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Methods of Intellectual Property Valuation

This note addresses the methods used in valuing intellectual property, with particular emphasis on valuing patents. Additionally, the note defines intellectual property and explains its growing importance in the world market. Detailed descriptions of income approaches, market approaches, and a review of cost approaches can be found in the text.

Defining Intellectual Property

Intellectual property (IP) shares many of the characteristics associated with real and personal property. For example, intellectual property is an asset, and as such it can be bought, sold, licensed, exchanged, or gratuitously given away like any other form of property. Further, the intellectual property owner has the right to prevent the unauthorized use or sale of the property. The most noticeable difference between intellectual property and other forms of property, however, is that intellectual property is intangible. That is, it cannot be defined or identified by its own physical parameters. Consequently, IP must be expressed in some discernible way to be protectable.

To be patentable, an invention must be novel, unique, useful, and nonobvious. A prerequisite to patentability is that the invention must be capable of some practical application. This emphasizes the importance the patent system puts on usefulness. One might say that a patent is a contract between society as a whole and an individual inventor. Under the terms of this social contract, the inventor is given the exclusive right to prevent others from making, using, and selling a patented invention for a fixed period of time in return for the inventor's disclosing the details of the invention to the public. Thus, patent systems encourage the disclosure of information to the public by rewarding an inventor for his or her endeavors.

Under all patent systems, once this period has expired, people are free to use the invention as they wish. The benefits of an effective patent system can be partially illustrated as follows:

- A patent rewards the investment of time, money, and effort associated with research. It stimulates further research as competitors invent alternatives to patented inventions, and it encourages innovation and investment in patented inventions by permitting companies to recover their research and development costs during the period of exclusive rights.

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- The limited term of a patent also furthers the public interest by encouraging quick commercialization of inventions, thereby making them available to the public sooner rather than later. Patents also allow for more latitude in the exchange of information between research groups, help avoid duplicative research, and, most importantly, increase the general pool of public knowledge.

Intellectual Property's Increasing Importance in Corporate America

Intellectual property? Ten years ago, that phrase wasn't even in the vocabulary of many CEOs, let alone a part of their business strategies. Indeed, many chief executives still regard patents, trademarks, copyrights, and other forms of intellectual property as legal matters best left to the corporate attorneys. But the burgeoning knowledge economy has given rise to a new type of CEO and a new type of business competition--one in which intellectual property, not fixed assets, have become the principal sources of shareholder wealth and competitive advantage.

The rise of the knowledge economy means that the intellectual property owned by a company is likely to determine its future economic success. Because intellectual property offers differentiation between products, it often holds the key to fast growth in market share and premium profits. Indeed, a leading product may derive its success from all seven of the major types of intellectual property: trade marks, design rights, copyrights, patents, know-how, confidential information for manufacture (so-called trade secrets), and finally databases (e.g. software to manage the supply chain and targeting). **Exhibit 1** lists some important innovations of the last twenty years.

An analysis of the *Fortune 500* companies shows that in 1975, 60 percent of their market value was represented by their tangible assets. But twenty years later this percentage has fallen to just 25 percent. Since then, the proportion has fallen further and this trend looks to continue.

Companies are increasingly looking to acquire undervalued and underused intellectual property. Indeed, the new millennium will see a new breed of corporate raiders, who strip-out and sell intellectual property, just as their predecessors did with undervalued tangible assets in the 1980s. In recent years, IP valuations have crept into a wide array of business situations, including:

- Evaluating potential merger or acquisition candidates
- Identifying and prioritizing assets that drive value
- Strengthening positions in technology transfer negotiations
- Making informed financial decisions on IP maintenance, commercialization and donation
- Evaluating the commercial prospects for early stage Research & Development (R&D)
- Valuing R&D efforts and prioritizing research projects
- Supporting a valuation for loan collateral

Thus, the quality and accuracy of IP valuations have become an important focus of senior management. We turn now to a review of the valuation techniques frequently used to value IP.

Methods of Valuation

Income Approach

Income approaches focus on the future cash flow derived from a particular piece of IP. As with all income valuations the need to accurately forecast future cash flow is of paramount importance. The following variables are needed when using an income approach:

- An income stream either from product sales or licensure of the patent
- An estimate of the duration of the patent's useful life
- An understanding of patent specific risk factors and incorporating those into the valuation
- A discount rate

Unlike most enterprise or fixed asset valuations, intellectual property assets have their own set of unique risk factors. Some of these risks are:

- *New Patent Issuance*: New patents can either make existing technology obsolete or, more likely, allow for another competitor in the same space. If a similar patent is issued the value of the underlying technology will decrease. One key difficulty of the patent process is that it is nearly impossible to know what has been filed with the U.S. Patent and Trademark Office (USPTO). Only issued patents are publicly available information and therefore the risk posed by pending patent claims cannot be easily foreseen. **Exhibit 2** lists the number of new patent applications filed and granted by the USPTO from 1970 to 2001.
- *Patent Challenges/Declared Invalid*: An issued patent remains open to attack for invalidity, and it is a common defense for an alleged infringer to assert that the patent is invalid. Typically, patents are challenged on the grounds that someone other than the named inventor invented the claimed property, that the invention is "obvious" to persons skilled in the relevant technology, or that the patent is not unique and too similar to existing methods. Successful challenges can immediately invalidate the patent and corresponding licenses. In principle, proper due diligence should turn up these potential problems.[1]
- *Patent Infringement Suits*: Licensees could be held liable and ultimately pay three times damages. Again, due diligence should reveal any potential problems of overlapping, uncited prior or concurrent claims.

[1] Despite due diligence, it is estimated that over 43 percent of patent claims ultimately turn out to be not unique. David E. Martin, "Insurable Patents? Global Metrics for Actuarial Patent Risk Management," Conference on Growth, Prosperity and Patents, Danish E.U. Presidency, Aalborg, Denmark, October 28, 2002.

- *Trade Secrets:* Some patents are virtually worthless without the necessary trade secrets. An example of a "worthless" patent is a pharmaceutical patent for a specific drug that did not reveal the exact "recipe" for formulating the drug. The inventor(s) of the patent need to cooperate and share those trade secrets to maximize the value of the patent.

- *Foreign Governments failure to comply with Patent Cooperation Treaties:* This is a major issue for software patents, many of which are pirated in foreign countries and sold into the world market.

Discounted Cash Flow (DCF) Method

The discounted cash flow approach attempts to determine the value of the IP by computing the present value of cash flows, attributable to that piece of IP, over the useful life of the asset. Unlike an enterprise DCF valuation, terminal values are rarely used, as the useful life of a patent is typically a finite period of time. Since 1995, patents expire 17 years after issuance or 20 years after filing. While this does not imply that patents cannot have value after 17 years, it usually implies some diminution of the patent's value beyond this point. At expiration, competing identical technologies can enter the marketplace. A good example of this is generic pharmaceuticals, there is still value in the "name brand" product after a patent has expired, but numerous generics typically enter the market. Valuations of patents will vary based on the degree of post expiration cash flows assumed. For this reason, most analysts usually begin by assuming no value is expected after expiration of the patent and then consider other assumptions.

The same methodology used to forecast free cash flows and an appropriate discount rate in an enterprise valuation apply to an IP specific valuation. Free cash flows are forecasted for the useful life of the patent and the discount rate is the company's market based rate of return, assuming that the company's business risk is equivalent to the patent under consideration. The forecasted free cash flows should also be adjusted for the probability of a patent's success. The risk factors outlined above affect the likelihood of a patent's success

The benefits of the DCF method are its ability to compare values among different patents, likely availability of many of the required inputs from the firm's financial statements and market information. A drawback of DCF is that it does not capture the unique independent risks associated with patents. All risks are lumped together and are assumed to be appropriately adjusted for in the discount rate and the probability of success, rather than being broken out and dealt with individually (i.e., such as legal risk, technological risk, piracy, etc.) Further, often DCF fails to consider dependencies on properties held by others. In roughly 40 percent of cases, patents depend on other patents or property held in the public domain.

Venture Capital Method

The Venture Capital valuation technique also derives a value for a patent from the cash flows that arise over the asset's life. It differs from the DCF method in that a fixed non-market based discount rate is used, usually 50 percent (40-60 percent range), and there is no explicit adjustment for the probability of success. This method does not account well for the patent specific risk factors outlined above. Like the DCF, cash flows are assumed to be static and

independent risk factors are lumped together. In valuing intellectual property, this simplicity is the method's greatest drawback.

Relief from Royalty Method

Relief from royalty is based on deprival value theory and looks at the amount of income that a company would be "deprived" of, if it did not own the intellectual property in question but was required to rent it from a third-party instead. The royalty represents the rental charge, which would be paid to the licensor if this hypothetical arrangement were in place. The ability to determine an appropriate royalty rate depends upon the specific circumstances and requires the identification of suitable comparable transactions and prices involving third parties.

Obtaining a royalty rate is only a first step however and a reliable sales forecast is also required in order to estimate the income that flows directly from the intellectual property. As with other income approaches, an appropriate cost of capital has to be determined.

This method is useful because the market size and expected market share are generally accessible information. In addition, the method is also intuitive in that the value of a property is defined as a rental charge other companies would pay to use it. One significant drawback of the relief from royalty method is that a rental charge can always be assumed, when in reality one may never materialize. The plain fact is that some patents may be of little value and thus are not worthy of a rental charge.

Real Options Method

The Real Options Method (ROM) recognizes that a patent has intrinsic value based on its projected cash flows discounted at the opportunity cost of capital for the owner of the patent. Additionally, the ROM incorporates the value associated with the uncertainty inherent in a business and the active decision making required for a patent-based business strategy to succeed. The ROM values these items using the Black-Scholes option-pricing model.

The inputs for the Black Scholes pricing model are as follows:

Underlying Asset Value	The present value of the property's future cash flows over the life of the asset
Exercise Price	The present value of the fixed costs that must be invested to commercialize the product or to maintain the patent's strength
Time	The time until the patent expires *NOTE: Future benefits that continue past the time of patent expiration are not considered.*
Volatility	The standard deviation of the growth rate of the patent's cash flows

Risk-free rate	The risk-free U.S. Treasury rate over the remaining life of the patent
Dividends	Reduction of the option's duration due to competitive action, unforeseen delays, or other risk factors

The primary advantage of the ROM is that it accounts for the value associated with the uncertainty of cash flows and the ability to manage the patent investment. Like the DCF or Venture Capital methods, the ROM values the stream of cash flows but it also accounts for acquired knowledge. This method provides a more complete evaluation than either the DCF or the Venture Capital method, which only capture cash flows and static fixed costs.

The primary disadvantage of the ROM is that there is often an inexact mapping of the assumptions underlying option pricing theory and the real option application. For example, is the standard deviation of the growth rate of patent cash flows log-normally distributed? Likewise, the Chicago Board Option Exchange commits to pay an investor using traded options the exercise price of the option. No party assures that the fixed costs projected in the exercise price under the ROM are obtainable to the firm. The "break-through" aspect of the Black-Scholes model was the observable and reliable nature of the inputs into the model. The accuracy of the model inputs relies on the efficient capital market assumptions that underlie the traded option, bond, and stock markets. Real investments are typically infrequently traded and therefore their prices lack the reliability of market prices. As such, these limitations place some doubt on the accuracy of the economic values projected under the ROM.

Other disadvantages of using the ROM to value patents include the fact that patents contain adverse rights, not affirmative rights which run counter to the notion of "having an option." Further, as noted earlier, the option value of a patent can be reduced or eliminated by a third party filing and contesting the claim.

Exhibit 3 provides a simple comparison of the value of a patent under the Discounted Cash Flow and Real Option Methods. The example assumes that a single patent of a biotechnology firm has ten years remaining until expiration and no terminal value thereafter. In the example, the present value of the net operating cash flows under DCF ($32.2 M) corresponds to the "Stock Price" in the Black Scholes model or the Underlying Asset Value in the table above. There are projected costs of developing and maintaining the patent over the next ten years of $6.0 M, which is analogous to the "Exercise Price." Note that in this example, operating costs are included as part of net operating cash flows, defined as Revenues – Operating Costs – Taxes, whereas capital outlays for development (i.e., capital expenditures) are included in the Exercise Price. However, conceptually there is no reason why capital expenditures could not alternatively have been reflected in net cash flow as well. This framework is adopted because managers must make these projections using reported financial information which makes distinctions between on-going expenses and expenditures. Based on these assumptions, the NPV of the patent is $32.2M – $6.0M= $26.2M.

The remaining assumptions for the ROM are fairly straightforward with the exception of the standard deviation or volatility of the patent cash flows. For this example, it is assumed that the volatility of the patent cash flows will mirror those of the firm undertaking its development.

Therefore an estimate of the asset's volatility can be obtained from a group comparable publicly traded biotech firm's, shown below as 98.63 percent.[2]

Industry Name	No. Firms	Annualized Standard Deviation Equity	Annualized Standard Deviation Firm Value	Equity/Value E/(D+E)	Debt/Value D/(D+E)
Biotechnology	**76**	**100.06%**	**98.63%**	**98.55%**	**1.45%**
E-Commerce	27	125.09%	101.99%	80.58%	19.42%
Electrical Equipment	92	92.08%	88.39%	95.89%	4.11%
Electronics	196	86.22%	67.75%	77.33%	22.67%
Healthcare Info Systems	33	98.87%	86.38%	86.88%	13.12%
Information Services	19	56.49%	50.50%	89.03%	10.97%
Internet	421	124.73%	111.72%	89.20%	10.80%
Medical Services	208	83.05%	66.82%	79.42%	20.58%
Semiconductor	118	102.59%	97.49%	94.91%	5.09%
Telecom. Equipment	141	99.87%	87.11%	86.72%	13.28%
Telecom. Services	208	88.68%	57.37%	60.94%	39.06%
Wireless Networking	80	133.39%	94.68%	68.64%	31.36%
Market	**7,254**	**57.97%**	**45.39%**	**77.02%**	**22.98%**

With these inputs, one obtains a value for the patent of $31.2 million under the real option model. From here, the value of the patent can be broken down into its intrinsic value or static NPV ($32.2 – $6.0 = $26.2 M) and time value ($31.2 – $26.2 =$4.9 M). Hence an additional $4.9 million in value arises from the ability of management to factor in the knowledge acquired over time and change the direction of patent development.

Other Valuation Approaches

As with many types of valuation, other methods exist to value IP, which we touch on only briefly here.

Market Comparables

Conceptually, a market comparables approach should offer a good indication of a patent's value, as it reflects the exchange of value between two parties. However, in valuing patents it is difficult to find a suitable comparable transaction. The two primary reasons for this are the lack of disclosed sale or licensure activity and by its definition, a patent must be unique.

Historic Cost

This valuation methodology measures the amount of money spent in the development of the intellectual property at the time it was developed. But unless the intellectual property was developed in the recent past, an historic cost measure tends to be unreliable due to the impact of inflation and the changes that occur in technology over time. In addition, it is not always possible to provide accurate information on the resources spent for such quantification.

[2] The volatility estimates are obtained from Professor Aswath Damoradon's website at www.stern.nyu.edu.

Replication Cost

This measures the amount of money that would need to be spent in current cost terms in order to develop the intellectual property in exactly the same way and to achieve the same final state as it currently exists. This includes costs incurred on any unsuccessful or inefficient prototypes.

Replacement Cost

This measures the amount of money that would need to be spent in current cost terms in order to develop the intellectual property as it currently exists, but *excludes* the costs relating to unsuccessful or inefficient prototypes.

Summary

As intellectual property grows in its importance, managers must understand not only the methods of valuing these assets, but also the unique risk factors associated with intellectual assets. Each valuation technique outlined has its strengths and weaknesses, but as is true with enterprise valuation there is no definitive right or wrong valuation approach. However, it is wise to use several of these methods when valuing a specific IP asset. This provides differing viewpoints on the underlying asset value and is a useful check for consistency in assumptions and human errors that may occur in relying on only one method.

Exhibit 1

Methods of Intellectual Property Valuation

Late Twentieth Century Inventions

1978 Dan Bricklin and Bob Frankston invented the VisiCalc spreadsheet.
The artificial heart Jarvik-7 invented by Robert K. Jarvik.

1979 Cellular phones invented.
Cray supercomputer invented by Seymour Cray.

1980 The hepatitis-B vaccine invented.

1981 MS-DOS invented.
The first IBM-PC invented.

1982 Human growth hormone genetically engineered.

1983 The Apple Lisa invented.
Soft bifocal contact lens invented.

1984 The CD-ROM invented.
The Apple MacIntosh invented.

1985 Windows program invented by Microsoft.

1986 A high-temperature super-conductor invented by J. G. Bednorz and Karl Muller.
Synthetic skin invented by G. Gregory Gallico, III.

1987 The first 3-D video game invented.
Disposable contact lenses invented.

1988 Digital cellular phones invented.
Doppler radar invented by Christian Andreas Doppler.
Prozac® invented at the Eli Lilly Company by inventor Ray Fuller.
The first patent for a genetically engineered animal is issued to Harvard University researchers

1989 High-definition television invented.

1990 World Wide Web/Internet protocol (HTTP) and WWW language (HTML) created by Tim Berners-Lee.

1991 The digital answering machine invented.

1992 The smart pill invented.

1993 The Pentium processor invented.

1994 HIV protease inhibitor invented.

1995 The Java computer language invented.
DVD (Digital Versatile Disc or Digital Video Disc) invented.

1996 Web TV invented.

1997 The gas-powered fuel cell invented.

1998 Viagra® invented.

1999 Scientists measure the fastest wind speed ever recorded on earth, 509 km/h (318mph).

2000 Activa Tremor Control Therapy a treatment for Parkinson's disease where the brain is massaged by tiny electrical pulses.
Distance patient monitoring allows patients to track health information without visiting a hospital or doctor.

2001 AbioCor artificial heart represents groundbreaking medical miniaturization technology.
Ginger is a revolutionary mode of personal and urban transportation.

Source: Mary Bellis© at www.investors.about.com

Exhibit 2
Methods of Intellectual Property Valuation

U.S Patent Applications and Grants

	Applications	**Patents Granted by Type**					
Year	Total	Utility	Design	Plant	Reissue	Total	% Foreign
1970	109,359	64,429	3,214	52	269	67,964	26
1971	111,095	78,317	3,156	71	246	81,790	28
1972	105,300	74,810	2,901	199	275	78,185	30
1973	109,622	74,143	4,033	132	314	78,622	30
1974	108,011	76,278	4,304	261	435	81,278	33
1975	107,456	72,000	4,282	150	378	76,810	35
1976	109,580	70,226	4,564	176	422	75,388	37
1977	108,377	65,269	3,929	173	407	69,778	36
1978	108,648	66,102	3,862	186	363	70,513	37
1979	108,209	48,854	3,119	131	308	52,412	37
1980	112,379	61,819	3,949	117	285	66,170	38
1981	113,966	65,771	4,745	183	364	71,063	39
1982	117,987	57,888	4,944	173	271	63,276	40
1983	112,040	56,860	4,563	197	362	61,982	41
1984	120,276	67,200	4,938	212	300	72,650	42
1985	126,788	71,661	5,066	242	276	77,245	44
1986	132,665	70,860	5,518	224	260	76,862	45
1987	139,455	82,952	5,959	229	245	89,385	47
1988	151,491	77,924	5,679	425	244	84,272	47
1989	165,748	95,537	6,092	587	317	102,533	47
1990	176,264	90,365	8,024	318	370	99,077	47
1991	177,830	96,513	9,569	353	263	106,698	46
1992	186,507	97,444	9,269	321	360	107,394	45
1993	188,739	98,342	10,630	442	332	109,746	44
1994	206,090	101,676	11,095	499	317	113,587	43
1995	228,238	101,419	11,712	387	316	113,834	43
1996	211,013	109,645	11,410	362	279	121,696	43
1997	232,424	111,983	11,414	394	277	124,068	44
1998	260,889	147,521	14,767	561	298	163,147	44
1999	288,811	153,485	14,732	421	448	169,086	44
2000	315,015	157,495	17,413	548	524	175,980	45
2001	345,732	166,039	16,872	584	480	183,975	46

Source: U.S. Patent and Trademark Office

Exhibit 3

Methods of Intellectual Property Valuation

Comparison of Discounted Cash Flow and Real Option Methods

Discounted Cash Flow Method ($M)

Assumptions:											
Probability of Success	30.0%										
Tax Rate	35.0%										
Cost of Equity - ke (all equity)	14.0%										
Risk free Interest Rate	5.0%										
Beta	1.5										
Market Risk Premium	6.0%										
Terminal Value	No										
	0	1	2	3	4	5	6	7	8	9	10
Net Operating Income ($M)		$3.0	$8.0	$9.6	$13.4	$18.8	$26.3	$42.1	$67.4	$107.9	$172.6
Expected Operating Cash Flow		0.9	2.4	2.9	4.0	5.6	7.9	12.6	20.2	32.4	51.8
Exp. Operating Cash Flow – After Tax		0.6	1.6	1.9	2.6	3.7	5.1	8.2	13.2	21.0	33.7
Present Value of Operating Cash Flows	$32.2										
Present Value of Development Costs	6.0										
Net Present Value of Patent	$26.2										

Exhibit 3 (continued)

Methods of Intellectual Property Valuation

Comparison of Discounted Cash Flow and Real Option Methods

Real Option Method ($M)	
PV of Estimated Operating Cash Flows of Patent Today	$32.2
PV Costs to Develop Patent through Expiration	$6.0
Remaining Days until Patent Expiration	3,650
Risk Free Interest Rate (maturity corresponding to Patent Expiration)	5.0%
Standard Deviation of Biotechnology Firms (Assets)	98.6%
Value of Patent ($M) (Black-Scholes Call Value)	$31.1
Intrinsic (Static NPV)	$26.2
Time Value	$4.9