

# VALUING PATENTS AND INTANGIBLE ASSETS IN THE SEMICONDUCTOR INDUSTRY

by

Roy Weinstein and Shane Huang

## I. Introduction

### A. Intangible Assets

Intangible assets include patents and other forms of intellectual property that are legally identifiable but of undefined value. Increasingly, they have become the most valuable of corporate assets. How else can one explain the fact that Microsoft, with few major physical assets, is worth far more than GM, with its myriad plants, millions of vehicles and thousands of acres of land? How else can Yahoo be worth more than the *New York Times Co.*, or Amazon.com be worth more than Barnes & Noble and Borders combined?

We set forth below a discussion of issues associated with the valuation of intangible assets. We begin by identifying possible approaches to the valuation of semiconductor patents, and then expand the analysis to include a generalized approach to the valuation of all intangible assets.

### B. Semiconductor Patents

In the past 25 years, the U.S. Patent and Trademark Office has issued more than 80,000 semiconductor patents. Since many of the manufacturers obtaining those patents use both their own patented technology as well as patented technology developed by other semiconductor manufacturers, industry practice is to enter into cross-license agreements. Typically, parties to such agreements grant each other unlimited access to their patented technology for the duration of the

agreement if not longer. The need for access to technology developed by others has increased the importance of correctly valuing semiconductor patents. This valuation can prove to be a daunting task.

## **II. The Practice of Cross-Licensing**

Typical market transactions are straightforward: people pay for products or services at prices set by market conditions: \$1.69 for a loaf of bread; \$8.00 for a movie; \$20.00 for an oil change. Even more complex transactions, such as the purchase of an automobile or house, embody prices determined by overall market conditions.

Cross-licensing arrangements in the semiconductor industry are far more complex. Such transactions typically involve rights to use entire patent portfolios--strong patents as well as weak ones, old patents as well as new ones--rather than a single product or service. Sometimes money changes hands; other times it is simply a balanced exchange with each company obtaining rights to the other's technology. When payments are involved, they usually take the form of predetermined lump-sum amounts paid over time rather than a running percentage of sales. Whatever the form of transaction, cross-licensing can be attributed to a desire to simplify license negotiations by eliminating the need to reach agreement on a patent-by-patent basis.

In the language of economists, the practice of cross-licensing constitutes recognition that patents in the semiconductor industry tend to be *complementary* products, i.e., the freedom to use another company's patented technology enhances the value of one's own patent portfolio. It suggests that companies benefit from and are willing to pay for "patent peace," i.e., the right to use another's technology without fear of infringement. The practice also derives from the extraordinarily rapid pace of innovation and technological change that characterizes the industry: since it can be difficult, if not impossible, to predict which innovations will prove to be valuable five or ten years in

the future, and what, if any, that value will be, the safest, easiest and usually most cost-effective approach taken is to license entire patent portfolios. The licenses exchanged in these agreements generally include all patents that will be applied for during the term of the agreement in addition to any patents owned or controlled by the parties at the onset of the contract term. This means that licensees pay for technology that they may already be using, technology that they might want to use in the future, and technology in which they do not and will never have any interest. They do so because the benefits associated with access to technology that enhances the value of their own intellectual property outweigh the costs of paying for technology that to them is useless.

As mentioned above, license agreements may provide rights to technology that is not yet protected or that does not even exist at the time the contract was entered into, but which may be afforded patent protection or come into being and be filed for patent protection before the agreement expires. Such agreements make use of a "capture period" during which all patents issued to or applied for by each party are automatically licensed to the other. An important and sometimes neglected duty in license negotiations is determining the value of these rights, i.e., rights to non-existent technology.

A semiconductor manufacturer contemplating a cross-license agreement with a competitor must consider a number of factors before the transaction price can be determined. This is true because the industry is characterized by companies with uneven sales volumes that have developed and/or acquired patent portfolios of non-uniform size and quality. Indeed, within each company's portfolio, some patents may be critical to the manufacture and sale of certain current products; others may be obsolete, may no longer be used, or may not have been incorporated into products to date. Each company may have developed products that rely not only on its own

technology, but also on the patented technology of its competitors. As a result, cross-license agreements are fairly common between semiconductor manufacturers.

Because sales that rely on licensed technology vary across companies, because that reliance may be of varying degree across a broad range of products, and because companies have patent portfolios of differing size and quality, monies may be exchanged to "balance" the transaction. Texas Instruments, the owner of one of the largest semiconductor patent portfolios, is estimated to earn in excess of \$500 million annually in royalty payments from cross-license agreements with many of its lower-sales-volumed competitors, suggesting that, on average, Texas Instruments has possessed a more valuable patent portfolio than the portfolios of companies with whom it has licensed.

Several issues are of concern when assessing potential cross-licensing arrangements:

- A. The relative size of each company's patent portfolio.
- B. The speed with which each company's patent portfolio is growing, given that a cross-licensing arrangement may be in place for five years or more. Note that since growth in patent portfolios depends upon research and development, value attributed to access to the cross-licensed company's future patents presumes that the company will continue to invest in R&D. One can imagine a situation in which one company reaps the benefits of the other company's research and development but does not maintain its own effort.
- C. The quality of each portfolio. Two concerns are of particular interest:
  - One company may believe that the other firm cannot produce without using one or more of its patents and therefore expects considerably higher compensation for permission to use those patents. The other company may

have different ideas about which, if any, patents it is using and how reliant it is on them.

- The proportion of useful patents in the portfolio; each company has its own assessment of which of its patents are active and used by the company.

D. Contribution of other assets. Exploitation of a patent requires certain physical and intangible assets to create the final product. In addition to a return on its patented intellectual property, each company must ensure an adequate return on its physical property and other contributing intangible assets.

E. Rate of sales growth. As a royalty is applied to sales, each company must anticipate its own sales growth as well as the sales growth of the other company to determine the total compensation it is likely to receive or pay in royalties.

Historical research and development costs may provide some insight into the value the company places on research activity in general as a contributor to its current and future profits. However, the historical costs incurred in developing each patent in a portfolio provide little information on the patent's contribution to the company's profitability. A patent that was expensive to obtain may not be used in current production, but may be critical for future, yet-to-be-developed products. Alternatively, the cost to obtain a patent currently critical to production may represent a relatively small portion of the research budget. Further, some patents end up with no commercial value whatsoever. For cross-licensing arrangements, the amount spent on research and development provides information on the importance each company places on its research efforts, but comparable R&D spending by two companies does not ensure comparable quality of their patent portfolios.

### **III. Information Needed to Calculate Value**

#### **A. Relative Size of Each Company's Portfolio**

Other things equal, the larger the portfolio, the greater the value. Accordingly, one of the elements of information necessary to calculate value is the relative size of each company's patent portfolio. Basic information in this regard can be obtained from the U.S. Patent and Trademark Office (USPTO), which classifies patents along industry lines. USPTO class codes 257, 365 and 437 have been used to identify semiconductor patents. As a result, in a matter of minutes, anyone with access to the USPTO web site can determine the number of semiconductor patents issued annually to each semiconductor company. This can provide a helpful starting point for positioning the parties contemplating a cross-license arrangement.

#### **B. Changes in Portfolio Size Over Time**

Access to the USPTO web site allows one to tabulate the number of patents issued to each company annually since 1976. Review of these data can provide some insight as to which companies are aggressively adding to their stock of intellectual capital and which companies are falling behind. Individual company performance can be compared with industry norms. This provides another helpful starting point for calculating value.

#### **C. Quality of Each Portfolio**

Patent counts can be easy; quality assessments are not. In theory, each of the patents in a portfolio must be evaluated, one at a time. To facilitate the process, sometimes patents can be segregated into groups: those that seem particularly valuable; those that are of average use at best; and those that would appear to be essentially worthless. In devising these categories, the age of each patent and design-around issues might be considered. Once the categories have been created and patents assigned to each in some sort of preliminary basis, the first step will be to evaluate only those patents that fall in the first category on the theory that those patents will account for most of the value in the portfolio being licensed.

In evaluating the quality of a portfolio, a number of factors can be considered. These include the following:

- The effect of patented technology in promoting sales of other products manufactured by the licensee. Patented technology that assists in increasing the sales of other products is more valuable than technology that fails to generate any "convoyed sales."
- The utility and advantages of patented property over old modes or devices, if any, that have been used to work out similar results.
- The extent to which it is necessary to make use of the invention in manufacturing products sold to ultimate consumers. Patents that are difficult to design around are more valuable.
- The portion of the realizable profit that should be credited to the invention as distinguished from other elements, i.e., other contributing patents, manufacturing processes, business risks, know-how and improvements added by the potential licensee, etc.

#### **D. Contribution of Other Assets**

As noted above, exploitation of a patent requires the use of other assets to create a final product. In the semiconductor field, these assets include technology licenses from other semiconductor manufacturers, the licensee's own patent portfolio and other forms of know-how and capital necessary to produce final products.

It is possible to get some sense of the relative importance of the portfolio to be licensed to the potential licensee. A new portfolio license is likely to be less valuable to a company that already has licensed rights to technology owned by others. This conclusion reflects the fact that

the relative contribution of a new portfolio license to a company that has never licensed before and does not anticipate licensing in the future is much greater than the relative contribution of that same license is to a company with a long history of cross-license arrangements. Thus, other things equal, one would expect a company that has licensed 20,000 semiconductor patents from a number of its competitors to be willing to pay much less for a license to 1,000 additional patents than a company that has not yet acquired rights to semiconductor technology but will be able to enter the industry with such a license. Similarly, a company that *expects to* license technology rights from a number of other companies must keep something in reserve to pay these future licensors. Many companies must re-evaluate existing license arrangements after learning of other patent-holders to whom they are obligated to pay royalties. In doing so, a company may determine that it is paying its initial licensors too high a royalty to allow a fair return on other contributing assets.

#### **E. Rate of Sales Growth**

The primary reason for licensing technology from others is to allow companies to profit from the sales of products that embody such technology. Accordingly, the greater the volume of sales, the greater the value of technology necessary to produce those sales. This means that companies must consider not only the actual volumes of their past and current "exposed" sales, sales reliant upon the patent technology of the other party, but also must anticipate changes in such sales volumes over the term of the license.

#### **IV. Other Benchmarks to Consider**

There are at least three additional factors that may be relevant in an assessment of the value of intellectual property. First, it might be useful to identify existing license agreements, if any, associated with the technology in question. Even though markets change over time, values reflected in such agreements often are probative of the costs currently being incurred for access to that same

technology by competitors in a particular industry. This can be useful information since often it is important to a licensee to be on an even playing field *vis-a-vis* its competitors. For the same reason, it also can be useful to obtain information regarding license agreements covering technology comparable to the technology in question. Finally, it might be useful to consider "industry norms"--commonly accepted royalty rates, differing across industries, that provide useful starting points for valuing technology in a particular industry. Each of these areas is addressed below.

**A. Existing Agreements Involving the Same Technology**

One would think that a useful measure of patent portfolio value could be found in previous transactions involving the same portfolio. This approach is not without its complications. For one thing, portfolios change over time--old technology becomes public domain while new technology gains patent protection. In addition, changes over time in the market for products embodying patented technology can have a dramatic impact on market values. For example, the sharp drop in semiconductor memory prices in recent years has reduced the value of semiconductor patents relied upon by those memory products. In that sense, values reflected in transaction prices five or ten years ago may overstate the value of the same portfolio in today's market. Similarly, expectations that semiconductor product markets will strengthen in the next several years suggest that rights to recently patented semiconductor technology will increase in value over time. These expectations will be reflected in current price negotiations.

**B. Agreements Involving Comparable Technology and Industry Norms**

If the technology in question has never been licensed, it may be useful to look at values associated with licensing similar technology and at industry norms. This information may provide a useful starting point for determining value attributable to intellectual property rights in the industry. Despite unique characteristics of patented inventions and differences in growth potential

of individual entities contemplating royalty agreements, our experience is that technology values within a particular industry often cluster around a central mean. In such cases, industry-wide royalty rates, supplemented by further statistical analysis, can provide a meaningful benchmark.

### **C. Computational Aspects of Using Benchmarks in the Semiconductor Industry**

Technology valuation in the semiconductor industry can be further complicated if previous license agreements involve the payment of fixed lump-sum amounts rather than a running royalty rate. These lump-sum payments should reflect the contribution by the patented technology to sales of semiconductor products made by the licensee. Since it is unlikely that sales volumes of a new potential licensee would be identical to those of previous licensees, it is necessary to transform lump-sum payments received by a licensor into "effective royalty rates."

In order to make this transformation, information regarding the timing and amounts of previous lump-sum payments is required. Once identified, these payments should be discounted back to the date of the license agreement. That date marks the static point in time when the parties reached agreement on the specific terms of their license contract. The discounted present value of these payments must be divided by the total discounted present value of sales of products licensed to use the patented technology over the term of the license in order to calculate an effective running royalty rate. When enough license agreements exist, so that it is possible to repeat this process, a series of effective royalty rates can be calculated. These can be treated as measures of past patent portfolio license value. As such, they may serve as a starting point for assessing the current market value of a patent portfolio.

### **V. Valuing Intangible Assets**

As with individual patents, the first challenge in valuation of intangible assets is to identify them. The most obvious of these assets include trademarks, copyrights, patents, trade

secrets, technical know-how and computer software. These are clearly defined as "property" to which legal rights attach. Less obvious intangible assets include an assembled and trained work force, a company's corporate structure, accounting and management policies, major marketing campaigns, and similar items which cumulatively add value to an entity as a going concern. These items may be difficult to define and may not fall clearly under the definition of property, but they contribute in some way to a company's financial results.

With any valuation computation, a recent arm's length transaction can be an excellent measure; however, for intangible assets, this is rarely available. For certain intellectual property such as patents, there may be royalty information available from previous patent license agreements. Similarly, trademark and copyright licensing arrangements may suggest market values for these intangibles. However, it is typically difficult to ascertain complete terms of these agreements, such as the extent of license coverage and any non-cash considerations given in the exchange. This makes it complicated to assess comparability between the intellectual property that is the subject of the transaction and the property one is attempting to value. For other intangibles, transaction information is generally limited to company acquisitions, where an amount typically identified as goodwill embraces the value of all intangibles. Despite the number of recent company mergers, there is seldom sufficient or comparable information for intangible valuation by industry.

Although accounting data have their limitations, economic theory also is limited in its application to intangible assets and intellectual property. Economists' approaches to valuation include development of economic models designed to calculate values from available information. For proprietary intellectual property, economic theory treats the owner as a legal monopolist. In theory, the monopolist should be able to extract the value of proprietary information from the market in the form of higher prices. Alternatively, it should be possible to extract the same value by

licensing knowledge to competitors. Several authors have focused on determining the most effective mechanisms for exploiting intellectual property in order to extract the maximum rent from alternative licensing, royalty or auction arrangements. Unfortunately, extracting these values is not straightforward in practice. Markets are neither as perfect nor as frictionless as assumed in theory. Although the rights of private property ownership for intellectual property may be supported under the law, intellectual property rights are costly to enforce. In some industries, despite the fact that many participants may have certain proprietary knowledge, the market remains strongly competitive, with no one company able to establish monopoly prices.

An alternative approach sometimes adopted by economists makes use of "hedonic pricing models" to estimate the value of the various characteristics of intellectual property. Hedonic pricing models, which make use of information pertaining to particular characteristics to measure value, have been effectively used in markets such as real estate, where each house represents a possibly unique combination of characteristics. Such a model uses house selling prices and information on the presence or absence of various characteristics to determine the incremental value added by each characteristic to the price of a house. This approach has possibilities for estimation of the value of intellectual property in markets where particular patents or other intangibles can be associated with particular products.

In addition to the historical cost, comparable transactions and econometric modeling approaches to valuation of intangibles, a fourth approach of market-based valuation is suggested by the accounting treatment of intangibles in business combinations. The acquisition of one company by another results in revaluation of tangible and identifiable intangible assets to their fair market value, with any residual of purchase price identified as goodwill on the company balance sheet. Arguably, the amount of goodwill indicates the value of all the non-identifiable intangible assets

acquired. The general acceptance of this method for business combinations encourages consideration of a similar approach for valuation of a company outside the context of acquisitions, using the company's current stock price as the measure of total company value.

There are several advantages to the use of stock prices: they are generally available for publicly-traded companies, they are based on arm's length market transactions, and, according to economic theory, they represent the net present value of a company's expected future earnings streams. In considering these future earnings, the stock price reflects the expected returns to all assets, tangible and intangible. This approach to valuation of intangibles has been most thoroughly explored by Gordon Smith and Russell Parr, the authors of several texts on intellectual property valuation (*Valuation of Intellectual Property and Intangible Assets*, First Edition 1989 and Second Edition 1998, John Wiley & Sons, Inc., New York). Smith and Parr present a method of valuing intangibles which is similar to that of business combinations, taking advantage of both accounting information and the current market share price of company stock.

As with the other approaches to valuation, the Smith and Parr methodology has certain limitations. An early step in their process involves deducting the fair market value of tangible assets from total company value and assigning the residual value to intangible assets. Unfortunately, however, determining the fair market value of tangible assets typically requires many assumptions. Moreover, once the residual available to intangible assets has been determined, it is no small exercise to identify those intangible assets and allocate the residual among them. Once that step has been completed, it is necessary to determine the required rate of return for each asset. When these returns are weighted by their proportion of total assets, the overall return for the company must equate to the firm's cost of capital. A final step allocates actual company returns to each asset in proportion to their contribution to the return comprising the weighted cost of capital.

Despite the many assumptions required, this approach begins to exploit both the accounting and economic information available to come up with an estimate of the value of intangibles to a company and their contribution to company returns. The resulting analysis does not address many of the more detailed issues created by patent portfolios, but may provide a starting point for realistic royalty negotiations.

#### **IV. Conclusion**

Growing disparity between company stock prices and per-share book value suggests that new approaches to the valuation of company assets is needed. Management is responsible for effective stewardship of all assets under its control, yet probably few companies have a good understanding of the value of intellectual property which they own, let alone the less identifiable intangibles which combine to make the business worth more than the costs of its bricks, mortar, cash and machinery. The books of account treat tangible assets in detail, but provide only limited information about intangibles, although these may represent the greatest value for the company and the greatest source of potential growth and profits.

Valuation of intangibles represents an important area for future research, requiring accounting beyond that for business combinations and identifiable intangibles. There is a role for this type of supplementary information in internal company management as well as for external investment analysis. Careful stewardship of all intangible assets will benefit all company stockholders and ultimately result in more effective management. In the semiconductor industry, improved valuation techniques will allow companies to better maximize the revenue contribution of their patent portfolios and other intangible assets.