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Patents, their importance and valuation methods

Working Paper 2012

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The knowledge economy emerges rapidly and therefore intangible assets are more valuable to businesses. Valuing these assets attracts much research from the field of technology management. Intangible assets include intellectual capital and intellectual property. Intellectual property is often protected by patents. Intangible assets' importance has been well recognized by numerous researchers and intellectual property valuation methods have been videly discussed in several works. This working paper summarises the state of the art in patent valuation methods. In principle three general valuation approaches (market-, income- and cost approach) exist. Nevertheless more sophisticated methods exit within these approaches and several multy factoral, dimensional methods have emerged.

Acknowledgements: We thank Velina Petrusheva for her very valuable comments.

Please use the following citation when referencing to this Fraunhofer MOEZ Working Paper:

Tonisson, L., Maicher, L. (2012): Patents, their importance and valuation methods. Fraunhofer MOEZ Working Paper, issue 1/2012. Online available at:
http://www.moez.fraunhofer.de/content/dam/moez/de/documents/Working_Paper/WP2012%20Nr.1_Patent-Valuation_final.pdf

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The importance of patent valuation

Intellectual property rights are a cornerstone of the global knowledge economy. Today patents are an important and commonly accepted indicator for innovativeness while a patent defines new technologies that can be credited for and given ownership for. The global number of patent filings has been rising from 800,000 applications in the early 1980s to 1.8 million in 2009 WIPO, 2011). Growing investments in innovation and the globalization of economic activities are the key drivers of this trend. The importance of patents is increasing while the patenting systems are currently being optimized and aligned across the globe (WIPO, European Commission, "America Invents Act", 2011).

Patents can be obtained for any new and useful process, new machine, manufacture or composition of matter, or anything new, useful, and non-obvious (three requirements for a patent patentability), in relation to the prior art. However, a patent cannot be obtained for a system of doing business, an arrangement of printed matter, a mental process, computer applications, and product configurations (Hufker, Alpert, 1994). Patents offer a temporary monopoly on the exploitation of the new technology that might turn into innovation. Innovations and patents make important contributions towards economic growth (Rosenberg, 2004).

Assessment of the significance of patents and technologies for a firm's/product's market success requires a set of appropriate valuation tools (PriceWaterhouseCoopers, 2008). Intellectual property rights are viewed as being of increasing importance in many fields and on many levels. However, one potential hindrance to their being considered of significant value is the lack of practical methods for valuing them. This holds true particularly for their early life under conditions of uncertainty about future prospects. A lack of practical valuation methods for patents under these conditions may lead to sub-optimal decision-making in the course of managing intellectual property portfolios (Pitkethly, 1997). The high number of different patent valuation tools in use makes it difficult to agree on a commonly accepted valuation approach. Relying on a single valuation method for patents is not feasible at the moment (McClure, 2011). Uncertainty is one of the main problems when trying to estimate the value of a patent. Furthermore, when talking about intellectual property valuation, it is always necessary to keep industry specifics in mind. Different fields of technology have diverse values attached to their industry specific patents (University of St.Gallen, 2011). In conclusion, intellectual property, a significant source of intangible value, is more amenable to intrinsic value estimations than to fair valuation estimations.

But the introduction of intellectual property rights to accounting standards shows the increasing importance of acceptable intellectual property valuation methods. The "American Society of Appraisers valuation standard" that was accepted in August 2008 has been quoted as a public valuation standard that takes into account the unique aspects of different forms of intellectual property in providing valuation standards (Malackowski, 2009). With the "Financial Accounting Standards Board guidelines" for intellectual property that promote fair valuation, issued in the United States, practitioners and clients alike may seek additional methods to determine the fair value of intellectual property quickly and cost effectively (Kossovsky, 2002).

This working paper provides an overview of patent valuation methods that are currently mentioned in literature and referred to in research. It presents a general classification of different patent valuation methods and discusses some more sophisticated methods in order to create general understanding for the reader about various patent valuation techniques.

The remainder of the working paper is structured as follows: chapter 2 outlines the main patent valuation-related challenges. A comprehensive literature review on different patent valuation methods is presented in chapter 4, and discussions on the market approach followed by discussions on the income approach are presented in chapter 5 and 6. The third traditional method for patent valuation, the cost approach, is discussed in chapter 7. Accounting standards guidelines and further alternative methods for patent valuation are examined respectively in the chapters 7 and 8. Afterwards, the conclusions are drawn in chapter 9.

2
The challenge of patent valuation

In general it is important to understand that when talking about patent valuation it is actually partly about the valuation of the technology it protects. In other words, the valuation process considers the patent as a necessary but insufficient condition to the commercial value of a given technology. For example, a non-patented technology can be extremely valuable to society and yet, since it may be easily copied, worth nothing to the inventor. On the other hand, an invention may be fully patentable (i.e. novel, involving an inventive development and capable of industrial application) and would still be worthless if the market refuses to use it (Pugatch, 2005).

All methods of patent valuation involve some elements of forecasting ranging from forecasting depreciation rates to forecasting future cash flows, market conditions, effects of competition and distributions and volatilities of returns to patents. The "speculation" necessary is all the more unavoidable since decisions about continuing with patent applications and about paying renewal fees for granted patents have to be made. Even patent owners making quick unreasoned judgments on such matters are making implicit valuation decisions in addition to more explicit valuations necessary when considering licensing, litigation or sale. Owners cannot retreat into an assertion that valuation is optional and too difficult to produce any meaningful answers. The uncertainty factor every valuation tries to account for cannot be avoided.

The act of patent valuation, methodically scientific and advanced as it may be, is ultimately subjective, although many figures for patents and technology can be found in literature, media and research. Valuation of a patent or patent application - whether explicitly or implicitly - involves making judgments about the future similar to the stock market prices that have embedded in them judgments of investors about the future performance of a company. In that respect some degree of "speculation" is unavoidable (Pitkethly, 1997).

It has been quoted by intellectual property pioneers like Ocean Tomo that for most corporations 75+% of their value, sources of revenue and sustainability is directly related to intellectual property and intangible assets (Mobery, 2009). Therefore the importance of intellectual property is clear, but patents by themselves do not represent the full value of 75+%. Patents are valuable in case they are used to produce technologies and therefore they can create some value for society. Patent alone has little or no value in the hands of incompetent people who are not capable of utilizing it. A structural and statistical observation suggests that only a fraction of patented technologies are commercialized or utilized. It is estimated that less than 80 percent of patents worldwide are utilized (Pugatch, 2004). Even worse, it might be the case that most of the patented technologies are worth less than their registration and maintenance fee**.** Schankerman (1998) analyzed the value of patents in France between 1969 and 1982 and found that the median value of patents in different technology fields is surprisingly low: EUR 1,238 in pharmaceuticals, EUR 1,210 in chemicals, EUR 2,225 in mechanical and EUR 6,023 in electronic patents. Schankerman (1998) also reports that only one percent of pharmaceutical patents exceed a value of EUR 38,000. Scherer (1997) has compared the distribution of values of High Tech start-up companies over time with the distribution of values of individual patented inventions and found that they have similar highly skewed distributions. The value distributions of patents can be considered as lottery with big-payoffs for a little number of tickets and a huge number of consolation numbers (Barney, 2002).

To define the contributions of patents to economic accomplishment, patents should be valued and managed efficiently in order to recognize what is worth commercialization and if and how it is possible. Therefore the field of patent valuation has advanced quite dramatically over the past decade: from a fairly conservative or primitive one-factor model to rather sophisticated methods of analysis. Value in general is mostly defined as the present value of upcoming benefits to be derived by the holder of property. As such, valuation needs to quantify the future benefits and then calculate present value out of it (PriceWaterhouseCoopers, 1999). While the expenses for the issuance of a patent can be determined with relative ease, the actual valuation of a patent involves a proper combination of patent assessment tools.

In literature mainly three approaches for monetary patent valuation are described: capital value, market price and cost oriented methods (IDW ES 5, 2006). Within these approaches, several methods can be applied that can be divided into qualitative or quantitative valuation methods. In contrast to the quantitative valuation methods, the evaluation methods represent qualitative approaches to give value to patents (Gassmann and Bader, 2007). The literature on patent valuation and evaluation subject is quite extensive (Smith and Parr 2000; Megnatz 2002, Pitkethly 2002, Rozek and Korenko 2006).

This high number of methods, combined with the non-standardized precise procedures they involve, causes significant uncertainty in the valuation of patents (PriceWaterhouseCoopers, 2008). A clear overview of the existing patent valuation methods and an assessment of their usability for valuating patents could help setting the basis for development of a commonly accepted and used patent valuation method(s).

3 Literature Review

Valuation is the act of attaching a monetary value to a useful thing of quality. In terms of the business environment, valuation is important because it is the foundation upon which rational investments are made in order to secure, among other things, future cash flows. It is therefore the base of wealth creation. The valuation of intellectual property is particularly significant because it has percolated through every aspect of life, and in a knowledge economy, its significance as a driver of profitability and wealth is unquestioned (Bose, 2004).

Because of the difficult nature of valuing intellectual property, the models used for valuation purposes revolve around the traditional ones like market, income and cost valuation approaches. But in general intellectual property valuation can be viewed as an art of itself and its valuation methods vary to boundless extents. First of all within this working paper we refer to economic, numerical value when we talk about patent valuation.

Parr and Smith (1994) divided all possible kinds of valuation of individual patents into Cost, Market, and Income based methods. A research from Arthur Andersen has in principle done the same by dividing valuation approaches into Cost, Market Value and Economic Value methods (Anderson, 1992).

This elementary division for 3 simple valuation approaches is still used in some cases nowadays.

Within these three approaches, numerous methods can be applied. Conservative valuation models like the above mentioned simple versions are not generally applicable to patents (Bose, 2004). For example industry specifics and market conditions should be considered when estimating value. Secondly where the methods are more or less applicable, they are labour intensive, and often require a series of assumptions (Neifeld, 2004).

The value of a single intellectual asset is rarely recognizable. Harhoff et al. (2003) demonstrate in a formalized fashion that for a corporation involved in technological competition, the value of a patent is best determined as its asset meaning the technology it protects value. To define a patent's value, it is consequently necessary to consider its effects on prices, costs and sold quantities of patent-protected products by the patent holder and its simultaneous effects on the proprietor's competitors. As Reitzig (2003) indicates in a survey of the theoretic literature, counterfactual effects should become assessable when quantifying the patent's following latent value factors: state of the art (of existing technology), novelty, inventive step, breadth, difficulty of inventing around, disclosure and dependence on complementary assets. Literature on patent valuation methods is wide-ranging and contrasts from simple quantitative methods to more sophisticated forms combining qualitative and quantitative assessment methods in various forms.

Within this working paper the three most basic intellectual property valuation methods are explained, followed by introducing various more complex models for valuation. More sophisticated methods are chosen for this research for their diverse nature of valuation factors and sorted by the date of their publication.

4
Market Approaches for patent valuation

In general, a market approach parallels the subject intangible asset with comparable or similar intangible assets that have been sold or listed for sale in the suitable primary or secondary market. In patent valuation, this values the patented technology by equating it with recent transactions that involve patented technologies of an analogous nature and function. It offers indications of value by studying transactions of property similar to the property for which a value conclusion is required. Given that such a transaction did take place, a market-based approach is quite effective as it represents the "real" market value of the patented technology.

Nevertheless, if a market-based approach should be precise, one must acquire inside information about the particulars and nature of the transaction, as there are many factors other than the technology itself that influence the absolute value of that transaction. Recent EU tender (2011) on creating a market for IPR rights claims that the market for intellectual property is not transparent and price discovery therefore is nearly impossible. Bader et al. (2008) discusses the adoption toward market based valuation tools, once the intellectual property market becomes more transparent.

For the time being the market approach has some drawbacks. Parr and Smith (1994) claim that the transaction used may relate to an intellectual property right whose use may not characterize the best use of the intellectual property right to be valued. Additionally it could even be the same intellectual property right that has not been used optimally. For an intellectual property right to be exploited to the maximum degree possible requires 100% of the potential protected market for the underlying invention to be accessed. Some sale or licensing agreements might prevent this and values resulting from them will be suboptimal. Also, if a transaction of this kind is not obtainable at all, then a market-based approach is inadequate.

Even more critical is the use of a stock market valuation of the company as a foundation for estimating the value of its intellectual property. Under perfect market assumption the market is transparent and everyone has the same information, but in reality this is not the case (Pitkethly, 1997). Consequently, this valuation method overall usually reflects more accurately the actual amount that a third party would be willing to pay for the asset (Mard, 2001; Pugatch, 2005).

4.1
Royalties based methods

Market based valuation methods may also be constructed on comparable royalty rates. When deciding on royalty rates there are several surveys that look at industry averages (Ishii and Fujiono 1994; Sullivan, 1994a; Sullivan, 1994b). Such averages are often used as a base for setting royalty rates in licensing agreements or in establishing damages in litigation. However, these are likely to exclude rational consideration of virtually all factors other than the, although important, one of what people think is the “market rate”. The risk is that for a specific intellectual property right this might be a serious misevaluation and use of such typical royalty rates may just perpetuate sub-optimal decisions by a few leading companies throughout an industry.

Royalty rates designated on some other basis than an industry average rate can also have complications. Royalty rates set using returns to R&D costs or return on sales figures for the company or industry for example run the risk of valuing costs or extra factors rather than value (Pitkethly, 1997).

5
Income approaches for patent valuation

The income approach represents future economic benefits calculated to a present value. It is based on an approximation of future income attributable to the certain intellectual property asset in question and will inevitably involve some portion of forecasting the future cash flows (Mard, 2001).

5.1
Royalties based methods

Royalties are a way to calculate patent value. This method constructed on industry average royalty rates assumes that the income due to a patent per se is the royalty which would have to be paid by a licensee. Unnecessary to say, the same cautions apply as when setting royalty rates directly based on such industry average rates. The relief-from-royalty method is a subset of the income approach, wherein the value of the intellectual property asset is calculated based on notional royalties that the company is relieved from paying as a result of being the owner of the assets. The royalty rates can be estimated based on industry average ranges in the relevant field of technology, but these should be accustomed using pre-defined criteria indicative of, for example, the strength and/or scope of the patent in question. This will provide more precise and consistent results. The value obtained by this methodology is reasonably accurate in most cases. More importantly, it is a consistent indicator that allows you to compare relative values for decision-making purposes (Smith et al., 2005; Anderson et al., 2005).

5.2
Discounted cash-flow methods

An option-based approach that is an advanced method of income-based method includes simple discounted cash-flow methods (Parr, Smith, 1994). Simple discounted cash-flow methods can be divided further controlling for time variable, uncertainty variable and for flexibility:

- discounted cash-flow methods allowing for the time value of money
- discounted cash-flow methods allowing for the riskiness of the cash-flows
- discounted cash-flow based Decision Tree Analysis methods

One advantage of valuing patents with discounted cash-flow methods is that since patents have limited lifetimes one is not confronted with the problem of valuing residual values for the cash flows beyond the edge of the forecasting perspective.

The two key factors they account for are the time value of money and to some degree the riskiness of the forecast cash flows. These two issues could be solved in two ways. Either by using a risk adjusted discount rate to discount the forecast cash flows consequently accounting for both factors at once. Or using certainty equivalent cash flows, in which forecast cash flows are accustomed to account for their riskiness and changing riskiness over time. These are then discounted at the risk free rate to account for the time value of money or in other words for cost of time. The latter method splits the two issues of risk and time and can help foresee problems when the risk adjustment varies over time, as it will with patents (Brealey and Myers, 1984).

Most corporations nowadays use the discounted cash flow valuation method for valuing technologies. This approach embodies discounting the future cash flows arising from a firm's assets by its cost of capital and subtracting initial outlays, thus yielding its Net Present Value. But a number of severe limitations are obvious in this approach (Chew, 1977). Therefore some of the particularities involved in valuing a patent using discounted cash-flow techniques and some of the drawbacks of such discounted cash-flow analyses are important to keep in mind:

- The discount rate used should always be one which reflects the risk of the cash flow that's calculated (Chew, 1977; Brealey and Myers, 1984). For example if the project is not an average project for the business this will not be the same as the company's cost of capital. In practice using the assumptions of the Capital asset pricing model (CAPM) and by finding quoted companies with cash flows of equivalent riskiness suitable discount rates can be attained (Pitkethly, 1997).

- With a multi-stage cash flow such as with a patent or a patent application the risk associated with the cash flow will differ significantly over the lifetime concerned. For a newly granted patent which is about to be litigated for the first time it will be much higher than for a 15 year old old-timer which has survived many attempts to invalidate it (Pitkethly, 1997).

- Single constant discount rate makes the opposite assumption that the risk adjustment rises as the patent ages (Brealey and Myers, 1984). The discount rate's risk premium component varying over time is dealt with inter alia by Hodder and Riggs who promote the use of sequences of distinct risk phases in assessing high risk projects whose risk varies from phase to phase (Hodder and Riggs, 1985).

One of the options that might solve many drawbacks would be splitting the valuation of the patent into numerous distinct phases. Diving could begin from application to receipt of search results and then from the decision to continue to commencement of substantive examination followed by the period from acceptance to the end of the first year after grant and afterwards from grant to the first year of commercialization and so on until the product becomes well-known and the patent finally expires.

5.3 Monte Carlo simulation based methods

Monte Carlo simulation is a probabilistic discounted cash-flow approach. It attempts to solve for uncertainty with simulation methods (Stacey, 1989). Due to the fact that all the information involved in making a decision about intellectual property is unclear, the foremost that can be done is to think through the costs and incomes probabilistically. That leaves the outcome being a frequency distribution of net present values. In Stacey's example and other so called "Monte Carlo" simulations all the variables in a model are accustomed at once according to individual probability distributions to create an overall distribution of probable valuations (Stacey, 1989; Pitkethly, 1997).

5.4
Option Pricing Theory based methods

Opportunities may be understood as potential future operations. This opportunity may be thought of as an option, which provides their owner the right, but not the obligation, to create an investment decision at a future date, at a predetermined value (Copeland, Koller and Murrin, 1995).

The application of option pricing methods to real options involving innovation and repesctively patents is thus a difficult task for any valuer. This working papers does not to go into the details of the option pricing model, nevertheless a simple explanation can be found in Appendix 1. In general, the main problem is the development of a body of accepted variance values, not only for the specific type of intellectual property, but the specific industry as well (Dixit and Pindyck, 1995). There is also the responsibility of convincing the management that the consideration of option pricing theory issues is a worthy subject to deal with in connection with the consideration of real options in specific industry (Kemna, 1993). Although there is the question of keeping the complexity within manageable limits, there seems to be a reasonable possibility that any fundamental reservations about the general applicability of option pricing theory to real option valuation of patents can be overcome.

In general an option-based approach treats the R&D process, and the intellectual property it produces, as series of options to be bought or sold during the several phases of product development utilization. One of the key advantages of the option-based method is that it allows defining the value of patented technology during the earlier stages of product research and development. It allows intellectual property owners to factor in, at diverse stages, both the expected costs of developing the patented technology and the expected returns from utilizing it, taking into account the level of risk associated with the various phases of product development (Jensen, Pugatch, 2005). Development from the Black and Scholes (1973) calculation has been adjusted in many ways to take account of extra features such as dividends, changing underlying asset volatility and changing interest rates. However, even the most sophisticated adjustments cannot take every factor into account. Option pricing theory regarding share options, for example, assumes that competition will eliminate arbitrage opportunities and nonetheless whilst substantially correct, small differences in transaction costs, trading practices and information flows might give rise to apparent arbitrage opportunities when prices are compared with their theoretical values (Cox, Rubinstein, 1985).

In spite of these potential differences between financial and real options in the form of patents, there are numerous areas where there are certain similarities, for example the issue of limited liability and the formation of optimal exercise strategies.

The possibility to escape from financial commitments by going bankrupt and/or defaulting on interest payments or in other word limited liability is something, which is a risk, or benefit, depending in one's view of some financial engagements. When assessing a project using discounted cash flow techniques such financing considerations can be accounted for either by adjusting the net present value of the fundamental case in the absence of financing considerations or by adjusting the discount rate. Nonetheless in the case of an options based approach the financing considerations can be well-thought-out as an option to default on debt payments or to just abandon a project.

Trigeorgis (1996) points out that the joint value of default and abandonment options can be considerably larger than the project abandonment option value alone. In the case of a patent there are abandonment options to let the patent lapse. Abandonment of a patent is similar to the abandonment of a project except that, being a pure real option with no responsibilities attached to abandonment, there is no disadvantage of abandonment, save loss of the initial investment costs and a potential upside in the ability to exercise what amount to abandonment put options on the project. It is possible to sum up that project abandonment options where abandonment includes no costs or penalties involve a form of limited liability.

There is typically an optimal exercise strategy for the options involved in a patent. For example, when to let a patent lapse or when to carry on with an application, when to license or decline licenses etc. The more one thinks on the investment opportunities associated with a patent as opposed to the options inherent in the patent, the more the options concerned appear the same as any other investment option and the more ordinary investment option triggers become important. Nevertheless, comparable causes might also be devised for decisions about the options involved in a patent. Complexity related with numerous choices and assumptions behind option based intellectual property valuation methods can be overcome. However, the numerous assumptions behind the models make it quite subjective. It needs to be recalled that any valuation method is simply a starting point or a minor step towards smarter decision making process (Pitkethly, 1997). Please see Appendix 2 for further elaborations on Black–Scholes option pricing model based methods and Binominal Model based methods.

5.5 Capital Asset Pricing Model

The value of a technology might be identified to be the present value of its earnings over given future periods (Chew, 1997). Because considerable risks are involved in assessing future earnings, the Capital asset pricing model (CAPM) could be used as a valuation instrument for assessing risk/returns relationships. The model is constructed on the theory of the relationship between risk and return. It implies that the predictable risk premium on any security is equal to its beta times the market risk premium (Brigham and Houston 1998; Damodaran, 1994).

While CAPM has substantial intuitive appeal (Brigham, Houston 1998), it has long been known that the model suffers some strong drawbacks, which has raised concerns about its legitimacy and usability. A study by Fama and French (1992) discovered no historical relationship between stocks´ return and their market betas, confirming the opinion held by a number of academics, stock market analysts and researchers. Thus, while the CAPM embodies considerable progress in asset pricing theory, there are shortages, which must be addressed before it becomes a trustworthy instrument for valuation purposes (Pugatch, 2005).

6
Cost approaches for patent valuation

Knowledge of at least the future costs of creating intellectual property right is necessary as part of nearly all valuation methods. Being the most basic method for patent valuation, the cost approach is built on the principle of substitution. This approach pursues to assess the value of the patented technology by approximating the cost of replacing it with another (similar) technology. In its most direct expression, a cost-based approach values the patented technology by calculating the total costs of developing it and adjusting it to present value (Pugatch, 2005). A prudent investor will not be willing to pay more for an intangible asset than it will cost to replace that intangible asset with a ready-made similar substitute (Mard, 2001). Although simple and easy to use, a cost-approach is also very restricted, as it only takes one factor, namely cost factor, into account when evaluating the patented technology. It is also orientated towards past expenditures and is consequently retrospective by nature (Pugatch, 2005).

Valuation methods constructed on the historic costs of acquisition that possibly do not allow for precise allowances for depreciation or obsolescence are worth simply the very shortest of comment. Their most serious failing is that they make no allowance for the future benefits which might accrue from the patent. They are just historical cost based accounting systems useless for producing rational decisions (Pitkethly, 1997).

7
Patent valuation in accounting

Regardless of the noteworthy importance of intellectual property, valuation of intellectual property, and valuation of intangible assets, largely, is still an emerging field. It will be challenging to create compulsory standards for valuing intellectual property or voluntary standards any time soon (McClure, 2011). Nevertheless numerous organizations including governmental and professional, have in the last decade pursued to improve standards for valuation of intellectual property. As an outcome of the introduction of the International Financial Reporting Standards and US-GAAP accounting system, the intensely increasing interest of valuating immaterial assets has developed more and has become more visible (Daske, 2006).

The importance of intellectual property litigation to corporations is increasing as intellectual property has become a critical tool for the formation of new products and services and a key differentiator amongst existing products and services. Accounting standards that involve intellectual property valuation are possibly useful tools for litigation in which the complaining party has acquired the allegedly infringed intellectual property (Landers, 2006). GAAP requires that acquired intangible assets—including intellectual property, such as patents – has to be recognized and valued upon acquisition[1]. Companies that need to account for acquisitions under standard FAS 141 may report limited detailed data on attained intellectual property in their financial statements. For example, companies may aggregate, for presentation purposes, data on various types of intangible assets under one or more equally nondescript line items on the balance sheet and deliver little additional detail in the notes to the financial statements. Nevertheless, even if the financial statements do not disclose significant details, other documentation, including third party or internally-prepared valuation reports and analyses and auditor work paper files, normally provide significant detail related to any acquired intellectual property. This type of documentation inevitably includes detailed assumptions used in classifying and valuing the intellectual property. Moreover, such valuation reports and work papers similarly include intellectual property that was not valued, effectively valuing those assets at $0 (Annis, Pursel, 2010).

In terms of intellectual property relevant standards, a revised FAS 141 (“FAS 141R”), effective for financial statements issued for fiscal years beginning after December 15, 2008, extended the scope of fair value[2] measurements and the requirements related to

[1] Statement of Fin. Accounting Standards No. 141, ¶ 39. FAS 141 applies to all business combinations accounted for using the purchase method for which the date of acquisition is July 1, 2001 or later. The acquired assets may not encompass a “business” as defined in accounting literature and, therefore, assets acquired under something other than a “business combination” would be valued under other applicable accounting guidance that may include a fair value aspect. The value of internally developed intangible assets is not recognized in financial statements. The term “intangible assets” is defined as “assets (not including financial assets) that lack physical substance.” Statement of Fin. Accounting Standards No. 141, app. F.

[2] The standard of value under GAAP is “fair value,” which was previously defined in as “the amount at which an asset (or liability) could be bought (or incurred) or sold (or settled) in a current transaction between willing parties, that is, other than in a forced or liquidation sale.” Statement of Fin. Accounting Standards No. 141, app. F. By contrast, under FAS 157, fair value is defined as “the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date.” FAIR VALUE MEASUREMENTS, Statement of Fin. Accounting Standards No. 157, ¶ 5 (Fin. Accounting Standards Bd. 2006).

such intellectual property intensive items as "in-process research and development" projects[1]. In addition, FAS 157, effective for financial statements issued for fiscal years beginning after November 15, 2007, delivers a formal fair value framework that impacts the meaning of fair value and defines important factors for measuring fair value under GAAP.[2] To confuse matters, FASB's new Accounting Standards Codification ("ASC") revised the references for applicable accounting standards and other guidance.[3] However, due to the relatively recent nature of the above mentioned progresses and the familiarity of the FAS 141 reference among management, valuation specialists, and auditors, this Article mostly refers to the original FAS 141. In addition, neither FAS 141R nor ASC are thought to alter the substance of the procedures and requirements connected to valuing intellectual property under FAS 141. FAS 141 does not provide significant guidance associated to the valuation of acquired assets, including intellectual property. Instead, FAS 141 states that independent appraisals, amongst other information, may be used in determining fair value.[4] In addition FAS 141 also addresses the concerns regarding the complexity of valuing acquired intangible assets, including intellectual property.[5]

According to Mohammed J. Abdolmohammadi and Lynette Greenlay (1999), there are three accounting methods that should be implemented for the purpose of calculating and valuing intellectual capital for accounting standards.

The first method is named the "Return on Aassets Method", which uses the average pre-tax earnings of a corporation for three to five years. When divided by the average tangible assets of the corporation over the same period, it will yield the Return on Assets (ROA). It is then compared with the company's industry average to estimate the difference. If this difference is zero or negative, the company is seen not to have an excess intellectual capital over its industry average. However, if the difference between the company's return on assets and its industry average is positive - the company is assumed to have excess intellectual capital over its industry. This excess return on assets is then multiplied by the company's average tangible assets to compute an average annual excess earning. By dividing this excess earning by the company's average cost of capital, one is able to derive an estimate of the value of its intellectual capital. This method is easy to use and the information needed for it is readily available in historical financial statements.

The second method, known as the Market Capitalization Method, states the excess of a company's market capitalization over its stockholders' equity as its intellectual capital. Considering the effects of inflation or replacement costs would furthermore rectify the value.

[1] Statement of Fin. Accounting Standards No. 141, ¶¶ B151–B153.
[2] Statement of Fin. Accounting Standards No. 157, ¶¶ 5–17.
[3] Effective for reporting periods ending after September 15, 2009, ASC is the single source of authoritative nongovernmental GAAP. THE FASB ACCOUNTING STANDARDS CODIFICATIONTM AND THE HIERARCHY OF GENERALLY ACCEPTED ACCOUNTING PRINCIPLES, Statement of Fin. Accounting Standards No. 168 (Fin. Accounting Standards Bd. 2009). FAS 141 references are contained within ASC 805. Id. at ¶ 13.
[4] Statement of Fin. Accounting Standards No. 141, ¶ 36.
[5] Before issuing a final standard, the FASB issues exposure drafts for public feedback. Such feedback is considered by the FASB in drafting the requirements of the final standard. BUS. COMBINATIONS, Statement of Fin. Accounting Standards No. 141, ii (Fin. Accounting Standards Bd. 2001).

This method is reasonably easy to use, and gives fairly precise results. However, to fine-tune this method, historical financial statements have to adjust for the effects of inflation or replacement costs. Using historical data may misrepresent the measurement, mostly in industries with particularly large balances of old capital assets, such as mines and heavy engineering production plants.

The third method, known as Direct Intellectual Capital method, is the most complex means of calculating intellectual capital. It results from the decomposition of intellectual capital into the market and intangible assets, which are then independently assessed. This, according to the authors, provides the most precise method of valuing and assessing intellectual capital. However, the Direct Intellectual Capital method is difficult and expensive to implement and maintain due to the large number of components that have to be recognized and individually measured.

8
Additional methods for patent valuation

Intellectual property rights cannot be valued through a single dimension: it is essential to know the value of patents from several dimensions such as (Chiesa et al, 2005) financial accounting (purchase price allocation, impairment testing), tax purposes (change of ownership, licensing in or out), merger and acquisition purposes (influence on purchase price determination, single patent transactions) and financial and securitization purposes (refinancing costs, start-up financing). Therefore many different methods to assess patent values or price patents from numerous aspects have been elaborated. Cost, market and income based approaches focus on quantitative assessment of patents, but some researches (Cromley, 2004; Chiu, Chen, 2007 etc.) emphasize the importance of the qualitative factors. Therefore there are multidimensional methods as well as ranking and rating methods. The following section will try to explain some of the methods ordered by the time of elaboration.

Hirschey and Richardson (2001) deliver three scientific-based dimensions of patent quality. These are listed with their characterizations in the table below.

Abb. 01: Scientfic-based indicators of patent quality

Scientific-based indicators of patent quality	Definition
Current Impact Index (CII)	Number of citations generated by a company's most recent 5 years of patents, divided by the expected number of citations for similar high-tech companies.
Science Linkage (SL)	Average number of "other references cited" on the front page of the patent, including academic journal articles and papers presented at scientific meetings.
Technology Cycle Time (TCT)	Median age (in years) of earlier US patents referenced on the front page of a US patent.

Source: Hirschey and Richardson (2001)

Cromley (2004) provided 20 steps for pricing a patent from different perspectives. The 20 steps are explained in Appendix 3. In short he looked into various aspects of what can be considered important when estimating the value of a patent. For example, prior art, demand for that technology etc. Among many other factors he also looked at legal aspects.

A variety of variables have been verified as indicators of patent value in empirical surveys. Reitzig (2004) examines the suitability of the 13 best-known indicator variables for business purposes by 23 empirical studies associated with patent indicators and value. The table below shows the results for known patent value indicators.

Abb. 02: Indicators of patent value

Indicators of patent value	
Patent age	Number of claims
Market value of corporation	Patenting strategy
Backward citations	Number of applicants

Forward citations	Number of trans-border research co-operations
Family size	Key inventors
Scope	Legal disputes (opposition in particular)
Ownership	

Source: Reitzig (2004).

The methodology from a valuation perspective adopted in the "Australian Multi-Factor Technology Valuation Model" (Bose: 2004) study was to identify, evaluate and analyze the key factors that drive the value chain of technologies throughout the development process. The steps involved in the research process that led to the development of the valuation process models were as follows (Bose 2004: 14):

Consistent with current academic research that agrees that there is need for new valuation models for patents, the study recognized the underlying factors that generate and drive value, specific to each of the technologies observed in this study. A survey containing 40 questions was sent to 300 corporations which sought to establish if the value drivers identified from the case study analysis were present in each of the industries in the study.

The framework for valuation models for intellectual capital was adopted from earlier works on intellectual property valuation namely by Heller (1994), Mavrinac (1996), Lev (1996), Helfer (2000). Bose (2004: 166 - 178) identified the underlying aspects that generate and drive value specific to each of the technologies being looked at in the research by subjecting specific case studies pertaining to them to analysis, using case study analysis software. The full list of value drivers plus the literature with what the value drivers are backed can be found in appendix 4.

In addition to methods investigating qualitative values, McMillan and Thomas (2005) established a valuation of corporations based on the quality of their patent portfolios where patent quality was assessed using a number of patent citation indicators. The underlying assumption in patent citation analysis is that a patent, which is highly cited, is a significant and valuable one. McMillan and Thomas (2005) offered some indicators of patent quality. They are CII, SL, TCT and R&D intensity (R&D expenditure/sales).

Y.-J. Chiu and Y.-W. Chen (2007) suggested a measurement system that contains both quantitative and qualitative perspectives from multiple dimensions. For the dimensions please see Appendix 4. Razgaitis (1999) would specify their developed AHP method as ranking/rating patent valuation method. This method has emerged more recently and therefore literature on it is not very extensive (Chiu, Chen, 2007).

Mary Adams (2012) developed a multi-dimensional simple and easy to use tool for assessing the value of intellectual property called QuickScan. It is argued, that the QuickScan allows testing the strength of the corporate resources that an organization intends to use to exploit the intellectual property. It examines the four elements of intangible capital that are necessary for business:

Human Capital – management's and employees' competences and knowledge needed to successfully exploit and continue to renew this intellectual property.
Structural Capital - processes needed to support the production, marketing and sale of this intellectual property.
Relationship Capital - right networks to get access to target customers and partners. Intellectual properties' fit with your existing brand.
Strategic Capital - market opportunity for this intellectual property and a feasible business model in place to take advantage of market opportunity.

9 Conclusions

With the fast development of the global economy, intellectual capital has developed as a critical driver of businesses sustainability. Banks, investors and insurers nowadays have come to acknowledge that patent rights have significant impact on the value of enterprises and on the stability of patent-based business models in the “knowledge economy”. What remains vague is how exactly the value is determined (Martin, 2004).

The crucial difference between corporations operating in the "old" and the "new" economy is that, where value in the past was formed within industrial sectors such as manufacturing, education, retail, wholesale and financial services, value in the future will be created mainly from the application of knowledge. Increasingly, the key assets of "smart" corporations will be in the form of intellectual, and not physical, capital. Technology development and patents are valid parts of intellectual capital. Thus, in the new economic paradigm, companies perceive technology developments as essential commercial activities to underpin their competitive standings, and deliver a platform for economic growth, profitability and shareholder value.

However, the development of commercially feasible intellectual capital projects also requires considerable investments in intellectual property, often without certainties of success due to uncertainty in value aspects. Because valuation techniques and processes are essential for business investments much research on the topic has been done already. Ittner and Larcker (1996) stated: “if you use the incorrect measure, or if it doesn't map to economic performance, not simply have you lost a lot of money, but you've also potentially made disastrous decisions”. It is quite clear that without proper valuation tools, capital allocations could not take place in a situation in which ideas could not be developed into effective, revenue producing products and services, and ensure an on-going stream of cash flow in the future.

In the earlier days and to some extent even now three simple methods could be classified as the ones most referred to in literature. Among all literature and research done, the tree methods stand out:

	Market approach	**Income approach**	**Cost approach**
Definition	Valuing based on the price of comparable subjects in market	Valuing based on the present worth of future income flow	Valuing based on cost required to reproduce or replace subject
Merits	Possible to calculate the most rational value if market data is available	Possible to capture present worth based on profit-generating capability	Easy to calculate if cost data is available
Demerits	Absence of market data on comparable assets	Chance of error due to subjective estimation	Ignorance of future potential of subject

Source: Y. Park, G. Park / Technovation 24 (2004) 387–394

More recent studies have shown that patent evaluation should be measured both by the quantitative and qualitative aspect using multiple dimensions. Several sub-methods exist within the above-mentioned three simplistic methods in recent literature. The complexity of methods varies as well as the reasons for using some of them, which makes patent valuation rather complicated. In fact in the earlier days, Drucker (1985), argued that to compute a meaningful "return on knowledge" would be a nearly impossible task, probably because it is so difficult to price the value of intellectual assets. Even large firms have no established framework for valuing their innovative technologies, but use "guesstimates" and "rules of thumb" for this purpose (Bose, 2004). Recent research shows that although there have been rapid developments in intellectual property valuation, no clear one precise method can be distinguished. Despite the variety of articles from industrial organizations or legal specialists on value-related matters of intellectual property rights, there is a lack of scientific papers that present the knowledge on the valuation of patent rights from a corporate perspective (Chiu, Chen, 2007). Therefore the industry and corporate perspective on patent valuation is suggested for further research.

Option pricing which is assumed to be the most accurate and commonly used method of various valuation methods (Smith, 1997), but it has not yet been as widely used as it could for intellectual property. Bader et al. (2008) discusses the adoption toward market based valuation tools, once intellectual property market becomes more transparent (BGW, 2007). For now the three simple valuation methods most referred to in literature have developed further and the high number of methods, combined with the non-standardized specific procedures they involve, result in a great deal of uncertainty in the valuation methods for patents currently used (PriceWaterhouseCoopers, 2008). As there are no commonly accepted valuation methods for intellectual property or accounting guidelines it is up to every enterprise to choose their own way of valuing their intangible assets.

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11
Appendices

11.1
Options theory

(The following text is a direct quote from Bose 2004: 54 – 55).

A common type of option is a call option, which gives the owner the right to buy an asset at a fixed price during a particular time period. This is analogous to exercising the option to make the investments in a new technology after due consideration of all factors about the project. The price of a call option has been described as a function of five variables (Black and Scholes 1973). These are:

The current share price. The higher the current share price, the higher the value of the lower (and upper) bound of the option price. Thus, the option's price will increase as the share price increases. This relationship can also be appreciated by recognizing that as the share price increases, so does the expected payoff of the option.

The exercise (or strike) price. The higher the outlay to acquire the underlying share at the time of exercise of the option, the less the option is worth, which means that the call option price would be a decreasing function of the exercise price.

The risk-free rate of return. As the risk-free rate rises, the present value of the exercise price falls and the option becomes more valuable. Therefore, a call option price is an increasing function of the risk-free rate of return.

The time to maturity. Increasing the time to maturity also increases the price of an option. The further into the future the payout of the exercise price is, the lower its present value is. Like an increase in the risk-free rate, the effect is an increase in the lower boundary for the price of the option.

The variance of the share price. The price of an option is an increasing function of the variance of the underlying share price. At first, this relationship may seem to contradict a standard assumption that investors are risk averse and, therefore, would pay a lower, rather than a higher price for greater variance. When an investor holds a share he/she is concerned about both good and bad share price outcomes, as payoffs are received from the entire probability distribution of possible share prices. If, however, an investor holds a call option on the share, a payoff is received only if the current share price exceeds the exercise price. Thus, only the probability of the current share price being greater than the striking price is of interest. If the variance of the share price increases, the probability of the current share price being greater than the exercise price increases, and therefore the option becomes more valuable. Thus, an increase in variance of the share price increases the possible positive pay off without affecting the size of possible losses from the option, and would, therefore, lead to an increase in the options' price.

Black et al. (1973) derived a formula for pricing call options, which is referred to as the Black-Scholes Options Pricing Model. Formulas four parameters are observable: the current share price, the exercise price, the risk-free rate of return, and the time to maturity. The variance of the share price must be estimated.

11.2
Discrete time: Binomial Model based methods

This method attempts to answer the problem of fluctuating discount rates by using the basic assumption that the returns to a call option on a share are corresponding to those of a portfolio or "synthetic option" involving borrowing some money and buying some of the underlying shares. Under assumption that there are no arbitrage opportunities, the option price for the underlying share will be given by the price of the above-mentioned synthetic option. This permits the creation of equivalent risk neutral decision tree probabilities so that the probable payouts can be discounted at the risk free rate. The necessity to set a suitable risk adjusted discount rate for each branch in the tree is escaped in that case (Pitkethly, 1997).

Copeland and Weiner (1990) investigate cases where non-financial or in other words real-options occur and where a contingent claim analysis valuation method could be used involving a portfolio of borrowing and shares being set up to replicate the returns of the project including an option. One example given is a pharmaceutical R&D project (Copeland et al. 1990). Trigeorgis and Mason (1987) also deliberate contingent claim analysis of options involved in a project. Contingent claim analysis applied to a decision tree in the lack of any flexibility offers the same answers as a conservative discounted cash-flow analysis because the use of a single discount rate does not matter.

Continuous time: Black–Scholes option pricing model based methods

Decision tree analysis methods can become very complex resulting in what Trigeorgis (1996) calls “Decision Bush analysis”. An additional problem with decision tree analysis methods is that whilst choices among courses of action with a few discrete outcomes may take place in most cases a range of values is likely. For example in the case of share prices the range of values may be modeled as a log-normally distributed process. The problem is that decisions about the underlying asset or project may have to be taken continuously or the price of the underlying share may evolve continuously and not only at discrete stages. As stated above, discrete stages involving diverse risk requires different discount rates. Once one involves continuous decisions one has a multiplicity of stages and thus the discount rate now changes continuously as well, varying with the underlying asset’s value and time. Unlike discounted cash flow based decision tree analysis using a single risk adjusted discount rate, option pricing theory methods accounting for continuous time such as the equation derived by Black and Scholes provide an answer to these problems.

Emery and Parr et al. (1978) discussed the differences between traditional capital budgeting methods and option pricing methods in the manner the latter treats the probability distribution of returns, the relationship to interest rates and time to exercise date of the option and concluded that using option pricing theory for real investment decisions risked irrational decisions). Rao and Martin (1981) claimed in favor of the use of the Black and Scholes model for "Real World" capital budgeting decisions and rejected criticisms by Emery, Parr et al.. Emery and Parr’s concerns in favor of using the Black and Scholes approach to value real options still involved unease about the requirement for continuous trading in the underlying asset and the option and for the fact that the underlying asset must not produce interim cash flows.

Trigeorgis (1996) and Kester (1993) detect crucial points at which real options may vary from conservative financial call options on shares.

The option holder has to take into account the effects of competition when holding shared real options. This is not the case with proprietary call options on shares. Patents are by definition proprietary consequently this should be of minor concern save for the likely effects of competition due to non-infringing substitute.

The underlying real asset may not be one which is traded or traded without difficulty. It is now clear though that the fact that an asset is not traded is not a bar to using option pricing methods. However, the Black and Scholes equation depends for its derivation on no arbitrage equilibrium with a synthetic option including a traded security and some debt. Contingent claim analysis usually requires a “spanning” traded asset or portfolio of assets whose stochastic change in value matches precisely that of the underlying asset on which an option is to be valued and from which volatility can be obtained. For most commodities and manufactured goods this should be feasible.

Real options might consist of several or compound options in a chain with multiple interdependencies. Option values are not automatically additive due to these interdependencies and so usually compound options will require more sophisticated analysis.

Dixit and Pindyck (1994) have nonetheless discovered that there might be circumstances in which the assumption raised in Trigeorgis (1996) work will not hold.

Option based valuation is principally a matter of identifying for a patent the variables described above which are necessary for option valuation.

11.3
20 steps for pricing a patent

Cromley (2004) provided 20 steps for pricing a patent from different perspectives. They were as follows:

1. check whether the patent is in force,
2. identify the context,
3. gather information,
4. assemble a valuation team,
5. read the patent,
6. investigate the patent’s scope,
7. talk with a patent attorney,
8. inquire about the patent’s validity,
9. inquire into blocking patents,
10. consider synergies among patents,
11. investigate foreign patent protection,
12. consider the remaining life of the patent,
13. analyze any prior royalties paid for the patent,
14. inquire into any actual or threatened litigation involving the patent,
15. identify the next-best alternative technologies,
16. estimate a demand curve for the patented item,
17. determine the patented product’s point of profit maximization,
18. consider the applicability of traditional valuation approaches,
19. do an income-approach valuation, and
20. write the patent valuation report.

11.4
Quantitative and qualitative dimensions for patent valuation

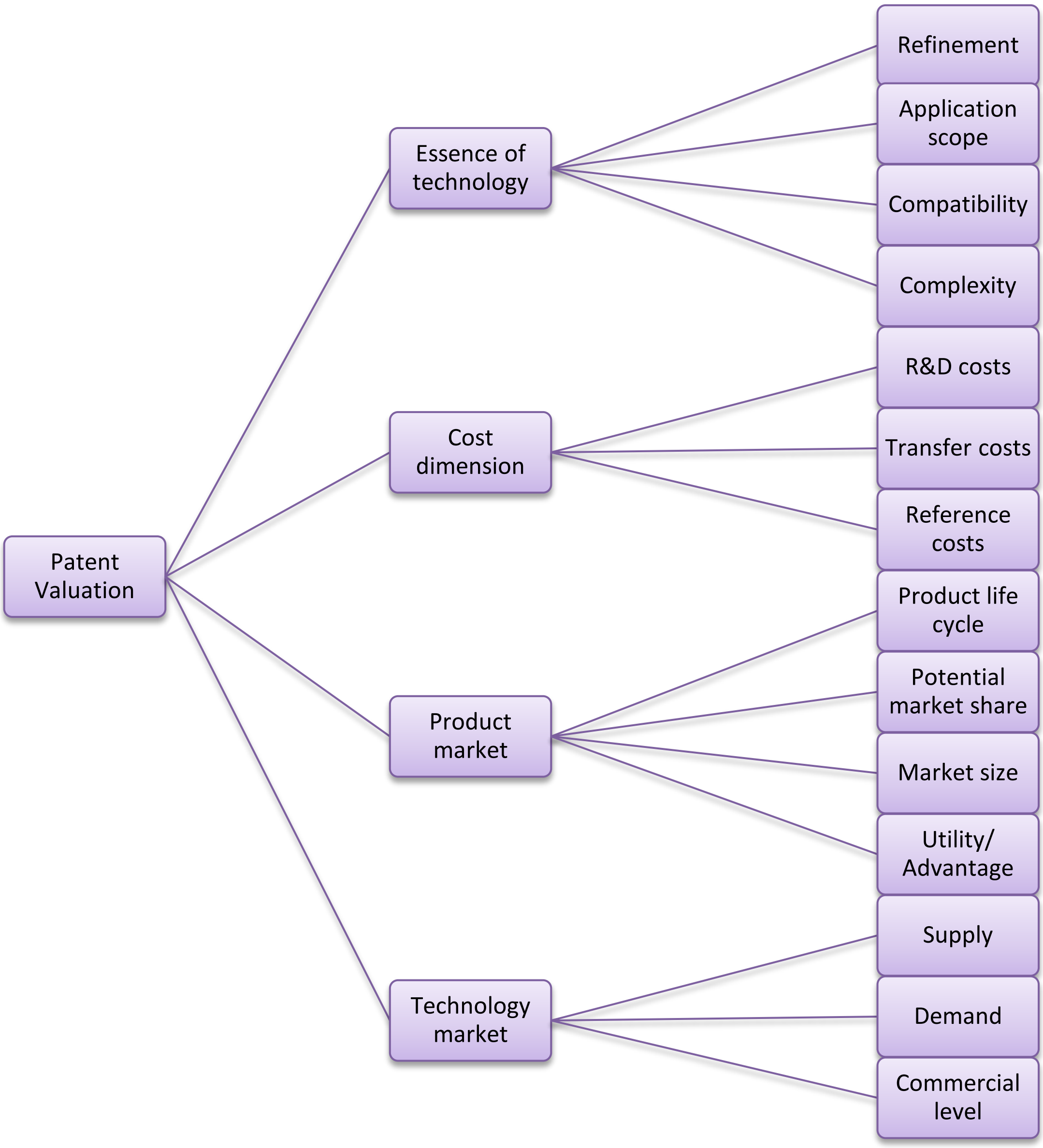

Abb. 03: Methods of patent valuation.
Source: Y.-J. Chiu, Y.-W. Chen / Mathematical and Computer Modelling 46 (2007) 1054–1062
Different quantitative and qualitative dimensions for patent valuation.

Questionnaire	Value-Driver	Literature
The possibility of profiting from the good reputation of the user firm of the technology.	Reputation of technology recipient.	Firms developing new technologies often refer to well-known companies who have either purchased their technologies in the past, or have licensed their development (Hovey, 2002).
Reputation of the technology developer for defending its invention and for technology protection.	Patent Protection.	This is an important value driver because managers and markets are well aware that that these assets need to be protected as vehicles of wealth creation, just as any tangible assets (Cheeseman, 2002). And the very reason why firms invest in intellectual assets is to gain rewards from their use in the knowledge economy (Hovey, 2002). Patents not only protect a firm's investments in intellectual assets, but also provide a basis of valuation (Leuhrmann, 1997).
Manufacturing, management and marketing capability of the technology recipient	Quality of Management.	Firms appear to be well aware of the need to understand and manage all aspects of a firm's operations in order to profit in the knowledge economy. Successful management involves not merely discovering new solutions or adopting seemingly effective innovations, but also finding a home for the discovered products and services in the marketplace (Day, 1999). The key to effective management in knowledge-based companies lies in linking products and services to market realities (Narayanan, 2001). Further, the costs and risks involved in developing intellectual assets must be issues of careful management consideration (Weil, 1983; Contractor, 1988).
Capital, marketing talent and other values invested by the technology recipient/licensor	Investment in Capital and Marketing Values and Talent	In order to succeed, innovative firms must develop the skills and talents in managing the financial and marketing resources of the firm (Razgaitis, 1999, Day, 1999).
The ability of the technology recipient/licensee to significantly increase	Profitability	This perceived value driver is reasoned to be important because technologists and scientists with a tract record of success in developing intellectual

their profit margin by using this technology		assets add weight to the chances of commercial success, and is consistent with the findings of Darby et al. (1999) who hypothesized that high-tech ventures with strong link to "star scientists" should be more highly valued by investors and examined the effects. They concluded that an increase in a firm's intellectual capital would lead to higher market valuation.
Ability of the technology recipient/licensee to roll out the products quickly	Expediency of Rollout.	One of the results of globalization is that of 'time compression', that is, firms must roll-out products and services quickly into the market place, to ensure profitability at the "Innovative pricing" phase of the life cycle (Georgiou, 1994).
Amount of technology recipient/licensee's expected cost savings, risk savings, and other burden saving which follow using this technology	Quantifiable Benefits.	Cost savings in operations, and the reductions of specific, identifiable risks will enhance the chances of commercialization (Helfert, 2000). Thus, these factors are regarded as value drivers.
The reputation of the firm developing the technology	Reputation of research team and firm.	This perceived value-driver is consistent with the findings of Darby et al. (1999) who hypothesized that high-tech ventures with strong link to "star scientists" should be more highly valued by investors and examined the effects of ties to star scientists on the market value for new biotechnology firms. They concluded that an increase in a firm's intellectual human capital would lead to higher market valuation.
A lower risk of technological obsolescence.	Technological Obsolescence.	Firms are reluctant to invest in technologies that evaporate into obsolescence quickly because this introduces an additional risk, in that, investments will not be recovered during its commercial life (Levy, 1998).
Strategic alliances entered into with other firms to ensure the profitability of the technology.	Extending the Market Reach through Strategic Alliances.	Often value is added when small firms with advantages in developing technologies, but disadvantages in marketing them, enter into strategic alliances with firms who have global marketing networks, which can be employed in commercializing innovative products (Sullivan, 2000).

The technology is a pioneering technology, not just a mere improvement.	Uniqueness of Innovation	The uniqueness of an innovation is a major determinant of value, because it would have intrinsic market appeal (Levy, 1998). Uniqueness of innovation arises out of creativity, and this has a major role to play in the creation of products that are genuinely unique as distinct from those that are merely extensions or improvements (Kuratko, 1998). Most innovations result from a conscious, purposeful search for new opportunities (Josty, 1990). Intellectual (or knowledge based) assets are products of innovative thinking, new methods or new knowledge (Drucker, 1985). Further, there is a strong perception that firms in the knowledge economy succeed because they are able to develop range of unique products and services (Karakaya, 1994).
This area of innovation would produce a higher differentiated value.	Whether the technology is highly specialized or may be applied to a wider user base.	Razgaitis (1999) states that certain technologies will not attract competitor reaction, not because of highly complex technological barriers, but because the target market may be too small to afford sustained profits.
Non- reliance on the state of the economy and the effect of trade cycles.	Economic Factors.	The fundamental value of a firm is the expected present value of the firm's future payouts if these expectations take all currently available information into account, consistent with the efficient market hypothesis. Thus future payout must ultimately reflect real economic activity as measured by, for instance, gross domestic product - GDP (Shapiro, 1988). Consequently, stock prices should react to these measures of real activity as stock prices are built on expectations of these activities. Barro (1990) and Fama (1990) support the argument that stock price should lead real activity.
A low possibility of the demand for the technology being depressed by unemployment, union attitudes etc. in the main markets for the technology.	Union Attitudes towards Possibility of Job Losses Arising out of the Adoption of the New Technology.	Delays in respect of the technologies may result from union perceptions of adoption of new job losses. Labour laws should, therefore, be flexible to accommodate changes without dissipations to business activities (Cheeseman, 2002).

The degree of economic and industrial development, the labour and capital availability and cost, etc. in the technology recipient's country.	Degree of Sophistication of Labour and Capital Market.	Nascent technologies are more likely to survive the rigors of commercialization if educated and trained staff, and capital is available to realize their potential for revenue growth (Sullivan, 2000).
Availability and cost of capital and labour.	Availability and Cost of Capital and Skilled Workforce.	Availability is insufficient to guarantee success. Costs of a skilled workforce and capital, if excessive, will have the effect of driving up the costs of operations (Sullivan, 2000).
The costs associated with commercialization option	Options for commercializatio n	The decision to sell, patent, transfer or commercialize within own organization has different costs and benefits attached to them. In order to maximize the financial benefits, managers must weigh each option carefully (Razgaitis, 1999).
A low possibility of product liability suits.	Costs of Product Liability.	Where it can be perceived that nascent technology will not, in reasonable circumstances, result in high legal costs arising out of product liability litigation, the commercializer will pay a premium for this lower risk (Cheeseman, 2002).
The ability of the technology recipient/licensee to use clauses protective against product liability suits, particularly in connection with trademark licenses.	Defenses Against Legal Actions.	In situations where the commercialize is able use protective clauses to block costly legal action in respect of alleged breaches of patents, product liability suits and trademark, the value of nascent technologies will increase (Cheeseman, 2002).
Low risks and costs of litigation in product liability suits.	Risks and Costs associated with Product Liability Litigation.	(Cheeseman, 2002)
Low financial and other risks arising from a failure to police patent infringements.	Policing Policy of Patent Holders	If firms holding legal ownership of intellectual capital assets like patents and trademarks acquire a reputation for aggressively defending their positions, it will discourage infringements, which will add up value to the owners (Cheeseman, 2002).
Proactive Government policies in respect of the	Government Attitude to	In many countries, firms often lobby their governments for legal and

technology being developed.	Specific Branches of Technology Development.	financial support, and to adopt policies, which support the development of technologies that will cultivate economic progress. If such support is given, it will impute value to innovative technologies (Dabek, 1999).
Lack of legal restrictions on the technology being developed.	Legal Impediments to New Technologies Development	In situations where proactive government support is not available, value can still take place if there is an absence of legal restrictions on specific types of technologies being developed (Dabek, 1999).
Lack of ethical and environmental issues connected with the technology.	Ethical and Environmental Issues	Innovative firms now must not only have to contend with business risks, but with growing concern of ethical and environmental issues (Common, 1998).
The stage of the technology's technical and market development (commercially proven).	Envisaged Commercial Promise	From a glint in the eye to commercial success is an extensive and complex road, but the closer that idea gets to commercial production, the better the basis for valuing it (Levy, 1998).
The intrinsic quality of the technology as a cost effective, marketable quality, safe, stable technology.	Cost Effectiveness.	This factor refers to the cost effectiveness of the R&D activity that is aimed at creating marketable, safe and stable technologies. It is an established fact that investments in R&D are risk intensive because of a low probability that such expenditures will result in any tangible commercial success. In the knowledge economy, there is ongoing pressure to make those investments in developing intellectual capital assets, in order to maintain a firm's market and competitive standing (Weinstein, 2001). But expenditures on R & D are business costs, and like any other costs and expenses, they have to be effective, that is, they must yield profitable results (Narayanan, 2001). Thus business managers must establish budgetary controls over R&D expenditures, and subject them to the same budgetary rigors similar to other classes of expenditures (Kuratko, 1998). Thus business managers try and ensure that R&D costs are minimized, while the probabilities of commercial success are maximized.

The perceived utility by the buyer or user of the technology or its product, in terms of increased productivity.	Productivity.	This factor defines the productivity benefits that the end-user would derive from using the technology developed by the knowledge firm. Chen, Roll and Ross (1986) suggest that industrial productivity is one of the economic variables that have a high correlation with value and is related to performance, growth and profitability.
The lack of ability of competitors to develop around the technology, or patent, or independently duplicate the secrets, in terms of the burdens of cost, time, quality, and risks of a legal, technological, environmental ethical nature.	Risks.	Major risks for nascent technologies arise from competitors (Levy, 1998), breaches of patent laws (Hovey, 2002), and safety fears (Razgaitis, 1999). There is a systematic risk component associated with the cash flows of technology intensive ventures while the technical risks are idiosyncratic (Berk, Green and Naik 1998; Oh 2001). The relevant risks affecting the valuation of technology ventures need to be determined and measured in the evaluation process for high-tech firms be they in the form of risk premium earned for firm external factors such as *NAS, CC* and *FE* (Oh 2001), during development (Berk et al, 1998) or human capital Darby et al. (1999).
Size of the total relevant market (local, national and international), and the licensee's likely share.	Market Size Potential.	In order to achieve satisfactory profits, a firm has to establish a critical mass in its target market segment, and much will depend upon its ability to tap the potential of the local and international market place (Barwise, 1997).
Low price sensitivity of the potential market for the technology.	Price Sensitivity.	If a new technology is sensitive to price, it m a y signal the presence of competitors, each with their own offering in the market, thus reducing the ability of the firm to profit from innovations (Day, 1999).
Lack of intense competitive activity in the target market(s).	Competition and Rivalry.	Competition has the effect of margin reduction. The higher the competition the lower the margins. Innovative products allow a breathing space for firms to increase their profits; even it is for a short time (Levy, 1998).
The potential of the technology to deliver	Differentiated Products and	Differentiated products and factors that allow firms to compete strongly

differentiated products to the target segments, or deliver price and non-price competitive edge to the user of this technology.	Non-Price Competition.	create the basis for additional value. Innovations are one way to achieve differentiated products (Lehman, 1996).
The potential of the technology to allow technology recipient to achieve increased market reach.	Market Reach.	In order to achieve satisfactory profits, a firm has to establish a critical mass in its target market segment and much will depend upon its ability to tap the potential of the local and international market place (Barwise, 1997).
High barriers to competitors developing the same or competitive technology by their own effort.	Technological Barriers.	Major risks for nascent technologies arise from competitors (Levy 1998). Highly innovative firms impede the entry of possible competitors, both by their speed of rollouts, and by the excellence of innovations (Levy, 1998).
The scope and reliability of the protections of the technology be it patent, trade secret, trademark, or copyright.	Reliability of the protections of the technology	If firms holding legal ownership of intellectual capital assets like patents can effectively defend their inventions, it will add to the price that a purchaser is willing to pay (Hovey, 2002).
Low risk arising from non- protection of the technology.	Risk form non-protection.	There are a few examples where the risk from not patenting innovations is relatively low Hovey, 2002). Certainly this would reduce the costs of commercialization, but management must be careful that it does not underestimate the risks arising from failing to make investments in legally protecting its innovations (Razgaitis, 1999).
The potential for achieving financial growth by the user adopting this technology.	Growth prospects.	Growth is derived from a firm's market share, competitive positioning and profitability. Thus business managers are keenly aware of the need to make the necessary investments to maintain and increase their market share (Kotler, 2001).
The potential for export and/or export growth for adopters of this technology.	Export Potential.	The ability to find external markets would certainly add to commercial appeal as this would extend the market size and reach, which will increase the revenue potential (Day, 1999).
The availability of government or other	Government	The government's legal, R&D and infrastructure support is regarded as

grants for the adopters of this technology.	Support.	an important value driver, primarily because it reduces the costs and risks of developing intellectual assets (Westland, 2002). In many countries such as the U.S, there are active lobbies that seek to maximize the availability of government support for the development of intellectual capital (Razgaitis, 1999).