

*Sale and license transactions*

Before a company buys or sells IP, it must be aware of its value. Likewise, when negotiating a license contract, both parties must be clear about the values involved. Often, a due

diligence report is required in outlining the details of the purchased, sold or licensed IP (EPO, 2009).

### *Raising finance*

To finance their development plans, many knowledge intensive companies can only offer their own IP as collateral. More recently, there has been increasing debate about the collateralisation of IP in both cash flow based financing and asset based financing. Due to insufficient knowledge about IP and its valuation, banks are as still reluctant to accept such assets. In the future, this type of collateralisation will be more accepted in the industry and IP valuation will become a key process. Financing through venture capital is also important for many (especially knowledge based) companies. As well as, for legal entities, knowing the value of their IP is important for possible tax deductions and tax compliance (EPO, 2009).

### *External reporting and accounting*

In general, accounting standards are not useful when IP is represented in company accounts and often it causes to undervalue and mismanage the IP. Accurate IP value estimation is required for many aspects of reporting and accounting such as the reporting of fair value estimates in annual reports of the company. In addition, precise estimation on IP value is also needed in the event of intellectual property rights infringement or breaking of a legal agreement on an IP (EPO, 2009).

### *Internal management*

The successful exploitation of IP (for example in the ways outlined above) can lead to a company's success or failure. IP exploitation and creation of business strategies require effective management within the company. Research, development, legal, industrial protection application and commercialisation decisions involve high but measurable levels of risk. IP valuation facilitates cost effective decision-making and helps to understand and deal with the risks involved (EPO, 2009).

To evaluate a patent, there are several reasons depending on the technology in question, these are optimization of patent portfolio expenditures, remuneration of inventors, positioning of patent strategy to overall business strategy, financing, licensing, mergers and takeovers, accounting (IAS 38), enforced evaluation in case of bankruptcy and damages (Office, 2011).

Licensing is the major reason for evaluation of a patent. Patents are constituent of intellectual capital of innovative companies. Valuation of a patent can be helpful in discovering potential licensing income sources, and arranging the licensing fees (van Triest and Vis, 2007). Therefore, to be able to perform a solid portfolio management of patents and patent applications for innovative companies, it is crucially important to obtain an estimate on economic value of patent (Sullivan, 1994) and understand what are the most remarkable factors on determining value of patent. Since biotechnology is a highly innovative field (Hunt et al., 2007), estimating economic value of patent also has a special significance for biotechnology companies.

## 2.4 The Literature on Patent Value

In this section, related definitions and explanations to patent value, determinants of patent value and patenting process are given.

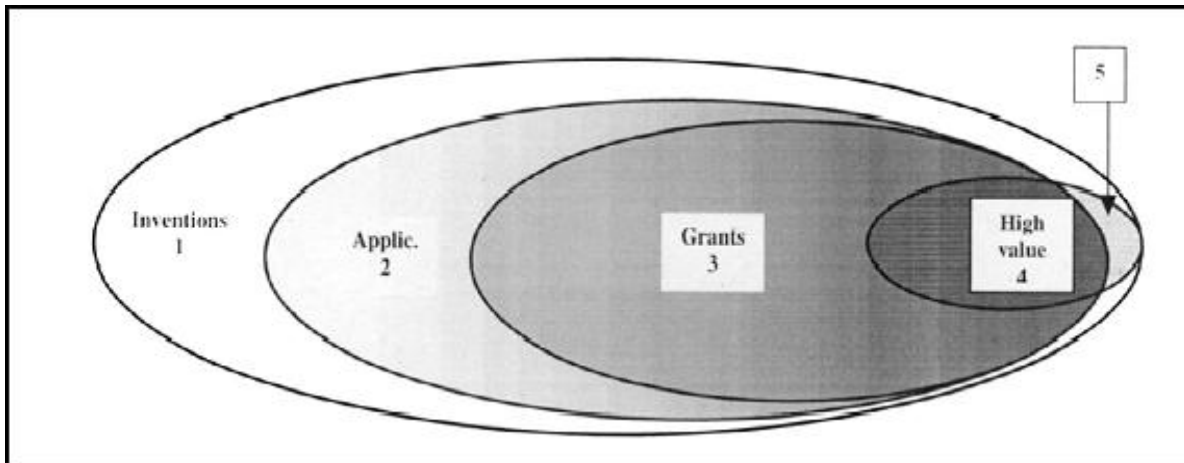
Since the first studies in 1960s, researchers have studied a variety of patent value determinants such as patent breadth, novelty, disclosure, and inventive activity; and most of the literature relating to patent value focuses particularly on theoretically modelling of the patent system (Holger Ernst 2010).

### 2.4.1 Patenting Process and Value Determinants of Patent

In the economic literature, it is assumed that value of patent is mainly determined by number of times the patent is cited, length of its renewal and number of countries where the patent is granted. In most of studies relating to estimating value of patent, this information is used in different functional forms (Guellec and van Pottelsberghe, 2000). However, there are also several other parameters which may better contribute to determining value of patent at different stages of patenting process. This research is dealt with these most remarkable value determinants and their relative effects on estimating value of patent at each stage of patenting process.



Value of a patent can be calculated empirically by using several different criteria at different stages of patenting process. Value of a patent increases through patenting process -from invention to granted patent. The darker the zone gets, the higher the value of inventions have (Guellec and van Pottelsberghe, 2000). Figure 3 demonstrates a value scale in the universe of inventions.



**Figure 3.** The figure illustrates a patent value universe. In zone 1, a new technology emerges; invention has the lowest value. At the application stage, invention has more value as compared to space 1. From zone 3 to zone 4, invention reaches the highest value by getting granted (patented) and increasing market demand. After patent expires in zone 5, invention's value decreases to the level of zone 2 (Guellec and van Pottelsberghe, 2000).

Invention value can be guaranteed to some degree with patent. However, it is also well known that value of an innovation can change after patent granted, often dramatically for many different reasons. One of these reasons is technological substitutions. New technology may appear to supplant the old one, making the old one partially or totally useless and hence less valuable. In a contrary manner, complementary technology may be developed in a way to enable better commercialization of an old innovation which previously could not be implemented very well.

The other reasons are commercial; the market for the related invention may simply disappear because of a change in "consumer taste". Or the complementary assets used to commercialize the innovation could increase the value of the innovation in the process. Furthermore, innovators may have different ability to commercialize their innovations, and

the value that the innovator can obtain from commercialization depends not only on the appropriability regime<sup>1</sup> but also on the commercialization strategy the innovator chooses (Sherry and Teece, 2004).

## 2.5 Main Value Determinants of Patent

In the following section, it is intended to define and understand most remarkable patent value determinants directly regarding invention itself and how the determinants affect the patent value at each step of patenting process.

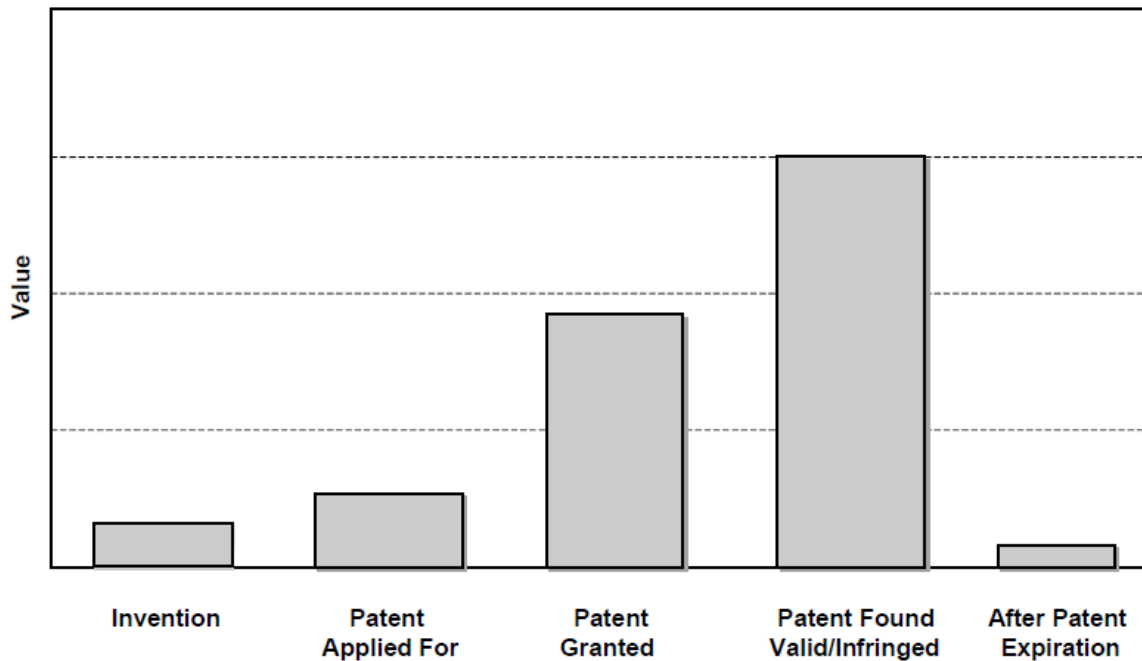
### 2.5.1 Lifetime

Mainly, all models of patent value assume that the value of a patent increases monotonically during its lifetime with exponentially decreasing marginal returns. The literature strongly suggests that returns by patents per period are not constant, but that they rather increase until the global maximum of the technology cycle to decrease again (Reitzig, 2003). Lifetime of the patent is prolonged with renewals according to technology of the invention and continuity of its utility. However, for specific inventions such as effective or common medicines like aspirin, the main factor on patent value is total financial returns per period as well as the technology. Additionally, the litigations and oppositions against a patent by competitors can also push the patentee to renew the patent. And so, we can see that there are also many sub parameters affecting the lifetime of patent.

Lifetime of patent was first introduced as a patent value determinant in a study by Gallini (Reitzig, 2003). Remaining life time of a patent is a significant indicator of the value as shown in Figure 4 (Sherry and Teece, 2004).

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<sup>1</sup> The appropriability regime means those factors that influence a firm's ability to capture profits, which are: the nature of the technology; and the strength of legal barriers against imitation. TIMOTHY, O. H. 2006. Guarding Profits From Innovation: Successful IP Strategies. *In*: DAY, J. (ed.).



*Figure 4.* The figure indicates how patent value changes as the milestones are reached (throughout invention's/patent's lifecycle) (Sherry and Teece, 2004).

## 2.5.2 Novelty and Inventive activity

In intellectual property literature, novelty is defined as the technological distance between prior art and the patented invention. Inventive activity is described as the technological distance between existing technology and patented invention regarding obviousness. The degree of novelty and inventive activity are essential to fulfil patenting requirements, which determines value of the patent for the patent owner.

In several empirical surveys, backward citations<sup>2</sup> appear as significant indicators of patent value (Reitzig, 2003). Another study (Ma and Lee, 2008) emphasizes three different factors which have been frequently used to examine the various aspects of inventive activities: (1) R&D expenditure, (2) number of scientists, engineers, technicians, and (3) patent statistics. In many empirical surveys in the scope of assessment of patent, researchers have found that

<sup>2</sup> If Patent A (1993) is cited by Patent B (2003) then: Patent A is a backward citation of Patent B; Patent B is a forward citation of Patent A. 1.15.0, M. 2009. *Citations* [Online]. Available: <http://www.intellogist.com/wiki/Citations> [Accessed].

novelty and inventive activity have significant characteristics to estimate value of patent (Reitzig, 2003).

### **2.5.3 Difficulty to invent around (infrangibility)**

Inventing around is to work on previously patented invention and take patent of this new modification of the previous invention. In other words, it is a legal infringement of previous patent. Therefore, inventing around is a risk for previous patent owner but opportunity for competitors. Because of inventing around risk, inventor companies prepare their claims of patent application very carefully and revise their application many times via guidance of patent attorneys to block the others as much as possible. Increasing the difficulty of inventing around also increases the competitors' costs and time for imitation for inventing around the patent. In this way, competitors' willingness to pay for a license increases too or it keeps the competitors away from the market, thereby patent value increases (Granstrand, 1999). Inventing around is a value determinant for patent practitioners. However, how strongly value of patent is affected by inventing around parameter is not exactly known (Reitzig, 2003).

### **2.5.4 Breadth of a patent**

Claims of a patent determine its breadth. Theoretically, higher numbers of the claims provide larger size for breadth of patent. Not only number of claims but also scope of the claims determines broadness of the patent. Value of a patent increases with scope (number of different technologies of the patents) for American Biotechnology firms. It is assumed that breadth of a patent provides positive return to the inventor's (patentee) profit positively (Reitzig, 2003). Inventors try to keep the claims of patent application broad as much as possible to maximize innovation rents (Yiannaka and Fulton, 2006). A higher number of claims or a larger scope of invention can cause the oppositions (litigation) against patent by competitors (Harhoff et al., 2003). Number of oppositions against a patent is a sub value determinant of the breadth too. Breadth of a patent should be involved in patent valuation, in each step of patenting process.

### **2.5.5 Portfolio Position**

Patent portfolio is a list of patents belonging to an individual or a company. Managing the patent portfolio and comparing it to those of other companies are necessary for technology producing companies in order to justify economic expenses and economic value of their patents and to maintain their competitiveness in the market. Patent portfolio management also cover identification of opportunities and risk factors (e.g. growing markets and emerging of competitive substitute technologies) (Office, 2011).

It is emphasized that a company's patent portfolio is increasingly regarded as of major interest for strategic business development decisions in Littman-Hilmer's analysis on patent portfolios (Littmann-Hilmer and Kuckartz, 2009). In Reitzig's study, it is also mentioned that value of a single patent can depend on overall patent portfolio of the patent owner (Reitzig, 2003). Size of the portfolio and function of a single patent in this portfolio affect value of patent. Portfolio position of a patent must be taken in to consideration for estimating patent value.

### **2.5.6 Market Size (market value) and Status of Commercialization & Production**

Market size of invention, namely patented product, is an inevitable value determinant of patent. It is better to figure on this determinant as observing the changes on patent value at all phases of patenting process. Therefore, the better investigation and knowledge about the relevant market of invention contribute to companies for estimating patent value. IPscore® also requires inputs about marketing conditions of the product/invention. By achieving the proper amount of financials, innovation can get passed into production step.

Production of the invention is dependent status of commercialization (Zimmerer et al., 2008). Commercialization is the process that converts ideas, research, or prototypes into viable products that retain the desired functionality, while designing them to be readily available at low cost and launching quickly with high quality design. Commercialization may be a necessary step for commercial success for innovations coming from enterprise or company research efforts (Anderson, 2010).

### **2.5.7 Geographical Coverage (patent family)**

In a study by Harhoff et al., (2003), geographical coverage is used as one of patent value indicators. A patent family is a set of either patent applications or publications taken in multiple countries to protect a single invention by a common inventor(s) and then patented in more than one country. A first application is made in one country with the priority and then extended to other offices (Office, 2007). In the pharmaceutical and biotechnology areas, one should file in countries in which the major pharmaceutical companies have established research-and-development facilities. These countries would include the United States, the United Kingdom, Japan, Switzerland, France and Germany (Fordis, 2006). Hereby, value of a patent is supposed to change in correlation with geographical coverage of the patent.

### **2.5.8 Difficulty of Proving Infringement**

Difficulty of proving infringement was chosen as value determinant first time by Markus Reitzig in 2003. In materials and methods section, it is asked ‘‘ *whether it is easy to differentiate infringing copy products from the original* ’’.

## **2.6 How do companies value their patents**

In fact, there are nearly as many potential methodologies to estimate the value of patent as the number of existing investigations (Sapsalis et al., 2006). And most of those solutions are highly variable depending on the technological field and market conditions. On the other hand, there are a number of common models which are accepted by financial and accounting professionals in general. In brief, these are the cost-based model, the market-based model and the income-based model (Review, 2006).

In ip4inno student handbook (EPO, 2009) methods for valuation of intellectual property is explained. According to this source, depending on the reason for the patent valuation, a specific valuation approach or a combination of approaches is chosen. For example, patent valuation for the purpose of internal management requires an internal value; for sale or licensing, and a market value. These two valuations may not be equal. A number of

approaches have been proposed and each has their own set of unique strengths and weaknesses. It is important to choose the appropriate method or toolbox of methods for each individual case, to obtain an optimal result. In practice each valuation toolbox is likely to include more than one of the methods discussed in further sections. The most important parameters to consider during valuation of the patent and selecting the appropriate toolbox are the following:

### **What is the purpose of the valuation?**

The type of value (internal, market) and the type of required value result (qualitative, quantitative) is determined by the purpose of the valuation. Different value estimation methods are applied according to the target group. The target groups can be potential investors or internal management (EPO, 2009).

### **Date of the valuation**

Appropriate value estimation method is chosen according to time of patent valuation. For instance, expected licence income of a patent can be calculated for next 5 or 10 years depending on remaining lifetime of the patent or remaining lifetime of licensing agreement. Assume that subject patent has 10 years remaining lifetime from date of evaluation then evaluation for license income is carried out for 10 years, but not for entire lifetime of subject patent (EPO, 2009).

Methods, which are used for business purposes, can be divided into two groups. These are **qualitative** and **quantitative valuation** methods in general. The qualitative methods provide a value guide through the rating and scoring of patent on the basis of factors which can affect the value. The quantitative valuation methods are used to calculate the monetary value of patent and include cost, market, income and option pricing approaches. Summary of commonly used methods is given below (EPO, 2009).

## **2.6.1 Quantitative Evaluation Methods**

### *Cost based methods*

Cost based models measure the value of IP quantitatively through the calculation of the incurred costs if the company is to develop a similar asset either in-house or externally. The

costs to produce the IP are taken to be its value. Cost based methods include the historic cost, replication cost and replacement cost models. The historic cost model measures the costs incurred through the development of the IP, when it was developed. The replication cost model measures the amount of investment needed to develop similar IP, at the present time, in exactly the same way and achieving the same IP as currently exists. The whole cost of research and development must be included in this calculation, including the costs of unsuccessful prototypes as well. The replacement cost approach measures how much money would be needed to develop the current IP. Yet, as the term “replacement” implies, the costs of failed and unsuccessful research are not included. It is easier to think of this in measuring the cost of purchasing the already developed IP from an external source (EPO, 2009).

Approaches based on the measurement of cost are generally used in accounting, bookkeeping and in accordance with accounting rules. The cost based methods cannot be used to solely estimate monetary value of a patent. They are only relevant in historical cost based accounting systems or where taxation methods are relevant to use. Main advantage of this method is that patent becomes visible in the company’s books and IP awareness is increased. The method is also a useful indicator of IP value in case of IP assets whose future benefit is not evident (EPO, 2009).

There are many pitfalls related to using the measurement of cost to determine the value of IP. The main disadvantage is that there is no direct correlation between cost of development and the future revenue potential of assets. Actually, most costly IP may not necessarily be the most valuable. The same applies to old IP which has been written down in value. This IP could still be the most valuable for the company, even though the historical cost approach does not show this. The measure of historic costs is unreliable with rapid technological advancement. It is not always possible to provide accurate information on the resources spent on development and there will always be a practical challenge to determine which costs to include or exclude. Most importantly, cost based methods make no allowance for the future benefits which might accrue from the IP (EPO, 2009).

### *Market based methods*

Market based methods value IP through comparison with prices achieved in recent comparable or similar IP transactions between independent parties. Observing the prices of comparable assets traded between parties in an active market gives a value to the subject IP.



The idea behind these approaches is that the market decides the accurate price and therefore the value of the IP. Market based methods include IP auctions, comparable market value and comparable royalty rate methods. In an ideal IP auction, there are many potential buyers with ideal information about all aspects of the IP. The value of the IP is determined by the price reached through bidding. Comparable market value method, the value of the IP is given by comparison with similar comparable independent IPs or similar transactions (EPO, 2009).

Market based valuation methods may also be based on the comparison of royalty rates used when licensing similar IPs. Many sectors often use industry averages as a basis for setting royalty rates in license agreements or in establishing damages in litigation. The value of the IP is given through the comparison of the subject IP with the royalty rates in similar license agreements (EPO, 2009).

Market based methods are useful when a market value is required for any given subject IP. These methods require an active market, a comparable exchange of IP between two independent parties and sufficient access to transaction price information. However, there are limited formal markets for IP and the relevant pricing information is not usually public. As a result, the use of the comparable market value approach to valuing IP is rare. The use of comparable royalty rates are more widespread, especially as databases of industry royalty rates and comparable transaction information have been collated by larger IP right-holders and independent companies offering valuation services. In the future, when IP markets become active and public, the use of market based approaches can become more established (EPO, 2009).

Observing the market is a relatively straightforward valuation method. It is useful to check the validity of other approaches. As well as the issues raised about the lack of IP markets and information, there are many other disadvantages to these approaches. Firstly, the uniqueness of IP makes direct comparison difficult. There is a risk of comparing the subject IP with other IP which has been traded but has still not been utilised to the possible full extent. In these cases the IP can be undervalued. When royalty rates are compared, there are also some potential distorting problems. Royalty rates set using returns to R&D costs, return on sales figures or industry averages run the risk of valuing costs or other factors rather than value (EPO, 2009).

### *Income based methods*

The most fundamental definition of the value is dependent on the capability of an asset to generate future income, and this is especially valid for IP. Income based methods attempt to estimate the potential future benefits of the IP in an effort to determine its value. There are many income based valuation methods; each of these methods differs from each other according to the reason for the valuation and the type of industry. Some of the income based methods comprise the discounted cash flow (DCF), risk adjusted net present value (rNPV), relief from royalty methods and the technology factor method (EPO, 2009).

#### **Discounted Cash Flow (DCF)**

The Discounted Cash Flow (DCF) is the most basic and common model of the income based valuation approaches. This approach attempts to determine the value of the IP by computing the present value of future cash flows from the IP. The methods under this category are all centred around evaluating these future cash flows and then discounting them back at a discount rate to achieve a present value (Cooper et al., 2005). The two key factors which must be accounted for in a DCF calculation are the time value of money and riskiness of the forecasted cash flows. These are dealt through the use of a specific discount rate chosen specifically for the subject IP, which accounts for both factors at once. Alternatively, the forecasted cash flows can be adjusted to account for their riskiness and changing riskiness over time. These are then discounted at a risk free rate, which accounts for the time value of money (EPO, 2009).

#### **Risk adjusted net present value (rNPV)**

Risk adjusted net present value (rNPV), approach is an extension of the DCF method mainly used in the pharmaceutical and biotechnology industries. It was developed to deal with technical risk during the development of IP assets such as in medicines. To explain risk, the method adjusts the cash flows of each stage of development by fixed probability rates based on established industry indicators. For example, the statistical probability of successfully completion of the first stage of clinical trials may be 20%, second stage is 30% and so on. The cash flows are risk adjusted using these probability rates and discounted as with the DCF method (EPO, 2009).

**The relief from royalty**

*The relief from royalty method* measures the royalty that the company would have to pay for licensing the valued IP, to a third-party. The royalty represents the rental charge, which would be paid to the licensor if this hypothetical arrangement were in place. The method assumes that the value of the IP is defined as the rental charge that other companies would pay to use it. Estimating this royalty rate is only a first step. A reliable sales forecast is also required in order to estimate the income flowing directly from the IP. As with other income approaches, the royalty rates are discounted through an appropriated discount rate (EPO, 2009).

**The technology factor method**

*The technology factor method* firstly estimates a risk free net present value for the IP (similarly to the DCF method) and then multiplies this with a risk-factor, or “technology factor”. The technology factor value is derived from attributes reflecting the commercial strengths and weaknesses of the IP. Aim of technology factor method is to understand technical (in case of technology), legal, market and economic risks related to the valued IP (EPO, 2009).

Income based approaches for IP valuation is only precise, if the following variables are available or can be accurately estimated: An income stream either from product sales or license of the IP, an estimate of the duration of the IP’s useful life, an understanding of IP specific risk factors for incorporation into the valuation and a valid discount rate (EPO, 2009).

The advantage of income based methods is that it is relatively simple to assess the value on the basis of the setup conditions. With the probable availability of many of the required inputs from the firm’s financial statements and market information, it may be possible to identify and or forecast particular cash flows. The methods are conceptually strong but can be difficult to implement in high-uncertainty environments. This task always includes some uncertainty and subjective assumptions (EPO, 2009).

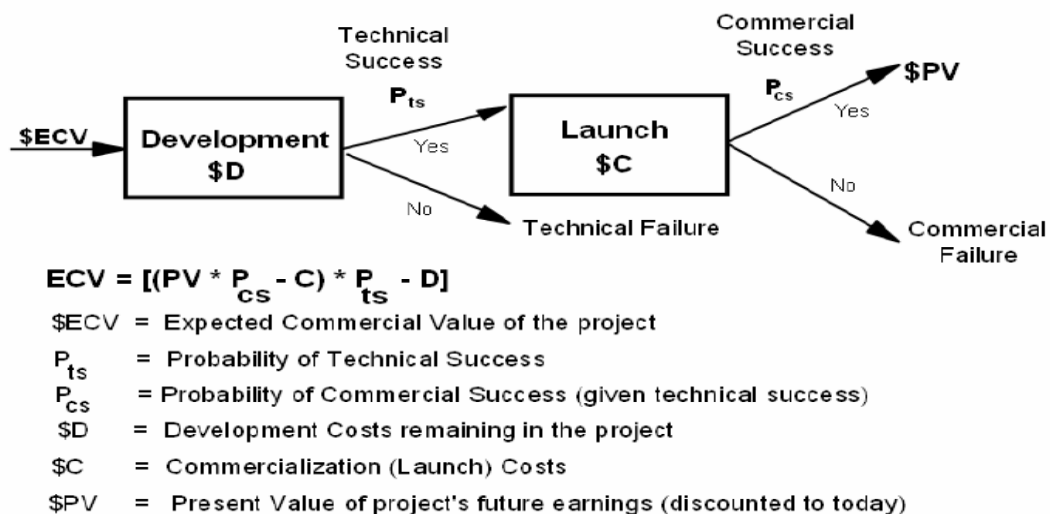
A significant disadvantage of these methods is that both uncertain and distant cash flows and the discount rate have to be estimated. For example, there is rarely an experience base when estimating the market potential and therefore cash flow of early stage IP developments. In

addition, all risks are lumped together and are assumed to be appropriately adjusted in the discount rate and the probabilities of success, rather than being dealt with individually (such as legal risk, technological risk etc.) (EPO, 2009).

A significant disadvantage of the relief from royalty method is that a royalty rate can always be assumed, while it may never materialise in reality. However, in specific circumstances this method is useful, especially if there are suitable comparable transactions involving third parties or industry standard royalty rates (EPO, 2009).

### *Option pricing based methods: Expected Commercial Value*

The theory behind option pricing was primarily developed for use in pricing financial options, but can also be applied to a number of other situations other than directly financial assets. The valuation of IP in development or already commercialised is one such framework (EPO, 2009). Option based methods essentially are in the income based methods category as they similarly use expected future cash flows to measure value. Calculation of expected commercial value of a project is explained in figure 5.



**Figure 5.** The figure shows calculation of the expected commercial value (ECV) from a project (Cooper et al., 2005).

The basic definition of an option is a right but not an obligation, at or before some specified time, to purchase or sell an underlying asset whose price is subject to some form of random

variation (Pitkethly, 2002). Options are priced using the Black-Scholes option-pricing model, which is a mathematical model for the valuation of options.

Real option valuation methods treat the development and commercialisation of IP as a series of options. As the IP is developed and commercialised, many decisions about investment timing, when to patent, abandonment, direction of research etc. must be made. The information to make these decisions is often not available at the time of valuation, but becomes available later. The real options method, using the Black-Scholes model, takes into account the flexibility of these future decisions (EPO, 2009).

The primary advantage of the real options method is its ability to incorporate the value associated with the uncertainty and to account for the flexibility inherent in the development of IP. The value associated with the uncertainty of cash flows and the ability to manage the development of the IP is accounted. Like the DCF method it values the stream of cash flows but it also accounts for acquired knowledge. As a result, it provides a more complete evaluation than the DCF as it captures more than simply cash flows and static costs. The main disadvantage of the real options method is the complexity of the model. It is difficult to understand and the evaluation can be costly to perform. Some experts doubt the accuracy of options based models for use with real investments such as IP. The main arguments are that option based models overvalue IP through the inclusion of non-viable development and commercialisation decisions (EPO, 2009).

The real options method is particularly applicable when there is a high degree of uncertainty, some managerial flexibility, and not all the information is known at a particular time. It is increasingly used in the biotechnology and pharmaceutical industries and early stage of IP developments (EPO, 2009).

## **2.6.2 Qualitative evaluation methods**

Qualitative valuation methods provide a value guide for the subject IP through the rating and scoring of different factors related to the IP. These factors or “value indicators” can influence the value of the IP both positively and negatively. In the same way, factors such as

location, numbers of rooms, nearby schools affect value of a house. A combination of these IP related factors acts as a proxy for the value of the IP (EPO, 2009).

In the case of patents, there is evidence to suggest that there is a strong correlation between patent value and standardised indicators which are observable in patent information documents. For example, the number of references to prior patents generated during the search and examination process, and the number of citations a patent has received indicate its importance scientifically and therefore its relative value. The observable result is a network of links called a patent citations network which is a useful qualitative evaluation tool. Likewise the number and quality of claims, the patent family size and the outcome of oppositions to the patent application can also be an indication of value. An example of this type of qualitative valuation method is the IPscore (In section 2.7, IPscore is described and discussed thoroughly).

The main advantage of patent information related and non-patent value indicators is their relative simplicity. Once the relevant information has been researched and is available in a useable form, it is relatively easy to classify and evaluate the IP without need for complex methods. Another advantage is that the data for the evaluation is often publicly available. With sufficient expertise, it is possible to value IP belonging to other parties. As a result, these qualitative methods facilitate the comparison and ranking of IP within a company's own portfolio or against competitors' IP. Valuing IP using patent information related value indicators has many drawbacks. For example simply counting citations avoids taking a stand on questions such as how and why citations arise and what type of information they convey. Focusing on simple counts deliberately ignores any added information within the network of citations. Using value indicators as a proxy for value is only as useful as the level of expertise of those who are conducting the valuation. One must also decide which indicators are relevant to the value of a particular IP. The quality and realism of the qualitative evaluation in IPscore, for example, are greatly dependent on the quality of information used.

Qualitative evaluation methods are most often used for the purpose of internal IP management. They are most useful for comparing, categorising and ranking IP within a portfolio or comparing with competitors' IP. They are also useful for assessing the risks and opportunities of IP (EPO, 2009).

## 2.7 Estimation of Patent Value by IPscore® 2.2

EPO currently brings in a software tool, IPscore® which combines the previously mentioned methods as in section 2. 6 of present thesis, for the innovative companies who need to understand and predict the value of their inventions (Nielsen E, 2004).

IPscore® 2.2 is a tool for evaluation of patents and technological development projects. It provides both qualitative and quantitative evaluation in the form of a financial forecast showing the net present value of the evaluated technology. In addition, IPscore® 2.2 produces output in the form of graphical overviews and a report to facilitate communication of the evaluation results.

At first, The Danish Patent and Trademark Office developed IPscore® 2.0 in 2001, in collaboration with the Copenhagen Business School and a number of Danish companies. In 2006, The European Patent Office purchased the tool from the Danish Patent and Trademark Office. In 2009, The European Patent Office developed IPscore® version 2.2 which is a multilingual (English, German, French) and slightly improved version. IPscore® 2.2 is made available to users free of charge in order to support the patent strategy of companies, mainly SMEs and to steer the volume of applications by eliminating potentially “worthless” applications (EPO, 2009).

IPscore® 2.2 includes a mathematical model and do not promise accuracy for the results of the financial analysis of the evaluated patented technology. The patent’s actual value may be significantly higher or lower than the value calculated by IPscore®, because the value is influenced by many commercial and economic factors which are not contained in the model, or other factors out of control (EPO, 2009).

IPscore® is the most prominent evaluation tool for the comprehensive use. The IPscore assessment of a patent consists of five categories: legal status, technology, market conditions, financials and business strategy, each of which has 5-10 associated index questions (inputs). Each question relates to a different value indicator. Each question is rated from 1 to 5 according to the patents strengths and weaknesses. Together, approximately 40 value indicators form a whole picture of the patent and its relative risks and opportunities. In

other words, outputs of the computation are given in relation with patent profile, net present value of the invention, financial forecast, diagnoses, portfolio and supplementary reports. Results are also given in different forms such as radar diagrams, charts, written reports and graphics (Organisation, 2010).

In appearance, IPscore® is a very appealing and useful tool for the patentees for estimating their patent value. However, when the user starts to put in necessary data, it is realized that user should have a comprehensive business plan to be able to evaluate the patent. This feature of IPscore® keeps itself away from practical use. Especially, inputs on the financial questions page of IPscore® prove the necessity for a business plan in order to approximate patent value. Figure 6 shows some required inputs of IPscore® for patent evaluation.

The screenshot shows the 'Input' page of the IPscore® software. The window title is 'EPO Input'. The main content area is divided into sections:

- Input data for the financial model**: Patent x2
- Financial results from the company accounts**:
 

Business turnover	252.000
Direct costs	180.000
Indirect costs	21.000
Provision for depreciation	5.000
Net result	46.000
- Depreciation period (yrs)**: 5
- Definition of business area**:
 

How great a share of current company turnover is attributable to the business area in which the patent technology is being utilised? (Answer range 1-100%. Note: %)

 40,0%
- Parameters used in the calculations**:
 

Discount factor (Note: %)	10,0%
Total growth in general company market (Note: %)	4,0%

A 'Back to the patent' button is visible on the left side of the interface.

*Figure 6. The figure indicates one of the input pages from IPscore® 2.2. It is showed that the necessary data which are supposed to be entered in by the user. These data indicates that the user should have a business plan to be able to evaluate his/ her patent/patent application (Organisation, 2010).*



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## 2.8 Need for a Quick Method to Valuate Patent

In previous sections, Intellectual Property Rights (IPR) and importance of patent especially for the biotechnology companies are emphasized. And following subjects are explained respectively; patenting process, notion of patent value, necessity of patent value estimation, patent value determinants, current IP evaluation methodologies used by the companies and estimation of patent value by IPscore. In summary, evaluation of the patent and patent application has vital role throughout the establishment of IPR strategy of companies. The companies are also required to have comprehensive business plan in order to use most of the current patent valuation methods.

There is a need for quick method since the current methods are costly and highly and also divergent from each other in terms of type of technology and industry, market conditions. In addition, efficiencies of the present methods are also open to discussion. Herein, by offering a quick model it is performed to help biotechnology companies, especially start-up biotechnology companies for evaluating their inventions. This method can also be used for purpose of internal management of big biotechnology companies.

In this thesis, it is attempted to develop a quick patent value estimation method, which is FF method, for core business patent (central patent) of biotechnology industry. There are three different types of patenting strategies for the companies establishing an IPR strategy. The backbone patenting strategy of those three is central patent. Defensive patent is another strategy to belt around a competitor's patents in order to prevent expansion of competitor's IPR field. Defensive patent also fences for protection to restrict and protect the company's own area. Another strategy is to use a patent as bargaining chip, that is often used for cross-licensing (Krohn, 2010).

In this project, a survey was carried out to be able to develop a method for value estimation of patent. Underlying reason for developing central patent valuator method is that patents of the sample group of the survey were central patents.

Table 1 shows which type of patent can be valuated with FF method in which way. FF method consists of two main components which are a questionnaire and a formula. The questionnaire was prepared based on determinants of patent value and interaction between

the determinants and patenting process. Whilst preparing the questionnaire and patent value determinants, which have been most often emphasized in the literature, were selected. Then, an equation deriving from the questionnaire was set up. Details of the questionnaire and equation are explained in materials and methods part.

*Table 1. The table indicates place of my method on matrix of patent valuation methods.*

Matrix of Patent Valuation Methods			
	Central patents	Defensive patents	Bargaining patents
Comprehensive methods	<i>IPscore</i> <sup>®</sup>	<i>IPscore</i> <sup>®</sup>	<i>IPscore</i> <sup>®</sup>
Quick methods	<i>FF model</i>		

### 2.8.1 Aim of Project

Specific aim of this project is to develop a model in order to estimate monetary value of biotechnological patents/patent applications quickly. Hereby, it was intended to help removing uncertainties during patenting process and develop better IPR strategies overall patent portfolio management of biotechnology companies. Under this main purpose of the study, sub-aims are listed like below;

**Sub-aim 1:** To prepare a questionnaire converting most remarkable patent value determinants to the questions.

**Sub-aim 2:** To carry out a survey amongst biotechnology companies for obtaining solid value (patent sales) by using the questionnaire (mentioned in sub-aim 1)

**Sub-aim 3:** To develop a fair scoring method in order to evaluate results of the survey (mentioned in sub-aim 2); this would help to develop a proper mathematical formula depending on results of the survey, for further estimations on patent value.

**Sub-aim 4:** To find out other possible mathematical formulations for further estimation of monetary patent value. Hereby, effect of the value determinants on the monetary value of patent is aimed to be observed individually.

**Sub-aim 5:** To observe weight of the value determinants via a survey study using the questionnaire in the scope of the ongoing debate about which criteria is the most significant on patent valuation in the literature.

### 3. Materials and Methods

#### 3.1 Progress of the Thesis Work

During the thesis work period from September 2010 to May 2011, regular meetings were held with the supervisors, once a month. In the first meeting with participation of all the supervisors, it was aimed to determine the problem; BioKapital were looking for the possible strategies to be able to maximize economic value of their patents and patent applications. In the second meeting, it was decided to find a solution for obtaining an approximate monetary value of a patent since it is necessary to have an estimate on economic value of patent to justify research and development cost for accounting purposes. This would help to remove the uncertainties throughout the filing/patenting process. Hence, it was intended to achieve better patent portfolio management.

After finding the problem, reading process was started and to be able to have a better background for analysis of the problem. Two months were spent for reading and one month for analysis of the problem. Following two months after the analysis step were used to develop a model for estimating patent value. Table 2 shows the timeline and progress of the thesis work.

*Table 2. The table demonstrates timeline of the thesis work.*

2010-2011 Thesis work study schedule							
Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May-Jun
Reading		Analysis of the problem	Developing a solution for estimating patent value		Obtaining the results		
						writing	

---

## 3.2 Questionnaire

In the beginning of February 2011, the questionnaire was prepared inferring from patent value determinants and IPscore®. The questionnaire was aimed at the patentees/inventors who have already sold or bought a patent, especially in biotechnology field.

On the top of the questionnaire (Appendix 1), four boxes (identifier questions) were placed. Participants are supposed to fill the first three boxes optionally and the fourth one compulsorily. In figure 7 these four boxes are demonstrated.

Please write your company name into the box (optional):

Please write your patent number into the box (optional):

Date of sale (year, optional):

Sales price of your patent (\$):

*Figure 7. The figure shows the required information about the participant's patent sales. The optional information boxes were placed to control the survey results in case of need. Sales price (MVP) was not kept optional since it was selected as one of the main component of the formula.*

The questionnaire consists of 13 main questions. There are also weighing questions in addition to each of the main questions.

Each of the questions has multiple answers in a particular order. Choices of each question were aligned in a qualitatively ascending order by weight. For instance, whilst choice (A) (first choice in the order) would have the lowest weight, choice (E) (last choice in the order) would have the highest weight during evaluation (scoring).

Each question of the questionnaire was prepared by being derived from patent value determinants. In this manner, different titles (representing scope of the question) were given to each of the questions in order to ensure the participants to better understand the questions.

Scopes of the questions are listed such respectively; Novelty of patent, Inventive activity, Legal status of patent/project, Infrangibility (Difficulty to invent around), Breadth of patent, Publication of patent and parties willing to buy the project/patent, Remaining lifetime of patent, Geographical coverage of patent, Status of commercialization, Identification of infringing copy products, Life expectancy, Portfolio position of patent and Status of production.

Some of the questions had already been designed by IPscore®'s producers. Thus, 1st, 3rd, 9th, 10th, 13th questions were adopted from IPscore®. The adopted questions were improved with little modifications. And also, weighing questions were added to each question in order to determine weight of the questions fairly. Thus, weight of each question was going to be determined by the participants (IP market). This also means that participants (IP market) determine significance of each patent value indicator via this survey. Determining fair weight for each question is essential for developing the formula as well. Hereby, questionnaire was adjusted to be compatible with the possible (rough) formula (patent value estimator). Third question of the questionnaire is shown in figure 8 as an example.

**3. - Legal status of patent/project**

*What is the legal status of patent/project?*

- A) Invention not yet disclosed to any patent attorney or patent office
- B) Invention disclosed
- C) Preliminary patentability search completed
- D) Patent application not done yet
- E) Patent application filed and publicized
- F) Patent granted
- G) Patent granted and opposition period is over without any opposition

How is the legal status of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

0  1  2  3  4  5  6  7  8  9  10

**Figure 8.** The figure indicates typical structure of a question from the questionnaire. It consists of a main question with multiple answers and an additional weighing question to the main question with its choices (0-10).

### 3.3 Formula for patent valuation

In the beginning of February 2011, the questionnaire was prepared. Then, a mathematical formula was developed depending on the questionnaire. The target group of the survey was patentees/inventors who have had already sold or bought a patent in biotechnology field. Depending on the answers to the questionnaire, it was planned to make a linear regression analysis to obtain required coefficient of the formula for the further estimations of monetary value of the patents. Regression analysis is a statistical tool for the investigation of relationships between variables. Usually, the investigator seeks to ascertain the causal effect of one variable upon another the effect of a price increase upon demand, for example, or the effect of changes in the money supply upon the inflation rate. To explore such issues, the investigator assembles data on the underlying variables of interest and employs regression to estimate the quantitative effect of the causal variables upon the variable that they influence. The investigator also typically assesses the “statistical significance” of the estimated relationships, that is, the degree of confidence that the true relationship is close to the estimated relationship (Sykes and Bhandari, 1997).

The formula was designed algebraically linear instead of exponential, polynomial etc. to be able to normalize the variability amongst the further patent value estimations. (Model of the equation (why a linear equation) is discussed in discussion chapter with the details.) Thus, a basic possible linear equation was set up and named as Fatih’s formula (FF) like below;

$$MVP = FPV \times \sum S_n + E$$

#### **MVP: Monetary Value of already sold/bought Patent (Sales Price)**

MVP will be answered by former or current patent owners who participate in the survey. According to linear regression modelling, MVP is the dependent variable

#### **FPV: FF Patent Valuator (Coefficient)**

Main purpose of the survey is to obtain a coefficient to make more patent value estimations. FPV is a dynamic coefficient; it would become stronger with higher number of the participation to the questionnaire.

### $\sum S_n$ : Sum of Scores from Each Answer to the Questions

According to participants' answers to each question, each answer takes a pre-calculated score. And then all of the scores are summed. ' $\sum S_n$ ' represents sum of the scores and ' $n$ ' represents number of each score obtained from answers to each different question. In this study ' $n$ ' is 13 since the questionnaire consists of 13 different questions. To state the matter more clear;  $\sum S_{13} = S_1 + S_2 + \dots + S_{13}$ . In this linear regression model,  $\sum S_n$  is the independent variable of the formula.

Another aim of the survey is to determine a proper scoring method for each answer to the questionnaire. To find a fair scoring method for the formula, two-stage method was developed. The first stage was to request an intellectual property rights (IPR) specialist to determine weight for each of multiple choices (answers) of each question in a proper way. Multiple answers of each question were weighed by Emeritus Professor Lars Monrad Krohn, he is a Norwegian engineer and entrepreneur. The determined weights for the choices of the questions are shown in table 3.

**Table 3.** The table shows weights (determined by the IPR specialist) for each choice of each question correspondingly. For instance, weight of choice C of question 3 is 100.

		Questions												
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Choices	A	150	10	10	10	400	0	10	400	0	100	10	100	100
	B	300	100	50	400	500	400	300	600	300	300	100	200	300
	C	500	800	100	500	800	500	600	750	800	700	300	500	400
	D	900	1000	200	900	890	900	800	800	900	900	600	900	900
	E	1000		500	1000	900	1000	900	900	1000	1000	900	1000	1000
	F			700		950		1000	1000			1000		
	G			900		1000								
	H			1000										

The second stage of developing a fair scoring method was to add a supplemental weighing question to each question, such as; '*How inventive activity of your patent is important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)*'. Thus, participants were supposed to select a point between 0-10 for each question. This would also help to determine significance of

patent value determinants corresponding to the questions. In the end of the survey, average value of each answer to the weighing questions was going to be calculated separately. And then calculated average value for each question was going to be multiplied by pre-determined weights of the choices according to the participants answer. The result of this multiplication gives scores (S) for each question.

For example, assume that in the end of the survey; only five participants answered the questionnaire. And they answered respectively 5,8,6,5 and 6 points to the weighing question of question #4. Then average value of those points is calculated as 6. And so, this average value is multiplied by each pre-determined weight of choice of the question #4 separately. According to the pre-determined weights on table 3, scores (S) for each choice (answer) of question #4 are calculated respectively;

$$\text{Score for choice (A)} = 6 \times 10 = 60$$

$$\text{Score for choice (B)} = 6 \times 400 = 2400$$

$$\text{Score for choice (C)} = 6 \times 500 = 3000$$

$$\text{Score for choice (D)} = 6 \times 900 = 5400$$

$$\text{Score for choice (E)} = 6 \times 1000 = 6000$$

According to this assumption, in future if any participant is supposed to answer the question #4 choosing choice (D), then score of the question #4 is taken as 5400 ( $S_4 = 5400$ ) for this patent valuation. Calculation of the score can be better understood with computation of the real data in chapter 4 (Results).

**E:** is called the error term, disturbance term, or noise. This variable captures all other factors which influence the dependent variable (MVP) other than the independent variable ( $\sum S_n$ ). The relationship between the error term and the independent variable, for example whether they are correlated is a crucial step in formulating a linear regression model, as it will determine the method to use for estimation.

According to the results of the participations to the survey, relationship between the score and monetary patent value was going to be observed. In other words, regression analysis was going to help to answer the question ‘Does the monetary value of patent increase as the score increases?’



### 3.4 Survey Method

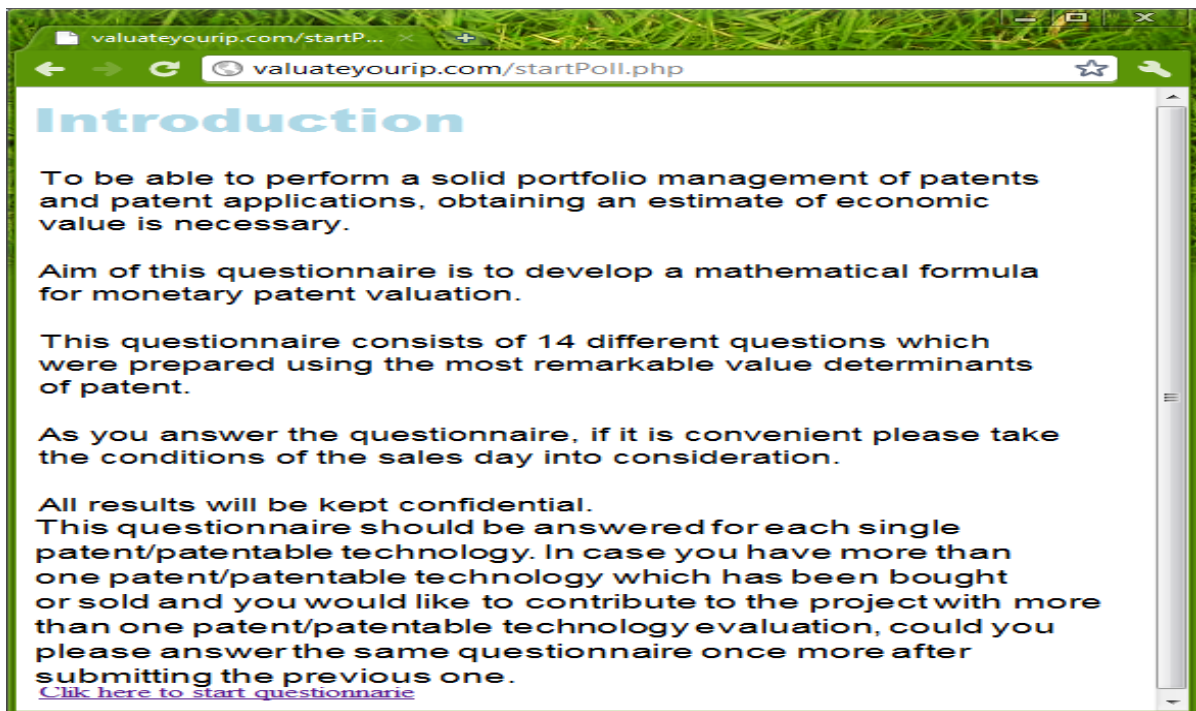
Since required data for setting up the value estimator formula such as sales amount of patents, does not exist in on-line sources, it was needed to obtain those data by carry out a survey. In order to increase the number of participants to the survey as many as possible and to reach the different type of biotechnology companies in an easier way, it was decided to make an online survey. Hereby, a web domain, [www.valuateyourip.com](http://www.valuateyourip.com), was purchased.

Questionnaire was redesigned and uploaded to the website by website designer in accordance with the survey. The website was constructed as password protected to prevent the accidental, undesired participations to the questionnaire as a consequence of the web searches. For instance, inappropriate people might make random searches on internet about patent valuation using related the keywords (such as ‘patent value’, ‘patent valuation’). Password of the website has been sent to the possible participants by e-mail.

After logging with the password on the entrance page, the participants were supposed to see the introduction page. And from there they could answer the questions on the questionnaire page after clicking on ‘[Clik here to start questionnarie](#)’ line. Following pictures (Figure 9, 10, 11) show which pages the participant would see in order.



*Figure 9. The figure shows access page of the website. Participants type the password into the box and click on “Log inn” button then pass to the next page (introduction page.)*



*Figure 10. View of the introduction page on the web page. Participants are briefly informed about the questionnaire and the project on this page.*

valuateyourip.com/poll.p...  
 valuateyourip.com/poll.php

## Questionnaire for Patent Valuation

Please write your company name into the box (optional):

Please write your patent number into the box (optional):

Date of sale (year, optional):

Sales price of your patent (\$):

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**1. - Novelty of patent**

What is the status of the invention as concerning its technological field?

A) Invention is an improvement on product of already existing technology and has a marginal effect in relation to existing technology  
 B) Invention is an improvement on product of already existing technology and has a significant effect in relation to existing technology  
 C) Invention is a unique product of existing technology and has a significant effect in relation to existing technology  
 D) Invention is a new technology and can create its own market  
 E) Invention is a new technology and applicable in many different industries

How important is the novelty of your patent to the patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

0  1  2  3  4  5  6  7  8  9  10

*Figure 11. The figure is a sample view from questionnaire page.*

An online database was constructed by the web designer. The database were connected to the questionnaire and tested like in figure 12.

PatentNr	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Question 10	Question 11	Question 12	Question 13	Sale value	Company name	Market numbers	Date of sale
3908901823	Answer: D Points: 2	Answer: A Points: 0	Answer: F Points: 10	Answer: A Points: 3	Answer: D Points: 6	Answer: A Points: 3	Answer: B Points: 1	Answer: F Points: 3	Answer: C Points: 7	Answer: C Points: 2	Answer: D Points: 4	Answer: A Points: 0	Answer: C Points: 6	2000	TestCompany	100	2010

*Figure 12.* The figure is a view from tested database of the website. Participant's answers to each question and corresponding points (weights) to each question are shown in this figure.

### 3.4.1 Trial Survey

Target group of the survey was around thousand different biotechnology companies. In the beginning of the survey, emailing process was launched with sending simple emails (without any details of the study) including the web address and the password. The emails were sent to 20 different biotechnology companies to be able to see whether they have any objection about any question on the website. It was also supposed to have some feedbacks from the participants about the study. And as expected, some feedbacks related to the some questions were received. For instance, some of the companies didn't want to give their company names, one of them did not want to give patent number, another one did not want to mention date of sale and those 20 companies did not participate in the survey either. In the earliest version of the website, all the questions were supposed to be answered by the participant to be able submit the questionnaire. If any question was skipped, participant could not submit

the questionnaire. According to the initial feedbacks, first three identifier questions were made optional as shown in Appendix 1.

### 3.5 Marketing of the Questionnaire

After completing the necessary changes on the website, a very brief and informative email (Appendix 2) was prepared for direct mail to the target companies. This email was sent to around thousand different biotechnology companies (Appendix 3) by evaluating profiles of the companies in accordance with their IPR activities. Web address of the questionnaire and required password (to access the website) were given in the email. The concerned personnel of the companies were requested to participate in the survey via email. In case of their involvement in the project, it was promised that the website would be an open source for valuation of their patents and patent applications in future without any demand.

The survey study took more than two months. During the survey, social media websites were also used to advertise the website on the relevant groups' pages of the social networks. In addition, direct phone calls and meetings were done with people who could contribute to the project. A high participation to survey was targeted to guarantee a stronger coefficient for the further patent value estimations.

Unfortunately, level of participation to the survey was very low in the end of survey period.

## 4. Results

In this section, even though very low number of the participation to the survey was obtained, regression analysis is applied on available data in order to explain how to calculate the coefficient (FPV) and how the model (FF model) works.

### 4.1 Respondents to the questionnaire

In the end of two months survey period, only 4 participants answered the questionnaire. Most of the companies replied the emails negatively. Some of the respondents even didn't want to participate in project without any excuse. Another group of the repliers did not contribute to the survey because of their confidentiality policy. And there were a low number of the repliers that have not had any patent/technology sales activities yet. In other, words emailing method was not successful.

### 4.2 Evaluation of the Results

As mentioned previously, four companies participated in the survey. Names of the participants are not given here because of the confidentiality agreement. In the study, representative names were used to symbolize names of the participant companies. Representative names are 'company 1, company 2, company 3 and company 4. Most of the participants answered all required questions for the value estimation, while one has not answered the sales price of the patent. Each of the participants contributed to the project with one patent. Their answers to the main questions are shown in the table 4 and answers to the weighing questions are shown in the table 5.

**Table 4.** The table indicates results of the survey, which are answers (given by the participants) to the main questions. For example, table shows that question 4 was answered with choice C (shaded with green) by 'Company 2'. \* Q is the abbreviation of 'Question' and \* A is abbreviation of 'Answer'.

		Questions													
		Sales Price	*Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Answers	*A of Company 1	1.000.000 (\$)	A	B	G	B	A	D	D	E	F	C	F	C	F
	A of Company 2	Not answered	B	B	F	C	A	D	B	C	C	D	F	D	D
	A of Company 3	50.000.000 (\$)	E	C	D	C	B	B	F	D	D	B	F	D	B
	A of Company 4	50.000. 000 (\$)	C	C	E	C	B	D	F	F	E	D	F	A	A

**Table 5.** The table shows the participants' answers to the weighing questions. W is the abbreviation of 'Weighing question' and A is the abbreviation of the 'Answer' to the weighing question. For instance, answer of company 3 to 5<sup>th</sup> weighing question is 7 (shaded with green on the table). Bottom row of the table shows the average of answers to the weighing questions. For weighing question #1, average value is calculated as 6, 75 (shaded with blue). Calculation of the average value for weighing question 1 is  $(6+9+7+5) \div 4 = 6, 75$

		Weighing Questions												
		*W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Answers	*A of Company 1	6	7	10	10	8	7	9	9	10	8	9	10	10
	A of Company 2	9	9	8	7	3	5	10	8	9	8	8	8	6
	A of Company 3	7	8	7	8	7	8	9	9	9	8	8	8	9
	A of Company 4	5	5	9	8	6	8	8	9	10	8	8	6	9
<b>Average weight for each question</b>		<b>6,75</b>	7,25	8,5	8,25	6	7	9	8,75	9,5	8	8,25	8	8,5

### 4.2.1 Calculation of Scores for Each Choice (Answer) of each Question

By determining a fair scoring method, it was also aimed to achieve converting quality of each value determinant of patent into quantity. In this study, quality of patent is determined by score which was derived from answers to the questionnaire. Hereby, to be able to calculate coefficient (FPV) of the formula, firstly it was required to calculate precise scores (S) for each answer (choice) according to results of the survey. In this point, average weight for each question (shown in table 5) and pre-determined weights for each choice (shown in table 3) in the questionnaire are multiplied. Results of the multiplications and an example about scoring system are given in table 6.

*Table 6. The table shows the calculated score for each answer placed under each question. Q1 represents question 1 and A, B...H represent choices of the questions. For example, assume that an inventor values his/her patent in future using FF method. If the inventor answers the question #9 choosing the choice C (shaded with purple), score (S<sub>9</sub>) for the question #9 will be 7600 in that valuation. 7600 was calculated multiplication of 9, 5 (see table 5; the intersecting box of bottom row and W9 column) and 800 (see table 3; pre-determined weight for choice C of question number 9)*

SCORES TO BE USED FOR FURTHER PATENT VALUE ESTIMATIONS														
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
Scores for the choices of each corresponding question	A	1012,5	72,5	85	82,5	2400	0	90	3500	0	800	82,5	800	850
	B	2025	725	425	3300	3000	2800	2700	5250	2850	2400	825	1600	2550
	C	3375	5800	850	4125	4800	3500	5400	6563	7600	5600	2475	4000	3400
	D	6075	7250	1700	7425	5340	6300	7200	7000	8550	7200	7425	7200	7650
	E	6750		4250	8250	5400	7000	8100	7875	9500	8000	8250	8000	8500
	F			5950		5700		9000	8750					
	G			7650		6000								
	H			8500										

### 4.2.2 Scoring the Results from each Participant

Since 'Company 2' did not answer the sales value question on the questionnaire as mentioned in section 4.2, there was no need to score for answers of Company 2.

Answers of the other three participants are already shown in table 3. Corresponding scores to answers of those three participants (Company 1, Company 3 and Company 4) are shown in table 7.

*Table 7. The table is combined version of table 4 and table 6. Corresponding scores to the answers given by the participants (companies) are shown in the table.*

	Corresponding scores to answers given by the participants		
	Company 1	Company3	Company4
$S_1$ : Score for answer to Question #1	1012,5	6750	3375
$S_2$ : Score for answer to Question #2	725	5800	5800
$S_3$ : Score for answer to Question #3	7650	1700	4250
$S_4$ : Score for answer to Question #4	3300	4125	4125
$S_5$ : Score for answer to Question #5	2400	3000	3000
$S_6$ : Score for answer to Question #6	6300	2800	6300
$S_7$ : Score for answer to Question #7	7200	9000	9000
$S_8$ : Score for answer to Question #8	7875	7000	8750
$S_9$ : Score for answer to Question #9	9500	8550	9500
$S_{10}$ : Score for answer to Question #10	5600	2400	7200
$S_{11}$ : Score for answer to Question #11	8250	8250	8250
$S_{12}$ : Score for answer to Question #12	4000	7200	800
$S_{13}$ : Score for answer to Question #13	8500	2550	8500
$\sum S_{13}$ : Sum of the scores	<b>72312,5</b>	<b>69125</b>	<b>78850</b>

### 4.2.3 Calculation of the Coefficient

Sum of the scores ( $\sum S_{13}$ : independent variables of the equation) and patent sales values (MVP: dependent variable) of the participants were placed on a Microsoft office excel sheet like in table 8.

*Table 8. Monetary value of participants' patents (dependent variable) and sum of the scores (corresponding to the participants answers are given in the table).*

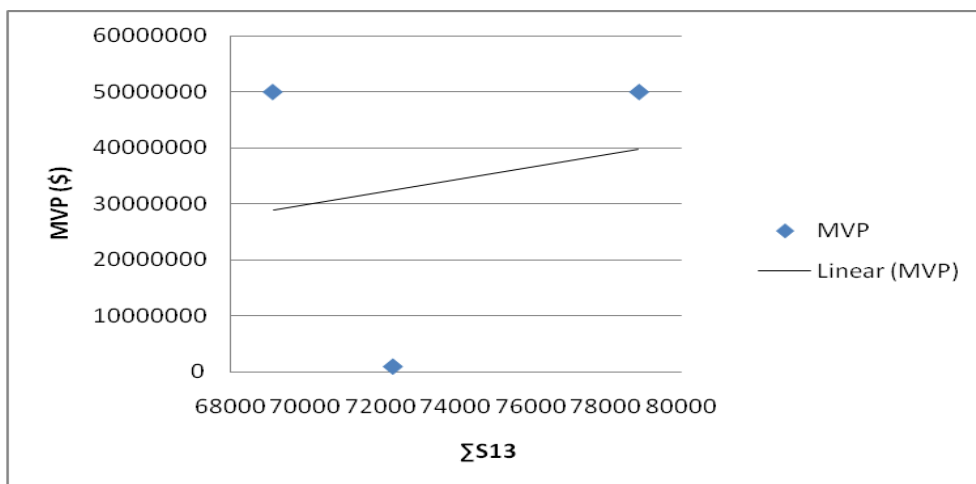
	$\sum S_{13}$	MVP
Company 1	72312,5	1.000.000\$
Company3	69125	50.000.000\$
Company4	78850	50.000.000\$



Using Microsoft office excels, regression analysis was carried out with the data that is shown in table 8. Summary of the regression analysis is shown in table 9 and figure 13 shows the relation between  $\sum S_{I3}$  and  $MVP$ .

**Table 9.** The table shows the summary of regression analysis of the  $\sum S_{I3}$  and  $MVP$  (\$) (see table 8)

Regression Statistics		
Multiple R	0.195061279	
R Square	0.038048902	
Adjusted R Square	-0.9239022	
Standard Error	6876.613447	
Observations	3	
	P-value	Standard Error
Intercept	0.06161762	7017.654157
X Variable 1	0.875018852	171.8795317



**Figure 13.** The figure shows the regression line between two parameters which are  $MVP$  (\$) and  $\sum S_{I3}$  (see table 8).

As a result of the regression analysis via Microsoft office excel, an equation was obtained like below;

$$y = 1113.1x - 5 \times 10^7$$

In this equation,  $y$  represents  $MVP$  and  $x$  represents  $\sum S_{I3}$ . The coefficient ( $FPV$ ) for further patent value estimations is  $1113.1$  and  $E$  is  $-5 \times 10^7$ . Hereby, according to result of the survey,  $FF$  (Fatih's Formula) is adjusted to a new version;  $MVP = 1113.1x \times \sum S_{I3} - 5 \times 10^7$ .

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#### 4.2.4 Summary of the results

According to the results (shown in table 9), effect of the independent variable on the dependent variable is statistically significant, because the *P value* ( $P= 0.06161762$ , shown in table 9) is higher than 0,05. In addition, *R Square* was calculated as 0.038048902 (shown in table 9), which means that barely %3.8 of variation in the dependent variable (MVP: Monetary value of patent) is explained by variation in the independent variable. Therefore, as concerning both *P value* and *R Square*, it can be concluded that estimates on further patent value, which would be carried out via FF model, would be very weak. (In figure 13, regression between MVP and  $\sum S_{13}$  is visualized.)

#### *How to Use the Current Results for the Further Estimations*

For instance, assume that a patentee answers the questionnaire and calculates sum of the scores in accordance with each answer about the subject patent using the table 6. Then the only thing he should do to put the sum of the scores ( $\sum S_{13}$ ) value in relevant place on the formula ( $MVP = 1113, 1 \times \sum S_{13} + 1414650$ ) and calculate the estimated monetary value of subject patent.

## 5. Discussion

Obviously, statistical evaluation of the results is not sufficient to prove exact validity of the current model (FF model) since number of the participants were very low. However, it is still possible to estimate further patent value using the formula. As mentioned before, these statistical calculations were carried out solely to explain how FF model was constructed and how it works even though very low number of participation to the survey.

### *Why the Formula was Set Up Linear*

The goal of setting up linear equation via linear regression analysis is to adjust the values of slope and intercept in order to find the line that best predicts dependent variable (MVP) from independent variable(s). More precisely, the rationale of regression is to minimize the sum of the squares of the vertical distances of the points from regression line, which is obtained from regression between monetary value of patent (MVP), and sum of the scores ( $\sum S_{I3}$ ). In this way FF model was simplified and so further estimations via FF model are optimized.

### *Why Simple Linear Regression Analysis was Carried Out*

Unfortunately, low number of participation to the survey affected construction of the formula negatively. This level of the participation caused formula to be constructed as simple linear equation via simple linear regression analysis. If there were high number of participation of the survey, the best way to develop a formula was to do multiple linear regression analysis instead of simple linear regression analysis. Therefore, best way of evaluating results of the survey was to make simple linear regression analysis in order to make logical comments on summary of the analysis.

To be able to carry out simple linear regression analysis, there must be two variables (independent and dependent). According to FF model, one of the variables is **MVP** (dependent variable: monetary value of patent) and the other one is  $\sum S_{I3}$  (independent variable: sum of the scores). Therefore, it was required to sum up the scores which are obtained from participant's answers to each question. Hereby, number of the independent variables (individual scores from answers to the questionnaire) was reduced from 13 to 1 by summing up scores ( $S_1$ - $S_{13}$ ) of answers to the questionnaire. This enabled the survey results to be compatible for simple linear regression analysis. And then explanatory comments on

summary of simple linear regression analysis supported the thesis. Hereby, the thesis was supported with explanatory comments on results of simple linear regression analysis.

### *Multiple Regression Analysis in case of High Number of Participation*

If there were high number of participation to the survey, multiple regression analysis could be carried out with those results instead of linear regression analysis. A multiple linear regression analysis is carried out to predict the values of a dependent variable, Y, given a set of p explanatory variables: independent variables ( $X_1, X_2... X_p$ ). In other words, multiple regression analysis enables to predict value of dependent variable by using more than one independent variable. For instance, model for estimating amount of heating oil used for a single family home in the month of January is based on average temperature and amount of insulation in inches. According to this model, amount of oil used for heating is dependent variable and average temperature and amount of insulation are independent variables (2007).

For FF model, to carry out multiple regression analysis, each score from each answer would be used as independent variable individually. So, there would be 13 different independent variables (scores obtained from answers to the corresponding questions). This means that there will be 13 different coefficients for each score ( $S_1...S_{13}$ ) instead of only one (FPV) for sum of scores ( $\sum S_{13}$ ) as well. Each of 13 different scores represents individual effecting degree of each value determinants to value of subject patent. And there would be one dependent variable which is monetary value of patent. So, possible formulation which can be generated via multiple regression analysis would be like in following;

$$MVP = FPV_1 \times S_1 + FPV_2 \times S_2 + FPV_3 \times S_3... + FPV_{13} \times S_{13} + B^*$$

*\*B is constant which is generatad by multiple regression analysis of the data*

So, by using multiple linear regression analysis, it is possible to observe how qualities of the value determinants affect monetary value of patent quantitatively in combination and to make better estimations on monetary value of patent.

### *What was Succeeded*

In spite of low number of participation to the survey, the current participants (company 1- 4) contributed to determining weigh of each value determinant of patent individually. There were very close and same answers from the participants, to the weighing questions (see table 5). Hereby, reliability of the scoring method was proved to some degree. It was possible to

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obtain better scores for each answer of each individual question. In this study, scoring method was developed at two stages (mentioned in section 3.3). At the first stage, scores for each answer of each individual question are determined by an IPR specialist. Then, at the second stage pre-determined scores for answers of each question are multiplied by the average weight (see table 5) of corresponding weighing question.

#### *Upper and Lower Estimation Limits: Estimation Interval*

Only drawback of the formula is that further estimations will always be made within an interval depending on results of the survey. This interval is determined by the results which are obtained from scoring (participants' answers to the weighing questions) and FVP is generated by regression analysis.

The scoring system of the questionnaire is limited by itself. Because, scoring system of FF model was developed by using pre-determined scores (by the IPR specialist) and post-determined scores (by participants to the survey). Pre-determined scores range from 0 to 1000 and post-determined scores range from 0 to 10. Additionally, dependent variable in the regression analysis (MVP) is given by the participants, and then MVP will always have lower and upper limits within data-set. According to the limits of MVP and the scoring system; FVP, which is generated from regression analysis of MVP and the  $\sum S_{13}$ , will consequently have upper and lower limits.

#### *Adjusting MVP(Sales Price: Monetary Value of Patent) to Present*

While evaluating results of the survey, there was no need to adjust MVP to present since there was low number of participation to the survey and sales dates of the participants' patents were very close to each other and present year. However, if number of participants to the survey was high, then MVP can be adjusted to present. For instance, assume that a participant answers the questionnaire and sales price of subject patent is 10 million American Dollars and sales year of the patent is 2005. Then, multiplying MVP of 2005 with cumulative inflation rate for 6 years (from 2005 to 2011) MVP of 2005 is adjusted to present year.

### *What can be improved*

As pointed out in the discussion part, best way of evaluating results of the survey is multiple linear regression analysis. To be able to perform multiple linear regression analysis and to summarize the result of the analysis reasonably, there must be high number of sample. In other words, number of patentees must be increased. It is possible to increase the level of participation through contribution from patent offices like EPO and USPTO in a PhD study and big biotechnology companies such as pharmaceutical companies. If they contribute to increase number of participants to the survey, stronger coefficients for the formula (FF) would be generated via multiple regression analysis.

It is also possible to improve the questionnaire by adding some more questions relevant with patent value. Especially, scoring method can be improved with additional weighing questions. In the scoring, score for each individual answer was calculated from multiplication of pre-determined and post-determined scores. Pre-determined scores were determined by an IPR specialist. This method was fair to some degree; however, it can be improved. Instead of benefiting from an IPR specialist about scoring, it can be asked directly to participants to weigh each individual answer of the questionnaire. Then, it is possible to place additional weighing questions next to each individual answer, similar to the current weighing questions.

## 6. Conclusion

A multidisciplinary study was carried out to achieve the goals of the dissertation. Specifically, the objective of developing a method (FF) in the project was succeeded to some degree. This project was based on a survey and since there were low number of interest in the survey, FF method could not be developed fairly. Even though the specific aim of the thesis could not be achieved completely, while sub-aims of the thesis were achieved fairly, which were preparation of a questionnaire by converting most remarkable patent value determinants to the questions, performing a survey by using this questionnaire, developing a fair scoring method on the questionnaire for further estimations on patent value, finding out other possible mathematical formulations for further estimations and observing weight of the value determinants with the survey study.

To achieve the goals mentioned above, firstly literature search was done. Hereby, notion of patent value was comprehended. Current valuation methods for estimating monetary value of patent were learned. Patenting process and value determinants of patent were investigated. By choosing most emphasized determinants of patent value from the literature and converting them to questions, a questionnaire was prepared. This questionnaire was prepared for the purpose of developing a quick method which can estimate economic value of core business patents. Then a website was designed for purpose of a survey. To convince as patentees many as possible about participation in the survey, many different strategies were carried out such as; e-mailing, promotion (promising use of the method free of charge), phone calls and meetings. However, desired number of participants could not be reached. Despite low number of the participation, functionality of the method and alternative methods were explained by using the available data from the present participants. The method helped to observe effects of the value determinants on patent value during patenting process.

As a result, the project has been concluded with low level of participation. However, most of the required subjects to develop a method for estimation of monetary value of patent were very well comprehended.

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## Appendices

### Appendix 1

#### Questionnaire for patent valuation

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Please write your company name into the box (optional):

Please write your patent number into the box (optional):

Date of sale (year, optional):

Sales price of your patent (\$):

#### 1. - Novelty of patent

*What is the status of the invention as concerning its technological field?*

- A) Invention is an improvement on product of already existing technology and has a marginal effect in relation to existing technology
- B) Invention is an improvement on product of already existing technology and has a significant effect in relation to existing technology
- C) Invention is a unique product of existing technology and has a significant effect in relation to existing technology
- D) Invention is a new technology and can create its own market
- E) Invention is a new technology and applicable in many different industries

How important is the novelty of your patent to the patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0  1  2  3  4  5  6  7  8  9  10

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## 2. - Inventive activity

*How innovative is your product?*

- A) There are competitive products doing the same work
- B) There are competitive products doing the same work but this one is more generative
- C) There is no competitive product for the invention
- D) Invention will have more value by developing complementary technologies

How inventive activity of your patent is important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0  1  2  3  4  5  6  7  8  9  10
- 

## 3. - Legal status of patent/project

*What is the legal status of patent/project?*

- A) Invention not yet disclosed to any patent attorney or patent office
- B) Invention disclosed
- C) Preliminary patentability search completed
- D) Patent application not done yet
- E) Patent application filed
- F) Patent application filed and publicized
- G) Patent granted
- H) Patent granted and opposition period is over without any opposition

How is the legal status of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0  1  2  3  4  5  6  7  8  9  10
-

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#### 4. - Infrangibility (Difficulty to invent around)

*Is it easy to produce the imitated products?*

- A) Invention can be easily identified and produced
- B) It is a complicated invention, it is needed to have high technology to produce copy products
- C) It is a complicated invention that is difficult to produce copy products
- D) It is extremely difficult to produce copy products
- E) There is no other technology to produce copy product

How is the infrangibility of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

0  1  2  3  4  5  6  7  8  9  10

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#### 5. - Breadth of patent

*To what extend is the invention breadth?*

- A) It consists of more than 2 different technology
- B) It consists of 2 to 6 different technology
- C) It consists of 6 to 10 different technology
- D) It consists of 10 to 14 different technology
- E) It consists of 14 to 18 different technology
- F) It consists of 15 to 22 different technology
- G) It consists of more than 22 different technology

How is the breadth of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

0  1  2  3  4  5  6  7  8  9  10

---

## 6. - Publication of patent and parties willing to buy the project/patent

*After disclosing your patent, who are willing to buy the product/patent?*

- A) There is no one willing to buy
- B) There are few companies/investors willing to buy
- C) Regional collaborators/partners of the relevant industry/technology are willing to buy
- D) Global collaborators/partners of the relevant industry/ technology are willing to buy
- E) Biggest collaborators/partners of the relevant industry/ technology is willing to buy

How is the disclosure of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0  1  2  3  4  5  6  7  8  9  10
- 

## 7. - Remaining lifetime of patent

*How long is left of your patent lifetime?*

- A) Less than 2 years
- B) 2 to 4 years
- C) 4 to 6 years
- D) 6 to 9 years
- E) 9 to 13 years
- F) More than 13 years

How is the remaining lifetime of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0  1  2  3  4  5  6  7  8  9  10
-

---

## 8. - Geographical coverage of patent

*What is the range of patent geographical coverage?*

- A) Patent is filed only in one country
- B) Patent is filed in JPO
- C) Patent is filed in EPO
- D) Patent is filed in USPTO
- E) Patent is filed in triadic regions (EPO, JPO, and USPTO)
- F) Patent is filed in almost all the countries having the relevant market

How is the geographical coverage of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0  1  2  3  4  5  6  7  8  9  10
- 

## 9. - Status of commercialization

*What are the marketing options?*

- A) There is no known market for the patented technology
- B) The patented technology has not yet been targeted at a particular market
- C) There is a well known market for the patented technology
- D) There is a well known market and further, well-defined market options
- E) There is a well known market and other tangible prominent markets

How is the market of your patent important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0  1  2  3  4  5  6  7  8  9  10
-



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**10. - Identification of infringing copy products**

*Is it easy to differentiate infringing copy products from the original?*

- A) It is not possible to differentiate the copy products
- B) It is extremely difficult to differentiate copy products but not impossible
- C) It is difficult to differentiate copy products
- D) It is easy to differentiate copy products
- E) It is extremely easy to differentiate copy products

How is the identification of infringing copy products of your patented product important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10
- 

**11. - Life expectancy**

*What is the life expectancy of the patented product/technology in the market?*

- A) Less than 1 year
- B) 1-2 years
- C) 4 years
- D) 6 years
- E) 10 years
- F) More than 10 years

How is the life expectancy of your patented product important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

- 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - 10
-

---

## 12. - Portfolio position of patent

*What is the position of Patent/Invention in your patent portfolio?*

- A) There is no patent portfolio yet.
- B) Patent is the least important of the portfolio
- C) Patent has moderate importance for the portfolio
- D) Patent has a higher importance than several patents in the same portfolio
- E) Patent is the most important patent of the portfolio

How is the portfolio position of patent important for you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

0  1  2  3  4  5  6  7  8  9  10

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## 13. - Status of production

*To what extent has the invention been tested?*

- A) The invention has been tested in theory according to calculations
- B) There have been experiments/ one-off tests
- C) Production test has been completed
- D) Production running
- E) Full-scale production

How is the production status of patented product important to you as concerning patent valuation? (Please choose one of the points from 0 to 10 below; 0 being least important and 10 most important)

0  1  2  3  4  5  6  7  8  9  10

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Submit form

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**Contact Info:**

M. Fatih Akaslan

Phone: +47 99 86 98 18

Email: [info@valuateyourip.com](mailto:info@valuateyourip.com)

## Appendix 2

### E-mail to Biotechnology Companies

To whom it may concern

Hello

I'm master student, studying on commercialization of biotechnology at Hedmark University College / Norway.

I'm currently studying on patent valuation in biotechnology field especially pharmaceutical industry.

Briefly, I'm developing a new mathematical formula, which is based on a questionnaire, for monetary valuation of the patents.

This questionnaire is for the patents which have already been sold or bought. So, I should find patentees who have sold or bought their patents in last 15 years and I should kindly make the former or the current patent owner answer my questionnaire.

In case **you might have sold or bought any patent**, here I have a website for the questionnaire, could you please visit following web link [www.valuateyourip.com](http://www.valuateyourip.com) you need a password to get access the questionnaire, which is **akademi1026**

I would be grateful, if you contribute to my project by answering my questionnaire online.

To be able to perform a solid portfolio management of patents and patent applications, obtaining an estimate of economic value is necessary. In the end of this study I will have an open web source for the patentees who want to estimate monetary value of their patents.

This study does not compromise the disclosure of any confidential information. I hope you would like to contribute to my project.

If you have any question about the project, please contact me.

Best regards,

M. Fatih AKASLAN

*Skolegata HiH BioHus 313*

*2315 Hamar Norway*

*Mobile +4799869818 (11.00h-18.00h UTC+01:00)*

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## Appendix 3

### List of Target Group of the Survey (Websites of the Biotechnology Companies)

<http://alphascience.de>  
<http://apogenix.com/>  
<http://aquabiotechnology.com>  
<http://atenglobal.com>  
<http://bifido.com>  
<http://bionamics.de>  
<http://bionutrigen.com/>  
<http://biosensor.se/>  
<http://biospectrum.com>  
<http://biostorage.com>  
<http://bsvbio.de>  
<http://bta-international.de>  
<http://cbnbiotech.hubweb.net>  
<http://chr-hansen.de>  
<http://dsmbio.cafe24.com>  
<http://ebioline.en.ecplaza.net>  
[http://ekvv.uni-bielefeld.de/pers\\_publ/publ/PersonDetail.jsp?personId=161617](http://ekvv.uni-bielefeld.de/pers_publ/publ/PersonDetail.jsp?personId=161617)  
<http://en.cetotec.com>  
<http://en.subitec.com>  
<http://endotherm-lsm.com/>  
<http://eng.cjcheiljedang.com>  
<http://everestbiotech.com>  
<http://genocheck.com>  
<http://gpbb.de>  
<http://investor.dionex.com>  
<http://oncophyta.org>  
<http://piramalhealthcare.com/>  
<http://sciencepark.ki.se/node/140>  
<http://shop.allelebiotech.com>  
<http://trd.as/wp02/>  
<http://wilex.de>  
<http://www.3b-pharma.com>  
[http://www.4base-lab.de/index\\_3.htm](http://www.4base-lab.de/index_3.htm)  
<http://www.4sc.de>  
<http://www.a2m-pharma.com>  
<http://www.aak-diagnostik.de/>  
<http://www.abdserotec.com>  
<http://www.abenzymes.com>  
<http://www.abexome.com/>  
<http://www.abigo.se>  
<http://www.abitep.de/en/Contact.php>  
<http://www.absorber.se>  
<http://www.abxis.com>  
<http://www.acceleratorab.se>  
<http://www.accelero-bioanalytics.com/>  
<http://www accuramed.de>  
<http://www.acino-pharma.com>  
<http://www.acrossbarriers.de>  
<http://www.actar.se/about-actar.aspx>

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<http://www.activaero.de>  
<http://www.activebiotech.com>  
<http://www.adapt-localization.com>  
<http://www.aditusmedical.com>  
<http://www.adnagen.com/>  
<http://www.advalytix.com>  
<http://www.aerocrine.com>  
<http://www.aeschemunex.com>  
<http://www.aesku.com>  
<http://www.aet.eu>

<http://www.affectis.com/about-us>

<http://www.affibody.com>  
<http://www.affimed.com>

<http://www.affitech.com/>  
<http://www.agennix.com/>

<http://www.agon.de/en/philosophy/>

<http://www.agrisera.com>  
<http://www.agroprotect.com/english.html>

<http://www.ahn-bio.de>

<http://www.aicuris.com>

<http://www.aid-diagnostika.com>

<http://www.aj-ebiochip.com>

<http://www.akampion.com>

<http://www.alcedo-biotech.com>

<http://www.alcon.com>  
<http://www.alcon-pharma.de/>

<http://www.alere.de>

<http://www.algeta.com/>  
<http://www.algonet.se/~binab/>  
<http://www.allergopharma.de>

<http://www.alligatorbioscience.com>  
<http://www.almagest.se>  
<http://www.alphalytik.de>

<http://www.alpharma.com/index.cfm>  
<http://www.alrise.de/>

<http://www.amedic.se/pf.html>  
<http://www.amgen.com>  
<http://www.amgen.de>

<http://www.amino.de>

<http://www.am-labor.de>  
<http://www.amocol.com>

<http://www.amodia.com>

<http://www.amplab.de/>

<http://www.amsilk.com>

<http://www.anagnostec.eu/>

<http://www.analytica.se>  
<http://www.analytical-services.com>

<http://www.anamar.com/1/en/home/home.php>  
<http://www.anatomica.se/index.asp>

<http://www.anatox.de>

<http://www.anbicc.de/>

<http://www.angio-lab.co.kr/>

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[http://www.anmedic.se/eng\\_index.php](http://www.anmedic.se/eng_index.php)  
<http://www.anm-medical.com>  
<http://www.anoxymr.de>  
<http://www.anterio.com>  
<http://www.antikoerper-biologo.de>  
<http://www.antisense-pharma.com>  
[http://www.anygen.co.krwww/portfolio/en\\_index\\_04.php](http://www.anygen.co.krwww/portfolio/en_index_04.php)  
<http://www.apara-bioscience.de/>  
<http://www.apimeds.com/>  
<http://www.apogene-gmbh.de>  
<http://www.aquazosta.de/>  
<http://www.argosbiotech.de>  
<http://www.artemis-ag.com/>  
<http://www.artemis-ag.com/>  
<http://www.artes-biotechnology.com>  
<http://www.asa-enzyme.de/>  
<http://www.asca-berlin.de>  
<http://www.ascendispharma.com/about>  
<http://www.ascenion.de/>  
<http://www.ascenion.de/en/aboutus.html>  
<http://www.astareal.com>  
<http://www.astrabiotech.de/eng/about/>  
<http://www.attana.com>  
<http://www.atto-tec.com/>  
<http://www.aurigene.com>  
<http://www.aurigon.de/>  
<http://www.autodisplay-biotech.com>  
<http://www.autotissue.de>  
<http://www.avaris.se/>  
<http://www.averionintl.com>  
<http://www.averionintl.com/>  
<http://www.avesthagen.com>  
<http://www.avesthagen.com>  
<http://www.avestin.com/>  
<http://www.avivasysbio.com>  
<http://www.axiogenesis.com>  
<http://www.axis-shield.com>  
<http://www.azigroup.co.kr>  
<http://www.bag-germany.com>  
<http://www.bavarian-nordic.com/about.aspx>  
<http://www.bayer.com/>  
<http://www.baypat.de/de/impressum.html>  
<http://www.bb Braun.de>  
<http://www.bbt-biotech.de>  
<http://www.bc-diagnostics.com>  
<http://www.bddcdrd.com>  
<http://www.bec-biotechnic.de/>  
<http://www.beckmancoulter.de>



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<http://www.beiersdorf.de>  
<http://www.beiersdorf.se>  
<http://www.belach.se>  
<http://www.bergenstrahle.se/>  
<http://www.berlinbiotechpark.de/en/Contact.html>  
<http://www.berlin-chemie.com/>  
<http://www.berninaplus.de/contact.htm>  
<http://www.berthold-ds.com>  
<http://www.bestechworld.com>  
<http://www.beuth-hochschule.de/impressum/>  
<http://www.bharatserums.com>  
<http://www.biaffin.com/>  
<http://www.bibitec.de/smail.php>  
<http://www.bicoll-group.com/>  
<http://www.bideco.com/flash/index1.html>  
<http://www.biedermann.com>  
<http://www.big21c.co.kr>  
[http://www.bilatec.com/pages/struktur\\_e.html](http://www.bilatec.com/pages/struktur_e.html)  
<http://www.binder-associates.de>  
<http://www.bioanalyt.com>  
<http://www.bioanalytic.de>  
<http://www.bioanalytical-solutions.com>  
<http://www.bioassay-online.de>  
<http://www.biocampuscologne.de/>  
<http://www.biocat.com/contact>  
<http://www.biocell.de>  
<http://www.biocentiv.com>  
<http://www.biocheck.de/>  
<http://www.biochem.de>  
<http://www.biochemagrar.de>  
<http://www.biochrom.de>  
<http://www.bio-city-leipzig.de>  
<http://www.biocon.com>  
<http://www.bioconcept.ch>  
<http://www.bioconweb.de>  
<http://www.biofluidix.com>  
<http://www.bioforsk.no>  
<http://www.biofrontera.com>  
<http://www.biogaia.com>  
<http://www.biogal.co.il>  
<http://www.bio-gate.de>  
<http://www.biogenerix.com/index1.html>  
<http://www.biogenes.de/>  
<http://www.biogenidec.de>  
<http://www.biogenidec.se/>  
<http://www.bioglobe.net>  
<http://www.bioinvent.com/>

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<http://www.biokjemisk.com>  
<http://www.biolabels.com>  
<http://www.biolandkorea.com>  
<http://www.bioleaders.co.kr>  
<http://www.biolight.se/>  
<http://www.biolin.se/>  
<http://www.bioline.com>  
<http://www.biolink.no>  
<http://www.biolog.de>  
<http://www.biolog-heppe.de>  
<http://www.biologicale.com>  
<http://www.biologis.com>  
[http://www.bio-mar.de/biomar\\_uk/index\\_prod.html](http://www.bio-mar.de/biomar_uk/index_prod.html)  
<http://www.biomecca.co.kr>  
<http://www.biomers.net>  
<http://www.biometec.de>  
<http://www.biometra.com>  
<http://www.biomeva.com>  
<http://www.biomex.de>  
<http://www.biomist.co.kr>  
<http://www.biomolex.com/>  
<http://www.bionas-discovery.com>  
<http://www.bio-nord.de>  
<http://www.biophausia.se/>  
<http://www.bioportfolio.com>  
<http://www.biorefinery.de/frameset.htm>  
<http://www.bioregio-stern.de/en/node/10>  
<http://www.bioriver.de>  
<http://www.bio-security.de>  
<http://www.biosense.de>  
<http://www.biosense.no>  
<http://www.biosentrum.no/index.htm>  
<http://www.bioservice.com>  
<http://www.bioskin.de>  
<http://www.bioskintech.co.kr/>  
<http://www.biosolveit.de>  
<http://www.biosphings.com>  
<http://www.biospring.de>  
<http://www.bios-schoenow.de>  
<http://www.biostep.de>  
<http://www.biosyn.de>  
<http://www.bio-synectics.com>  
<http://www.biosyntan.de>  
<http://www.biosys.de/en/imprint.html>  
<http://www.biotage.com/>  
<http://www.biotec.no>  
<http://www.biotecmarin.de>  
<http://www.biotec-rhein-erft.de>  
<http://www.biotecsistemi.it>  
<http://www.biotek.com>  
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