

CHAPTER 1

Introduction to Opportunity Discovery, Valuation, and Dealmaking

In this opening chapter we will review briefly the key points of **Technology D-V-D**, namely the **Approaches of** opportunity Discovery, Valuation, and Dealmaking, and the valuation Methods and Tools to be developed in this book.

Introduction: *Technology D-V-D*

This book is about three business processes used for transforming technology into money, usually by way of a license agreement. These processes, here referred to as **Approaches**, are technology: (1) opportunity Discovery, (2) Valuation, and (3) Dealmaking; the overall process is then designated **Technology or Licensing D-V-D**, where each letter corresponds to the respective **Approach**.

About half of this book is on the **Approach** of Valuation. There are mountains of books on the general subject of valuation in various business contexts; this one focuses on unique issues associated with *technology*.

Technology

One can think of three discrete species of transacted rights: businesses, products, and technologies.

- *Business transactions*. These are usually the outright sale of all assets relating to an operating business including all forms of tangible and intangible property. Such transactions typically include some form of manufacturing or contract-for-manufacturing capability; established sales, marketing, and distribution channels; and, importantly, customers with a revenue history; and all the other elements necessary to operate as a standalone entity for the buyer to take over or integrate into its own operations.
- *Product licensing*. This enables the buyer to duplicate the making of some device, system, or service that has already been completed and proven by the seller. In this situation, the buyer will need to provide the necessary surrounding business assets to realize a profit from the license.

- *Technology agreements.* Such agreements designate transactions for pre or early commercial designs and data, normally without the evidence of large scale manufacturability or possibly even a single legitimate customer. In some cases, the final or best formulation has not yet been established. Another way of thinking of technology is as a work product of research and development (R&D). Put yet another way, R&D is a business operation that has as its successful result technology. Such an R&D work product can range all the way from a raw concept, at one extreme, to the results of many years and many millions of dollars' worth of investigation with comprehensive data books, samples, test results, financial projections, and business plans, as well as outside verification by certification agents and potential customer feedback from trials.

However, the term “technology” is challenging to define exactly. It is meant to encompass the broad meaning intended by its Greek root, *techne*,¹ which designates the craft, skill, and “know-how” associated with making some product or performing some service. This meaning of technology would apply to not yet commercially demonstrated superconductivity inventions based on sophisticated semi conductor physics to software code that has a demonstrated potential of controlling some important business process.

The key ingredient missing from technology licensing that is present in both business and product licensing is a commercial track record. Without such ingredient, the customary approaches to product and business valuations do not work well because the underlying data usually relied upon do not exist. To make this more concrete, consider an automotive example. In early 1999, Ford Motor Company made an offer to buy and ultimately bought Volvo's automotive business (and in late 2008 Ford announced it is planning to sell its Volvo operations). In developing the valuation of this transaction Ford in 1999, as the buyer, and in 2009 Ford as the seller has access to many years of financial and operational data as well as forecasted performance based on such data, and any subsequent buyer of this asset will be able to study the Ford data during its period of ownership. This is the nature of sale of *business* transactions.

Alternatively, Ford could have licensed from Volvo the right to make and sell Volvo cars in the United States in Ford plants based on Volvo proprietary information and patents. Again, in such a situation, Ford would have been able to study an extensive historical basis of the costs and revenues of making a Volvo car, and use such information to develop projections of profitability. This would have been a *product* transaction, because Ford would have had to use its business assets to make and sell the cars.

An example of a *technology* transaction would be Ford's acquisition of the rights to a Volvo invention that Ford could then develop and use in their manufacture of Ford cars, or for some other business purpose. With such technology transaction species, there is often no product or business history because what is being licensed is newly developed and has not yet reached the stage of a product, or the nature of its commercial use would be substantially different in the hands of Ford as the licensee. Although the tools and methods discussed in this book can be of use in business and product transactions, the main objective here is in support of technology licensing.

Technology and Intellectual Property Rights

Technology rights are usually expressed in three forms of intellectual property (IP): patents, trade secrets (also known as know-how, or proprietary technical information), and copyrights. Such IP can be considered as the form by which the technology rights are documented, protected, and conveyed.

It will be assumed that IP protection exists when considering the valuation of technology. There is always some uncertainty about the breadth and strength of such protection, and this uncertainty factors into the value determination. If there are issued patents, there can be some uncertainty surrounding interpretation of claim language or even the validity of the patent itself. If the patents are still pending, then there will be uncertainty about what will be allowed by patent offices in various countries of the world. There can also be uncertainties about trade secrets. It may not be well understood how “secret” the trade secret really is; it could be that many other labs and companies have independently arrived at the same information or soon will do so. Also there is always some risk of inadvertent disclosure of the trade secret by the seller or buyer or by some third party that would damage the value of the underlying technology asset.

The extent and strength of IP protection are dimensions of a valuation. An extreme example of such effect is the absence of value if the inventing organization publicized all the details of its invention in such a way as to preclude obtaining a patent or any other form of IP protection. So the absence of protection can and normally does preclude value (although even with minimal IP protection there can be situations where the seller’s commercial assistance can accelerate time to market and create value for the buyer). However, the converse is not true: It is possible to have very strong patent and trade secret protection and still not have much or any value because, for example, of the absence of a market for the product made by the underlying technology (though there can be option value to ownership of a right with no immediately obvious commercial use).

Thus, as a general guideline, some extent and form of IP protection is a necessary but not a sufficient condition for value to exist.

Considerations about which forms of IP should be used in which contexts, and analysis of the strengths and weaknesses of each, are outside the scope of this book. In the valuation examples considered it will be assumed that the technology is protected in some way or combination of ways. When risk issues are considered, or when comparisons are made to reference agreements, then strength and extent of IP protection will be identified as a factor to be considered when performing a valuation.

Technology licensing is becoming an increasingly important transaction category but does not have the abundance of tools and experience available to business and product transactions. This book is intended to contribute to the field of technology valuation.

Technology Opportunity Discovery

In some situations the opportunity for technology licensing is obvious: There is a specific package of IP rights and underlying technology assets that the owner seeks to monetize in some way other than its own commercial development into products and markets. However in many situations, the IP owner has many technologies,

perhaps thousands, as a result of significant R&D investments over the years not fully utilized in its own products, or “left-over” technology assets from a major acquisition, or a closing down of a major operating division and the opportunity exists to sell it in parts. In the latter situation there can be more opportunities than can be practically analyzed in detail, and some prioritization must first take place.

In all cases there is the discovery issue of identifying potential commercial applications that may not have been envisioned by inventors or prior business developers. Technology can be created focused on purpose A and instead, or in addition, be valuable for purpose B, or A, B, and C. The challenge and need for a technology owner, is to develop an initial recognition, which is Discovery, of licensing opportunities that are valuable. This business process is the **Approach** of opportunity Discovery.

We will cover opportunity Discovery in Chapter 3.

Valuation

The heart of the matter with technology transactions is value. This is sometimes expressed as the “So, what?” question, which is the natural response to any long winded and involved description of the latest and greatest invention. The answer usually begins with a discussion of who in the world will have a happier life because of it, and then how much would that happier life be worth to them if someone were in the business of providing this vehicle of happiness.

For the reasons discussed above, determining technology value is a challenging task. We will consider six Methods, and numerous Tools that derive from such Methods in six separate chapters, Chapters 4 through 9, covering the **Approach** of Valuation.

Dealmaking

The vehicle of technology transactions is a contract between a seller and buyer, normally a license. Such license conveys technology rights from the licensor, or seller, to the licensee, or buyer. For simplicity, hereafter the licensor will be referred to as the seller, and the licensee as the buyer.

The transaction between buyer and seller is a trade. Sometimes the trade is as simple as money from the buyer in exchange for assignment of a patent by the seller. In most cases, the trade is much more complex. But it is always a trade. Building on this fundamental idea I have introduced the acronym **TR R A DE™** to structure this discussion. Within the scope of the book, all transactions are founded on the **TR R A DE™** framework:

- TR is used to designate Technology Rights conveyed in the licensing transaction.
- R is the risk involved in any transaction.
- A represents the art behind the opportunity Discovery, Valuation, and Dealmaking **Approaches**
- DE is the deal economics.

The process of valuation and pricing determines the transaction deal economics, (the DE in our acronym). So, in shorthand form, this book is about TR for DE. The

business process of making such happen as trade is here called Dealmaking, our third **Approach**. Dealmaking will be covered in two Chapters, 10 and 11. As we shall see this **Approach** also involves opportunity Discovery, because the technology opportunity discovered in Chapter 3 has to match with the business opportunity to be discovered with/for a prospective buyer.

Depending on the complexity of the transaction, there can be numerous issues and agreements that are included in the Dealmaking and additional to a technology license. For the transfer of physical assets, such as lab equipment or technology prototypes, there may be a separate purchase agreement. For circumstances where key employees are to leave the seller and join the buyer, normally there will be employment agreements. If the seller agrees to provide subsequent technical assistance to the buyer, there will be a separate services or consulting agreement. If the buyer is going to provide a licensed product to the seller for the seller's use in some other product, there will be a supply agreement. Sometimes, the parties choose to create a separate nondisclosure agreement so that it stands independently of the license. In the case of equity transactions, there are numerous other agreements that are needed related to stock purchase, incorporation, and shareholder issues. The legal details of all such licenses and related agreements are outside the scope of this book. Here we will focus on valuation and pricing of "the deal" as a whole unit, understanding there may be one or many legal agreements used to encompass all the deal issues.

Graphic Outline of the Book

A graphic summary of the organization of this book along with the key acronyms we will refer to is shown here:

| | | A M-T | | |
|--------------------|----------|--|---|--|
| | | A: Approaches | M: Methods | T: Tools |
| Licensing D-V-D | D | Discovery | The Box NPV v. Risk | Rating/Ranking DCF |
| | V | Valuation TR R ^k A DE | <ol style="list-style-type: none"> 1. Industry Standards 2. Rating/Ranking 3. Rules of Thumb 4. Discounted Cash Flow (NPV) 5. Monte Carlo; Real Options 6. Auctions | > Rating/Ranking > Rules of Thumb > Discounted Cash > Risk Assessment |
| | D | Dealmaking | Pricing, Structures, Term Sheets Dealmaking-Process Plan B | Rating/Ranking DCF/NPV Monte Carlo Real Options |

Taxonomy of Technology Licensing

There are various ways of categorizing the circumstances under which licensing valuation, pricing, negotiation, and dealmaking occur. Although a discussion of the

“how to’s” of licensing in each of these categories is beyond the scope of this book, it is useful to have a common reference of licensing situations.

Technology licensing can be understood to take place under six situations, as discussed below:

1. *Enforcement Licensing*. The seller (licensor) believes it has the right and opportunity to enforce patent claims, and/or perhaps misappropriated trade secrets, against a buyer (licensee/believed-infringer) whose licensing need is a freedom to practice. In many cases the buyer is already using the technology in commerce and may already be aware of the seller’s patent(s). This is sometimes called stick (or “the taxman cometh”) licensing. Valuation can occur in pre-litigation contexts, or expert opinion in litigation, or settlement discussions.
2. *Opportunity Licensing*. The seller has a technology IP and possibly other assets that it believes will be of value to a buyer who is seeking new or expanded new revenue opportunities. Such licensing would normally include know-how of some kind. This is sometimes called carrot (or “have I got a deal for you”) licensing. Valuation normally occurs in anticipation and in the midst of a negotiation.
3. *Opportunistic* (as distinct from Opportunity) *Licensing*. The buyer seeks out a technology owner for the purpose of securing rights to a technology and perhaps other licensable assets. Prior to such contact, the seller may not have realized that it possessed licensable value, or it may not have been previously willing to license its technology. Valuation typically occurs first by the buyer in anticipation of making the seller an offer, and also by the seller as well as by both parties in the negotiation.
4. *Divestiture Licensing*. The seller is exiting a business area that includes technology and, typically, other assets such as physical plant, property, equipment, people, and trademarks. Traditional M&A (merger and acquisition) activities would encompass this form of licensing, though M&A transactions are normally associated with operating businesses. So in our context, divestiture licensing would more likely be related to technology assets and rights that were unused or underused by the seller and for some reason has become part of the M&A transaction. Divestiture licensing can resemble opportunity or enforcement licensing depending on the circumstances. Valuation typically includes nontechnology elements, such as the value of equipment, buildings, and so forth. Often the value is expressed as a lump sum payable in cash or cash and securities, though there can also be earn out and other future payments.
5. *Partnering Licensing*. The seller is seeking a business partner who will provide certain resources (such as complementary technology, key people, market access, and money) to a joint effort in further R&D, product development, manufacturing, and/or sales. The technology license is normally just an element of a panoply of supply, joint invention, facility access, marketing, and other agreements. Valuation occurs in anticipation of and during the back and forth of partner negotiations and can be expressed in royalty payment or splitting terms, or in revenue apportionment in accordance with some form of a capital contribution calculation, which would include a value for the technology contributed to the partnership.

6. *Startup Licensing*. The seller is licensing to a new business (commonly referred to as a NEWCO as a shorthand for “new company”) being formed expressly for the purpose of commercializing the technology by making and selling products and services. Buyers, who may be traditional venture capitalists, private investors, or strategic investors, normally seek many things from the seller, not least of which are the employment of the key people. The closing documents associated with licensing are mountainous and include incorporation papers, corporate bylaws, employment agreements, stock purchase agreements, and the technology license itself. Valuation occurs in the preparation of term sheets in anticipation and in the midst of negotiation of the formation of the NEWCO and for subsequent rounds of investment. Equity is normally the principal valuation consideration.

In the first three categories, the agreement structure and valuation issues tend to be substantially simpler than in the last three categories. To keep our considerations manageable, we will not attempt to include a discussion of all six categories of technology licensing as we go through each of the six valuation methods. In Chapter 10 we will cover the special situation of taking equity as a principal form of compensation, which normally occurs with Startup Licensing, but can occur in other circumstances.

For convenience, most of the illustrations used in this book will use Opportunity Licensing as an assumed context, although the impetus could have originated from one of the other above contexts. It must be noted that enforcement licensing is not the subject of this book. Enforcement licensing is about specific infringement contention of certain patent claims (or, possibly, misappropriation of trade secrets), for a product in commercial use. Such context presumes a bare patent license, no other assets, in a nonexclusive license limited to the field and territory (corresponding to the court’s jurisdiction). The contexts we are interested in involve a seller offering a mosaic of assets and rights, which we will later refer to as The Box, in exchange for a structure of cash and noncash payments which may be obligations extending over time and conditional upon subsequent commercial outcomes. Opportunity Discovery, Valuation, and Dealmaking as discussed in this book is far richer and more complex than a litigation context.

High Significance, High Ambiguity Contexts

Another way of envisioning the scope of this book is shown in Exhibit 1.1.

As illustrated, Dealmaking opportunities can be segmented by potential value (high and low) and ambiguity of key business terms (again high and low):

- *Low potential value and low ambiguity*. A significant analytical investment in technology Licensing D-V-D is not usually warranted; the low ambiguity condition corresponds to the substantial availability of business information, such as revenues, margins, market, new production growth potential, and so on. In such circumstances the direct use of comparables and rules of thumb can be all that is needed. Opportunities in this quadrant can be (and need to be) valued and transacted relatively quickly at low Dealmaking cost in order for them to be worth doing.

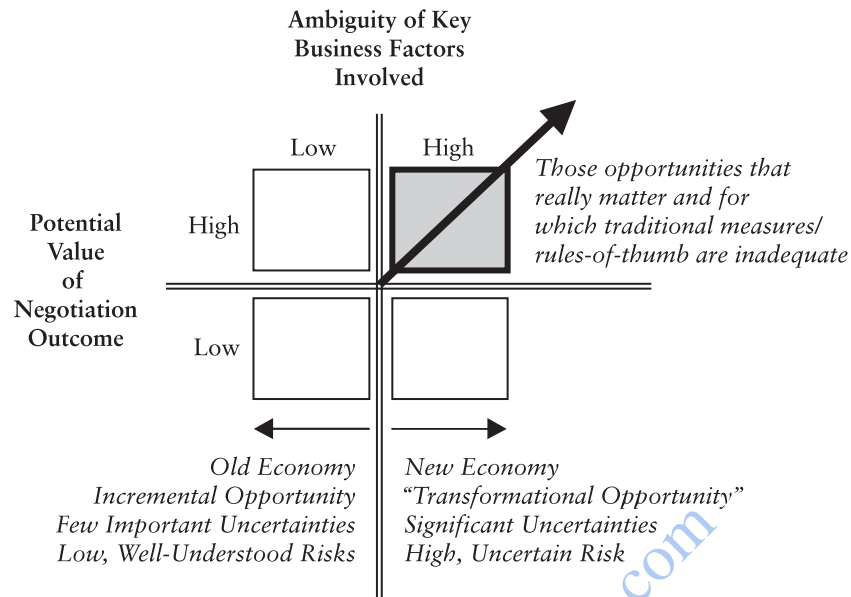


EXHIBIT 1.1 High Value, High Ambiguity Opportunities

- *High potential value and low ambiguity.* A greater investment in Licensing D-V-D is warranted to confirm the abundant business information and rationalize it for valuation, negotiation preparation, and agreement purposes, the Methods and Tools of this book can supplement and assist more traditional valuation tools and methodologies.
- *Low potential value and high ambiguity.* The power (and complexity) Technology Licensing D-V-D can be of value but a high level of effort in its application may not be warranted (if, indeed, the opportunity has low potential value).
- *High potential value and high ambiguity.* This is the “sweet spot” for Technology Licensing D-V-D: there is both a lot at stake and traditional data and methods are likely to be inadequate. This quadrant is sometimes characterized by colloquialisms that express the high potential opportunity with the corresponding, inherent uncertainties in the underlying technology, market, or business operation. For example, “transformational,” “game-changing,” revolutionary, disruptive, new paradigm or paradigm shift, step change, upset (or “tipping point”), “killer app” (deriving from “killer application,” often used in software, or quantum leap²). When such terms are used they are a strong indication that the opportunity is high potential value and, though it may not be overtly recognized, high ambiguity (low certainty) often because the transformational model is not achieved by some incremental, obvious new product adoption and growth pattern.

The Perils of Short Cuts

Over the past decade, with the emergence of the Internet and World Wide Web (WWW), the rapidly increasing power at a rapidly decreasing cost of personal computing, the ubiquity of mobile communication (phones, pagers, PDAs, and laptops)

provides “the Internet and worldwide connectivity in your pocket.” In addition, the corporate information technology (IT) revolution in content availability, data mining, and networking (Ethernet, LANs, VPNs, WiFi, WiMAX, etc.) has together fostered a maelstrom of new business ideas (e.g. Web 2.0) and a premium on decision speed (“Internet time”). For a while it appeared that every new business idea promised to revolutionize how we lived and worked. These ideas were clearly touted as high opportunity and even the ardent believers generally admitted that they had attendant high uncertainties. At work was another force, time ultra urgency. These opportunities were so compelling, it was thought, and so competitively pursued that there was little time to analyze, quantify, or even, it seemed, to think. It was said that no one could do “Ready, Aim, Fire!” It had to be “Ready, Fire! Aim” or, as it was in many cases, just “Fire! Fire! Fire!” and hope you hit something worth the effort. Even our vocabulary reflected the new urgency by the then common usage of “Internet time.” Its initial use was in circa 1994. During that year, the *Wall Street Journal* used the term in its writings just four times; in 2000, it was used 43 times.³ The term conveyed an idea that expressed a behavior that reflected a core belief: The rates of change were so dramatic that time for reasoning was scarce or even nonexistent and the opportunities for success so abundant that the absence of reason was insignificant. Put another way, doing something, anything, had higher value creation opportunity than could be captured by any reasoning process requiring more than the proverbial 15 minutes.

In such absence of reasoned analysis, how were opportunities valued and chosen? Well, the obvious global answer as one surveys the smoldering ruins beginning in 2002 is “not very well.” But, specifically, pursuers of such high value/high ambiguity opportunities used two primary methods: (1) simplistic rules of thumb and (2) unstructured auctions. Among the examples of simplistic rules of thumb was the use of \$2 million per software “developer” employed in valuing a potential software acquisition target. So, using the first method, if you were considering buying a software company with nominal revenues, but nowhere close to net earnings, with 500 “developers,” you would be prepared to pay \$1 billion.

The second method was the use of informal auctions. Potential sellers of opportunities had multiple pursuers. This situation enabled them in many cases to play one bidder off against the other in an informal auction process that they, the seller, controlled. This auction was informal because in most cases the buyers did not know who the other interested parties were, or even if there were truly other interested parties or actual bids. Additionally, there were no standardized rules of engagement such as those which exist, for example, in stock or commodity exchanges or even bankruptcy court auctions. The motives of greed for gain and fear of lost opportunity led many buyers to bid and pay for opportunities far in excess of what they now appear to be worth. The examples of such overpayment are legion. Are auctions really markets, and are markets not reliable? The answer to both questions, in the case of informal auctions when there is a frenzy of buyers with money chasing the ‘next big thing’ is “no.” Could not a potential buyer have, instead, resorted to advanced valuation tools and methods such as those that are considered in this book? At the time of the technology bubble in the late 1990s, a common view was “no” because, it was widely thought, that by the time they completed even a cursory analysis the opportunity would have been sold to a buyer unfettered by such concerns who simply looked it over and topped the previous and all competitive bids. A similar

BEFORE A FALL . . .

Merrill Lynch initiated coverage of InfoSpace in December 1999 with a rating of “accumulate-buy” and a price objective of \$160. The company’s share price fell much faster than its rating.

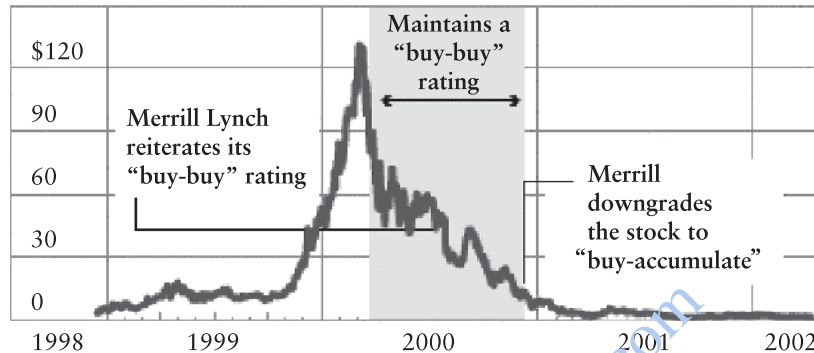


EXHIBIT 1.2 Buy Recommendations by Merrill Lynch for InfoSpace

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propensity to favor speed over reason may have contributed to collapse in value of complex “financial products” created, packaged, and traded in recent years up until late 2008.

Selecting one illustrative proxy for this point is difficult because there are so many to choose from. Exhibit 1.2 presents an easy to understand technology bubble example, namely, the public recommendations by a well known brokerage firm (Merrill Lynch) with respect to a high-flying Internet (.com) startup (InfoSpace). We will return to InfoSpace when we consider the valuation of various technology equities.

Consider the following as a benchmark for a poor return-on-investment standard. One can purchase a 12 pack of say, Coke[®] for about \$3.00 in no deposit states or for \$3.60 in the five states requiring deposits of five cents per aluminum can. After consuming the Coke, one’s “return” would be 95 percent loss of invested capital in a no deposit state (each can is 1/29 of a pound and a pound of recyclable aluminum cans is worth about 40 cents) or 83 percent loss of capital if you live in NY, CT, MA, VT, ME, IA, or OR; for those in Michigan (ten cent deposit) the loss of capital would be only 71 percent, and for Californians (2.5 cents) 91 percent. So, we might say that, on average, the “just-drink-your-investment” experiences a loss of invested capital of 90 percent. For many Fire! Fire! Fire! dealmakers, they would have done better in terms of enjoyment and return on invested capital to have purchased Coke, the soft drink itself (not the company) than many of the 1995–2000 merger and acquisition (or equity) investments, the most recent mania, many of which have exhibited

declines in value exceeding the just-drink-your-investment benchmark. This same aluminum can returns have likewise occurred in 2008 and 2009 for certain financial companies. Although financial markets are very different from the technology and Internet examples, there is an underlying similarity, an undervaluation of the price of risk.

We now know that there are allegations that brokerage houses compromised their judgment on stock value by their desire to win investment banking business, which may have been joined with less than well considered merger, acquisition and other Dealmaking advice. Similar motivation and lack of prudence appears also to have contributed to the collapse of multiple forms of investment vehicles created, marketed, and sold by financial companies. Whether, or to the extent, there has been fraudulent or recklessness in making public recommendations of such opportunities, they would not have been effective if the public markets in large part did not find such counsel credible. The point is that investors and dealmakers, with all the reasoning opportunity in the world, believed such prognostications, to their (in many cases) financial detriment.

Dealmaking preparation either by quick and dirty rules of thumb or informal auctions can lead to very damaging results. However, business is about exigency; a scholarly, methodical, patient inquiry into all matters relevant to a potential negotiation is simply not an always practicable option. What is needed are reasonable, powerful, quick-to-apply and -interpret Tools and Methods that can assess opportunities and prepare for negotiation. So urgency in preparation is important, but not to the exclusion of a rational, defensible analysis. Developing a rapidly deployable methodology using valuation tools is what Licensing D-V-D and this book are about.

The Challenge of Close Calls

In most business situations one frequently deals with “close calls,” meaning the go/no-go decision with respect to a particular offer is difficult. If we consider for a moment the internal decision of whether to go forward with some particular investment project, it can be argued that the level of analysis should take into account that all that is needed is the answer to the question of should we go forward or not. A common and powerful tool for making such determination is the discounted cash flow analysis leading to a net present value (NPV). In the case of internal project investment decisions, we can perform a simplistic NPV analysis to sort out those obvious opportunities that have strongly positive NPV values and accordingly should be undertaken, and those that have strongly negative values and should be killed.

In Dealmaking contexts, as opposed to internal investment analysis, near zero NPV projections can occur more commonly. Consider for a moment a seller and buyer each using the same data on which they make projections and the same overall business assumptions. Their calculation of NPV will be identical but for small differences perhaps in some secondary assumptions. In this situation, the seller will try to capture in its sales price the entire positive NPV under the argument that so long as the opportunity has any positive value, a buyer should say “yes” to the deal and terms proposed. Thus, sellers are by their self interest offering terms that

create near zero NPVs for the buyer, to the extent the market (the population of all potential buyers) permits. If there are multiple prospective buyers who then engage in a formal or informal bidding context, they will each be driven to increase their bids up to the limit of a zero or near zero NPV.

So it is common in Dealmaking contexts that the decision to proceed or not, from both the seller's and buyer's perspectives, ends up being a close call. In contrast then to many internal investment decision making situations, the natural contest and context of negotiations warrants the use of the Methods and Tools we discuss in this book.

Licensing D-V-D and Innovation

The focus of this book has been circumscribed by the term Technology (or) Licensing D-V-D. This subject is interconnected with three other important disciplines. One of them is the law of Intellectual Property (IP). It is such law that enable enforceable ownership rights. Two other important subjects are technology creation and entrepreneurship, which together can be termed "innovation."

A graphic of how the subject of this book interconnects with these other three areas is shown in a Venn Diagram in Exhibit 1.3. It includes the horizontal box

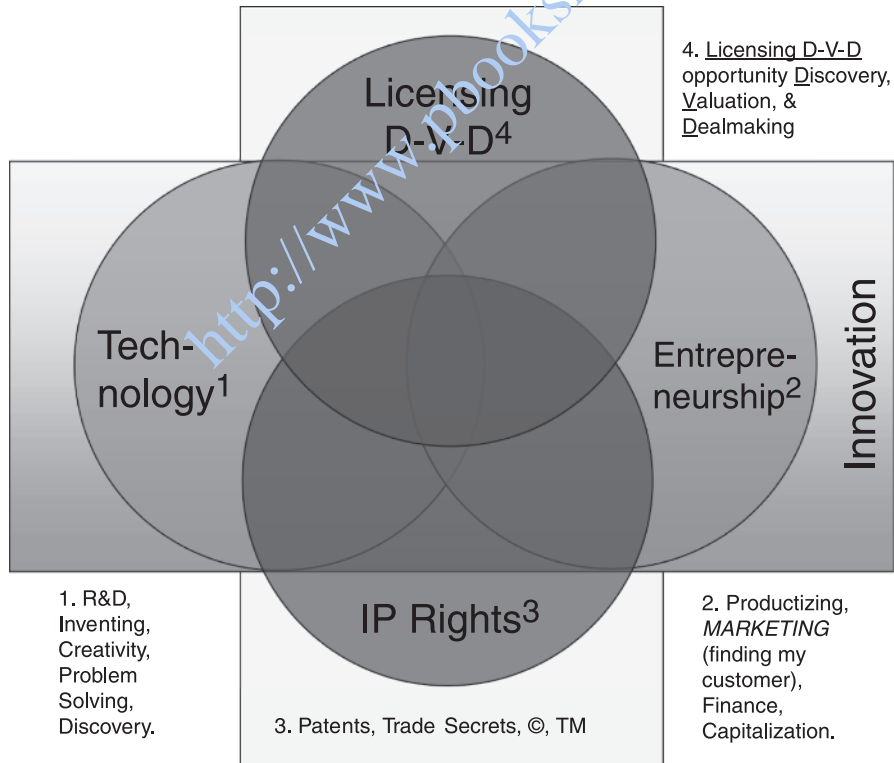


EXHIBIT 1.3 InterConnections of Licensing D-V-D

labeled Innovation, comprising Technology + Entrepreneurship. This is the conventional axis of a technology company's process of creating value for its customers and owners by the transformation of R&D results into products and services. Underlying Innovation is the establishment of IP rights that protect such investment and value.

Licensing D-V-D circle is shown in the Venn Diagram as overlapping all three circles. In some situations, there has been limited entrepreneurship, and Licensing D-V-D builds on Technology and IP Rights. This could occur because a university, institute, or private inventor developed the technology. It could also occur in situations when a company has technology opportunities for which it has not made entrepreneurial investments. In other situations, the technology could have been matured significantly along the Innovation box. In either situation, Licensing D-V-D provides an important commercialization pathway that does not require the technology's creator/owner to undertake commercial development into its own products and services. So, in a real sense, Licensing D-V-D is an always possible alternative to self commercialization. Sometimes such alternative is just an equivalent alternative, other times, a less desirable but necessary alternative, and still other times it is the best of all possible future worlds.

In the sub-sections below we will briefly consider certain proxies for size and scale of the four circles of Exhibit 1.3. We will focus on the most recent published data, 2006 and 2007, for the United States. Our purpose here is not to provide an exact analysis but to give some content and scale to these terms. The values reported below, as in U.S. dollars, are rounded and approximate. The reader is referred to the citations for the exact source data.

"Technology" as Measured by R&D Data

Industrial R&D spending is not exactly the same thing as "technology" as shown in Exhibit 1.3. But, annual R&D spending is a reasonable proxy for at least the *cost*, though not the *value*, of annual new technology creation.

R&D PERFORMED BY INDUSTRY R&D spending is a budgeted category, which is tracked and reported by companies on their income statement as part of a component of its overhead expenses along with sales, marketing, distribution, and administration. The U.S. National Science Foundation (NSF) has most recently reported on R&D Industry spending for the year 2006 in a report issued in August 2008:⁴

- Total spending was \$250 billion, 95 percent of which can be grouped into three broad categories:
 - Two-thirds was spent in "DICE" industries, where DICE is my own designation for Digital Information Computing Electronics, which includes software and instrumentation, computer systems design, but not medical instrumentation.
 - 20 percent was spent in "Health" industries, which I have aggregated to include pharmaceuticals and medicines, as well as medical equipment and supplies, in addition to healthcare services.
 - 10 percent was spent on Aerospace, and Machinery combined.

- Total industrial revenues were \$6.6 trillion, so R&D spending represented an industry average of 4 percent. 40 percent of total R&D spending occurred in three groups:
 - DICE revenues were nearly \$1.8 trillion, so its R&D percentage was nearly 10 percent.
 - Health revenues were under \$400 billion, with an R&D percentage likewise just under 10 percent.
 - The revenues of segments Aerospace and Machinery combined were over \$500 billion combined, with an R&D percentage of 5 percent.
- There were more than 1 million R&D scientists and engineers in all industry segments; 80 percent were employed in three groups:
 - 60 percent were employed in DICE industries
 - 10 percent in Health industries
 - 10 percent in combined Aerospace and Machinery

There has been an important transformation of the source of such R&D funding. Up through 1978, just some 30 years ago, the U.S. government funded more than 50 percent of total U.S. R&D; the peak percentage was 67 percent in 1964 during the peak spending years on Apollo (and which helped pay my salary as a then “rocket scientist”). In 2006, the year the listed data were obtained, industry paid 72 percent of the R&D bill. That 67 percent government to 72 percent industry is a remarkable shift in less than 50 years.

R&D PERFORMED BY UNIVERSITIES, INSTITUTES, AND RESEARCH HOSPITALS Another very important category of R&D is that which is done at U.S. universities and institutes, including research hospitals. These data have been collected and published annually by the Association of University Technology Managers (AUTM). The most recent data is for Fiscal Year (FY) 2006. For 2006 the total reported R&D (“research”) funding was \$45 billion. More than two-thirds of such funding was by the U.S. federal government. Nearly 20,000 invention disclosures were reported by 190 survey respondents, which resulted in more than 10,000 new patent applications filed; also during 2006 more than 3,000 U.S. patents were issued (emanating almost entirely on filings in prior years). During the most recent three years, the reporting organizations filed patents on 60 percent of the disclosures received compared to less than 30 percent for years prior to 1995.

TECHNOLOGY DICE AND THE LITTLE ELECTRON Someone has estimated that 70 percent of the U.S. economy depends directly upon the manipulation of the electron. As first that may seem hard to believe, until one tries to list the industry segments that do *not* materially depend upon such manipulation. And it is remarkable to recognize that the discovery of the electron was just over 100 years ago (1897).⁵

TECHNOLOGY AND “CREATIVITY” Technology creation is connected to the encompassing subject of “creativity,” the ability to create, or state of being one who creates, from the Latin word *creatus*, meaning to make or produce. Creativity of course exists in many domains outside of technology. When it is used with respect to technology it expresses the idea of bringing something new into being, and often with the flavor of the unexpected, or unpredictable. In this sense, creativity is also a key

element of entrepreneurship, though the context is then more about “productization” of a technology, customer/market creation, and new business formation, though the lines blur. Here I have taken the two, technology creation and entrepreneurship, as together being “innovation.”

There is a vast literature on fostering technology creativity and entrepreneurship. The reason for such interest, beside just the natural delight in observing it, is the widespread recognition of the importance of technology creation in economic development, meeting human and national needs (real and invented), and competitiveness (corporate and national).

TECHNOLOGY AND “SO WHAT?” Because this book is about discovering, in the sense of recognizing, significant commercial opportunities based on technology, valuing them, and Dealmaking with them, there is an intrinsic issue known as the “So what?” question. Such question arises in many frameworks, and contexts:

- *En emoī?* Ancient Greek for “What is it to me?”
- *Tai, kai?* Lithuanian for “So?”
- *Where’s mine?* The classic city politician’s expression

Creativity in technology, as opposed to say creativity in the field of art, is about what can the created thing actually do, and why such doing matters. The “So what?” question answer for “technology” differs from the answer for “science.” For science the answer⁶ is twofold:

1. *Explanation:* “theories that render intelligible and unsurprising phenomena that would otherwise seem incomprehensibly mysterious”
2. *Prediction:* “theories that can accurately and precisely predict the phenomena in their domains, in a non *ad hoc* fashion”

For “technology” the comparable definition is elusive. Using a parallel two factor definition, this is my attempt:

1. It is the craft, and art, of applying “science”
2. It moves toward some useful, economically justified benefit

The “craft/art” component is made actionable by **Approaches** (processes), **Methods**, and **Tools**, or **A-M-T** the organizing framework for this book—presented for the purpose of identifying, assessing, and Dealmaking the “useful, economically justified benefit” component.

It is common that with any pronouncement of something new there is an accompanying declaration answering the “So what?” we all ask. We will spend the rest of this book on **Approaches**, **Methods**, and **Tools** to prioritize, quantify, and communicate the answer. Here, let us think about a phenomenon of technology classification in terms of perceived significance.

Broadly speaking, claims about “So what?” for technology can be distinguished into two groups as shown under the headings shown in the accompanying table: “A Really Big Deal,” and “Not So Big a Deal.”

| A Really Big Deal | Not So Big a Deal |
|--|--|
| Major | Minor |
| Breakthrough | Improvement |
| Foundational | Enhancement |
| Transformative | Incremental |
| Revolutionary | Routine |
| Next Generation (e.g., G3) | Current Generation (e.g., G2) |
| Web “N + 1” (e.g., 2.0) | Web N (e.g., 1.0) |
| Next Wave | Same wave |
| Quantum Leap ⁷ | Next Step |
| Great Leap (forward) | Next Step (up) |
| Paradigm Shift ⁸ | Same declinations, conjugations |
| Game Changer | Same old game, but some new pieces |
| Tomorrow | Coming later this afternoon |
| Sea Change | Same old sea |
| The Pirate Ship that Sailed into the Yacht Club Harbor | <i>Little Toot</i> , “the little tugboat that could...” by just trying harder |

A great many technology pronouncements use some terms from the left, “Big Deal” column, especially words like “breakthrough.” A recent study of company press releases has documented a dramatic increase (one might say, a breakthrough) in the frequency of the use of “breakthrough” to describe some new technology or product. Factiva Consulting Services found more than 8,000 press releases with the word “breakthrough” in just the headline (which, I suppose, if it is a breakthrough it should be in the headline).⁹ A potential new software product idea, which idea I am giving away here for no extra charge, would be a word processor (1) that does not bomb with regularity, and (2) automatically sprinkles adjectives from the “Big Deal” column into a just-the-facts description of a new technology; it seems to me this could be a breakthrough product.

There are many challenges in making such “big deal” vs. “not big deal” distinctions:

- There is continuous spectrum from the really really big deal inventions, to the really really small improvements.
- “Technology” can be further subdivided into functional components:
 - Applied research
 - Development, demonstration
 - Manufacturing
 - Marketing
 - Service
 - Product/service continuous enhancement
- Almost everything belongs to some chain of history, meaning very few new technologies are genuinely without prior precedent.

But, perfection is for the next life. Making distinctions as best we can is both useful and necessary, especially when we are trying to distinguish and identify those things, including technology, that are of value: “No greater good can happen to a

man than to discuss human excellence every day.”¹⁰ We will address the subject of distinctions in Chapter 2 when we consider risk and uncertainty.

BREAKTHROUGH PATENTS To demonstrate the distinction between the above two categories of inventions, let us here consider two breakthrough patents:

1. **2,708,656 (May 17, 1955) “Neutronic Reactor,” Enrico Fermi and Leo Szillard.** This patent was awarded to the invention of the chain reaction method of nuclear fission that is the basis by which the more than 100 nuclear power plants in the U.S. (and many hundreds more around the world) operate. Fermi and Szillard were giants in the field. The technology embodied in this patent was a clear breakthrough, though economically it is unlikely to have been valuable for the inventors because of the very long period of diffusion of such technology from R&D to commercial use.
2. **2,297,691 (October 6, 1942) “Electrophotography,” Chester Carlson.**¹¹ This was the first of more than 100 patents invented by Chester Carlson, and his commercialization partner, Battelle Memorial Institute, that founded xerography. (The name xerography was “invented” over dinner across the street from Battelle in Columbus, Ohio during a discussion with an Ohio State University classics professor who suggested it because “xeros” is the classic Greek word for “dry” and “graphy” for writing). It was subsequently licensed to the Haloid Corporation which changed its name to Xerox[®] and founded an entire photocopying industry, and later with its Palo Alto CA laboratory (the famous PARC labs) created significant technologies that led to the personal computing industry. Although the basic xerography patent had expired before first significant commercial sales began (the Xerox 914 copier introduced in 1959), the many important follow-on patents created an important licensable package of IP rights, which led to substantial revenues for Xerox[®], Battelle, and Mr. Carlson.¹²

Both of these patents are recognized among the more than 100 inventors (with their patents) inducted into the National Inventors Hall of Fame.¹³

NOT BREAKTHROUGH PATENTS This category is a long one. Let me suggest two as examples:

1. **6,239,919 (December 11, 2001), assigned to IBM Corp.,** the annual leader in U.S. patents granted every year for more than a decade. This particular invention is for a reservations system of restrooms in commercial airplanes. Much like at a butcher counter, where you get a numbered ticket, whereupon you wait for your number to be called, this invention provides you a place in a virtual line to use the aircraft’s facilities.
2. **6,368,227 (April 9, 2002), “Method of Swinging on a Swing,” Steven Olson.** This invention is: “A method of swing on a swing is disclosed, in which a user positioned on a standard swing suspended by two chains from a substantially horizontal tree branch induces side to side motion by pulling alternately on one chain and then the other.”¹⁴

“Entrepreneurship” as Measured by Intangible Value and Venture Capital Investments

There is no simple corresponding measure for “entrepreneurship.” One very approximate measure is total intangible value reported on the balance sheets of companies. (A balance sheet is the measure of all a company’s assets and liabilities as of a point in time, the year end of its fiscal year. Asset classes include familiar “things” like cash, accounts receivable, which should become cash, physical plant, property, and equipment. While “intangible assets” are a measure of its company value, a broad asset class that is not such a “thing.”).

The accounting for intangible value and the interpretation of its practical meaning, is by no means a straightforward subject. One widely cited paper, written for the Federal Reserve Bank of Philadelphia by L.I. Nakamura,¹⁵ estimates U.S. companies invest at least \$1 trillion annually in intangible assets. Such a figure is approximately equal to the annual investment in tangible (nonresidential assets).

A more concrete comparison between the R&D component of intangible asset creation and investment in tangible assets can be seen from a *BusinessWeek* study of the 10 largest U.S. companies over the period 2000 through 2005. These companies reported an increase in their combined annual R&D spending of \$11 billion or 42 percent over this period, while their capital spending increased by only \$1 billion or 2 percent.¹⁶

Venture Capital (VC) spending is one measure of entrepreneurship investment. VC is high risk investments in companies that cannot readily access debt financing and are not yet public with availability of equity financing. Venture Capitalists (VCs) are making high risk investments in creating entirely new companies or expanding nascent ones. (We will return to this category of investment in Chapter 10). In the period 1995 through mid-2002, nearly 15,000 companies received VC investments. Although the “boom” VC years of 1999–2000 have abated, U.S. VCs still invest about \$25 billion a year in 3,000 deals, which corresponds to approximately 10 percent of the total industrial R&D investment discussed above. Such monies are typically not for research, and some would argue there is not much spent on R&D either; this investment is primarily directed to the “Ds” of development and demonstration, especially market demonstration. But for technology or technology application, such investments can be considered as measures of entrepreneurship.

Companies of course make entrepreneurial-like investments in “business development” (biz dev, as it is known), an activity beyond just technology creation. Beyond this, some companies also have a separate initiative generally known as “corporate venturing,” for creating entirely new business outside the mainstream of their current operations. Both kinds of company investments are not typically reported even for public companies. However, most technology companies have very senior titled positions such as Chief Technology Officer, or Vice President (VP) of Strategic Development, or some similar permutation. Such people are considered to have important creation responsibilities of businesses and markets that are not presently an important source of revenues and earnings.

The literature of corporate innovation, “creating businesses within the firm”¹⁷ is overwhelmingly large. The subject is the corollary of all the stock picking books published for private investor consumption. Whole consulting industries, creativity workshops, team building, and such exist to help companies be more innovative.

Various companies have from time to time been noted for formal programs of “corporate venturing,” also termed “intrapreneurship,” including Xerox/PARC, Thermo Electron, and Tektronics.

INNOVATION EXAMPLES One interesting list was developed by *Forbes Magazine*. It published its list of the 85 “most consequential innovations since 1917,” one per year.¹⁸ Some examples on this list are:

- 1917, Sneakers (U.S. Rubber introduced “Keds”)
- 1924, Frozen Food (Clarence Birdseye)
- 1930, Jet Engine (Sir Frank Whittle)
- 1962, Telstar I (first communications satellite)
- 1972, Ethernet (Xerox PARC)
- 1976, The Personal Computer (Steven Jobs, Stephen Wozniak)
- 1991, World Wide Web (Tim Berners-Lee)

The technology foundation within each of these examples is only an element of their high value “So what?” answer.

DIFFUSION OF INNOVATION There is significant literature on the “diffusion of innovation,” meaning the rate and character of technology/innovation adoption. There is a common model known as the S-Curve that we will discuss in Chapter 8.

The classic model was published by Everett Rogers¹⁹ based on a Normal (Gaussian) distribution (which we will cover in detail in Chapter 8) of adopters (buyers) in five distinct groups, who adopt the technology in sequential waves:

- Innovators (2.5 of the of the total)
- Early adopters (13.5 percent)
- Early majority (34 percent)
- Late majority (34 percent)
- Laggards (16 percent)

The cumulative adoption corresponding to a Gaussian rate is an S-shaped curve, with asymptotes at the beginning (slow growth in adoption) and at the end (slow growth at the end), with a rapid growth rate in between.

Any Normal Distribution of adoption rate, however such a *rate* is characterized or sliced, will exhibit an S-shaped cumulative *adoption* curve.

One measurement of adoption has been the time from invention until 25 percent penetration of U.S. households. For the telephone (invented in 1876) it was 35 years for such 25 percent penetration. The television (1927) took 26 years. More recent technologies, especially based on Moore’s Law²⁰ exhibit much faster rates: The PC was 16 years, the mobile phone 13 years, and the Internet 7 years.

An example of one extensive data source²¹ on innovation diffusion is given in Exhibit 1.4. The S-shape is the general pattern, but like much of real world data, it is a little messy.²²

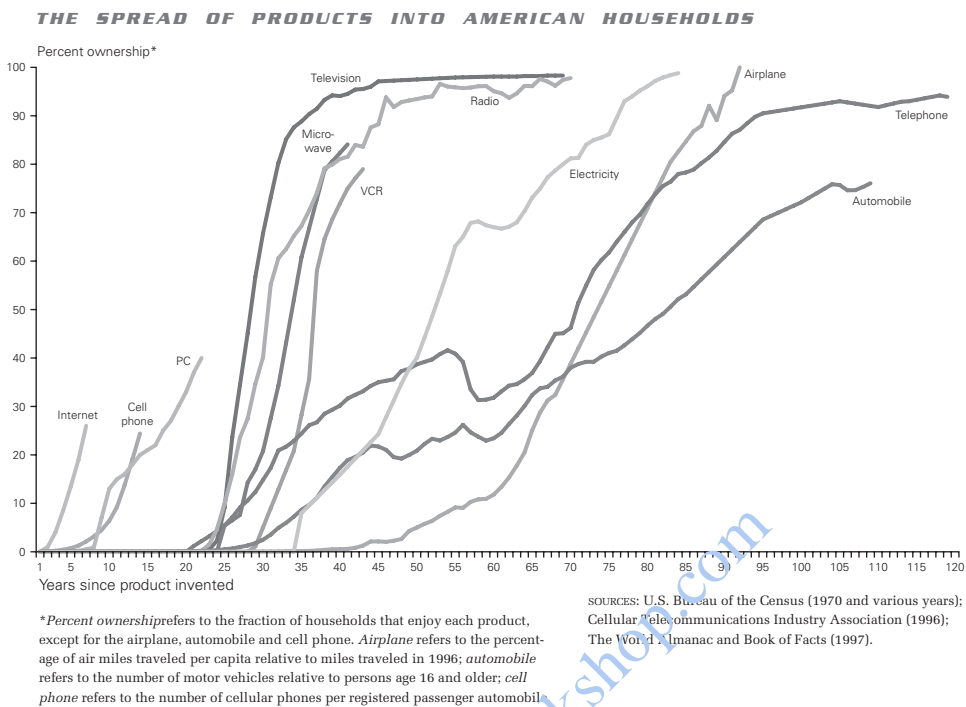


EXHIBIT 1.4 Diffusion of Innovation Historical Data

THE “NEW ECONOMY” The subject matter of many business negotiations is changing as fundamentally as the economic structure of the businesses themselves, from being about the value of tangible things such as machines and buildings, to the right to use intangibles such as information and technology. This shift in underlying business value is often characterized by the term New Economy. Although a full discussion of what constitutes such a New Economy deals with broad issues of economic theory and is beyond the scope of this book, it is useful for us to consider some concrete examples. Just over 100 years ago (in 1901) the first U.S. company to emerge with a market value of \$1 billion (\$1.4 billion in authorized capitalization) was U.S. Steel. (\$1 billion in 1901 is approximately equivalent to \$40 billion in 2008.) It achieved such valuation primarily through property, plant, and equipment (PPE), three traditional measures of industrial, tangible value. U.S. Steel, which became the company known as USX in 1986, was an icon of the new industrial age and the Old Economy. The company in 1901 owned 213 manufacturing plants, 41 mines, 1,000 miles of railroad and employed more than 160,000 people. U.S. Steel’s book value, as measured by accountants and reported on the company’s balance sheet was substantially determined by its PPE and closely reflected such market value.

One hundred years later, in 2001, the most valuable company in the United States was Microsoft, an icon of the information age and the New Economy, when it reached a market capitalization²³ (or market cap) of \$400 billion. We now know that in 2001 there was a “bubble” over valuation of technology companies, including Microsoft. In 2008, its value had fallen to \$200 billion (and less). Its book value of PPE in 2008 is \$13 billion, so the ratio of market cap to PPE book is still a dramatic 15 to 1. How can this be? Microsoft’s value lies in the very significant intangible

value associated with Microsoft's copyrighted software, which is just a string of 1s and 0s, bits, in an archived Microsoft facility; know-how and patents, along with its trademark and tradename value.²⁴

Yet another measure of the transformation of the U.S. economy is evident in transportation. In the first decade of the 20th century, ca. 60 percent of companies traded on the New York Stock Exchange were railroads, entities that stored and shipped things with mass. During the first decade of the twenty-first century our market economy is led by companies like Microsoft, IBM, Cisco, AT&T that store and ship massless data bits.

Think of the effect on a negotiation to buy or sell some component of the respective assets of a U.S. Steel in 1901 versus Microsoft in 2001. In the case of U.S. Steel we would be characterizing something tangible using available standards of reference for transactions of other like tangibles to guide both our valuation and negotiation preparation.

Estimates have been made of the value of IP to the U.S. economy. One recent estimate by Shapiro and Hassett²⁵ is the following: IP in the U.S. is worth more than \$5 trillion, which exceeds the nominal gross domestic product of any other nation. One has only to Google “\$5 trillion Shapiro” to see how widely cited is this claim. For example, the Global IP Center of the U.S. Chamber of Commerce²⁶ and even Congressional testimony²⁷ in addition to amicus curiae briefs filed before the U.S. Supreme Court,²⁸ and more recently in 2009 in the context of re-introduction of patent reform legislation,²⁹ where appended to the citation of \$5 trillion was a statement that such IP value represented “nearly 70 percent of corporate assets.”

“IP” as Measured by Patent Data

IP is more than just patents, but number of patents applied for and insured are usefully quantified figures that are reasonable proxies for the growth in investment in IP.

There are approximately 1.6 million U.S. patents currently unexpired out of more than 6 million that have been issued since 1790, including one to Abraham Lincoln. All these patents, as Judge Randall Rader of the Court of Appeals of the Federal Circuit (CAFC) has pointed out, are gifted to society upon their expiry, more than 4 million so far, and in another decade the total will be approximately 6 million.

In just calendar 2007, the U.S. Patent and Trademark Office received more than 450,000 “utility” (for our purposes “technology”) patent applications (nearly 10,000 a week!), and issued (granted) nearly 160,000 (more than 3,000 every Tuesday). Of course the patents applied for in 2007, in most cases, were not the ones that issued in 2007, because of pendency issues. Such figures include both U.S. and foreign inventor filings and issuances for U.S. patents.

In 1964, the referenced year of peak government investment (see the section R&D Performed by Industry earlier in this chapter) as a percentage for industrial R&D, the respective number of applications was under 90,000 and issuances 45,000. So, over this period the number of annual patent applications has increased by a factor of five, and issuances by a factor of nearly four.

The categories of technology patents have also changed. In the early 1980s “software” patents were a tiny percentage of the total; currently they represent approximately 15 percent of all patents issued.

Trade secrets, another form of IP rights, encompass a wide array of know-how valuable to the application of a technology that is not publicly known. There is no comparable registry or tracking means as there is with patents. Yet for many technology opportunities, trade secret IP is an important component of value.

RELATIONSHIP BETWEEN R&D SPENDING AND PATENTS A correlation between R&D investment magnitude and resulting number of patents is problematic at least because trade secret protection of technology does not get counted. Yet, there has been interest in this relationship. One comparison was reported by *Fortune Magazine* of seven large pharmaceutical companies in the period 1996 to 2001.³⁰ They found that these companies spent a widely varying amount of R&D per patent obtained: from \$6 million per patent (Merck, and Pharmacia) to \$26.5 and \$74.5 million (for Wyeth and Schering-Plough, respectively), with Eli Lilly, Bristol-Myers Squibb, and Pfizer in between these bounds.

As another benchmark, IBM receives about 3,000 U.S. patents a year, and spends about \$6 billion annually on R&D. So a simple ratio yields \$2 million per patent.

“Dealmaking” (of Licensing D-V-D) as Measured by Licenses and Royalties

There is no known measure of technology Dealmaking across the entire U.S. economy. The U.S. Internal Revenue Service (IRS) has reported on its analysis of corporate tax returns for “royalties” reported. For 2002 the total reported royalty income for active corporations was \$115 billion, but this includes copyright royalties for media and natural resources such as oil field royalties. The IRS reported \$73 billion for the “manufacturing” sector, and \$5 billion for “scientific and technical services.” The \$13 billion reported for the “information sector” includes copyright media royalties.

The best known source of Dealmaking data is the cited AUTM annual survey. For FY 2006, AUTM reported the Dealmaking data shown in Exhibit 1.5.

The top 25 respondents had a total licensing income in FY 2006 of \$1 billion, led by the University of California system with nearly \$200 million and New York University with more than \$150 million. 26 universities had licensing revenues

EXHIBIT 1.5 Dealmaking Data for AUTM Survey Respondents for FY 2006

| FY 2006 | Number of Respondents | Total Executed | Total Startups | % of Total | Small Companies | % of Total | Large Companies | % of Total |
|--|-----------------------|----------------|----------------|------------|-----------------|------------|-----------------|------------|
| U.S. Universities | 161 | 4,192 | 698 | 16.7 | 2,127 | 50.7 | 1,327 | 31.7 |
| U.S. Hospitals & Research Institutions | 28 | 755 | 66 | 8.7 | 289 | 38.3 | 321 | 42.5 |
| Technology Investment Firms | 1 | 16 | 0 | 0 | 0 | 0 | 0 | 0 |
| All Respondents | 190 | 4,963 | 764 | 15.4 | 2,416 | 48.7 | 1,648 | 33.2 |

between \$10 million and \$60 million. The top 25 universities had a combined annual license income of \$1 billion.

The ratio of R&D spending to current year number of patents ranged from just under \$3 million to nearly \$50 million for the top 25 universities in terms of license income.

Going Forward

In this chapter we have positioned the scope of this book in the broad context in which it belongs. In Chapter 3 when we discuss the package of assets that a technology owner-seller will offer to prospective licensees-buyers we will use the metaphor of The Box. We will assume that such Box will be encompassing the three lower circles of Exhibit 1.3, namely: (1) the technology plus (2) any available entrepreneurial results, (3) protected in some way by various IP forms. As we will see in Chapters 10 and 11 on Dealmaking, the licensee-buyer will provide consideration in trade likewise using a mosaic of values (which will be referred to as The Wheelbarrow). Such valuation and Dealmaking will be in the context of *opportunity* licensing, the focus of this book.

We introduced the core idea of making distinctions by creating discrete groups. This is a foundational idea for all that follows. In Chapter 2 we will have an expanded discussion on grouping, which, will recur when developing Rating/Ranking, risk classification, and other contexts.

In this chapter we noted the challenges of making forecasts of the benefits of the use/application of a technology. Yet making such forecasts is the basis of determining value, and so cannot be avoided. In Chapter 2 we will consider the effects of risk and uncertainty, factors particularly important to technology valuation.

Finally, we have given some sense of scale of technology. Massive annual investments are made in its creation, and its application to commercial use. All that ongoing investment and risk taking is for the purpose of making the world a better place and rewarding the investors, inventors, and entrepreneurs. Let us try to figure out how important technology opportunities can be discovered, valued, traded.

Additional information is available at my web site: www.razgaitis.com. In any writing, especially a long one, there are inevitable, maddening, errata; I will try to maintain a current list (contributions are welcome: errata@razgaitis.com). Also on the website are certain Excel[®] templates that are used in later chapters and a bibliography of other resources including interesting, relevant websites. Finally, there is a link to Oracle.com for a free trial of its Crystal Ball[®] Monte Carlo software that is used extensively in the Advanced Valuation Method (Chapter 8).

Notes

1. Aristotle defined *techne* as a capacity to do or make something with a correct understanding of the principle involved. So this book may be thought, I hope, as a *techne* about the business process of opportunity Discovery, Valuation, and Dealmaking of *techne* opportunities. (*Techne* itself comes from the Indo-European root *tektb* meaning to weave or join, which is the source of the Latin word *texere* meaning to weave or build from which we get the word *textile*.)

2. A quantum “leap” is likely the worst oxymoron in existence. A quantum is the *smallest* possible energy difference in the universe. What a “leap” in such context is meaningless, but the term “quantum” has some sex appeal so the phrase has entered our vocabulary.
3. “How Internet Time’s Fifteen Minutes of Fame Ran Out,” *Wall Street Journal*, October 28, 2002, p. B1.
4. Source: www.nsf.gov/statistics/infbrief/nsf08313/
5. Attributed to J.J. Thompson. There’s an interesting anecdote regarding Thompson’s announcement of its discovery: his audience thought he was joking, because it was widely accepted as dogma that nothing smaller than an atom could exist.
6. Prof. Edward Hall, “Philosophy of Science,” Massachusetts Institute of Technology, Course QM 24.111, 2 February 2005.
7. See footnote 2.
8. We have a widely cited book by Thomas Kuhn, *The Structure of Scientific Revolution* (University of Chicago Press, 1962), to thank for the introduction of “paradigm” into our common vocabulary. A *paradigm* is the rules of conjugation of verbs and declination of nouns. So a paradigm shift would be that instead of saying “I am, you are, and he is,” we might instead start saying “I am, you am, he am,” or “I are, you is, and he am.” It seems that “you is” is already catching on as we speak.
9. “Some ‘Breakthroughs’ Deserve the Title—But Not All,” *Wall Street Journal*, September 7, 2006. It can be argued that for an announcement to be warranted there is a perfectly appropriate bias toward the “big deal” category; minor inventions may just come into being without much drama.
10. Plato’s attribution to Socrates during his post-trial discussions with friends shortly before his death by forced suicide.
11. http://en.wikipedia.org/wiki/Chester_Carlson, www.lib.rochester.edu/index.cfm?PAGE=467, www.ieeeighn.org/wiki/index.php/Inventor_of_Xerography:_Chester_F._Carlson.
12. In my earlier career I was Vice President of Commercial Development for Battelle, and those xerography license agreements were part of our office’s files. In a delicious irony, those agreements were all *carbon copies* whose originals had been made in a mechanical typewriter.
13. <http://invent.org/>, http://en.wikipedia.org/wiki/National_Inventors_Hall_of_Fame,
14. Description from the patent abstract. The inventor made public that he was seeking licensees, whereupon I wrote and requested his term sheet for a nonexclusive license for the field of use of large Lithuanians; so far, five years later, no reply.
15. “What is the Gross Investment in Intangibles? (At Least) One Trillion Dollars a Year!” L.I. Nakamura, Federal Reserve Bank of Philadelphia, Working Paper No. 01-15, October 2001.
16. “Why the Economy is a Lot Stronger Than You Think,” *BusinessWeek*, February 13, 2006.
17. See, for instance, Zenas Block and Ian C. MacMillan, *Corporate Venturing—Creating New Businesses within the Firm*, Harvard Business School Press, 1993.
18. “Years and Ideas,” *Forbes Magazine*, December 23, 2002, p. 123ff.
19. Everett Rogers, *Diffusion of Innovations*, Free Press, 4th ed. 1995
20. This widely cited “law” is based on a prediction by Gordon Moore of Intel who, in 1965, predicted a dramatic rate of growth in integrated circuit capacity while, at the same time, declining unit price.
21. Federal Reserve Bank of Dallas, 1996: www.nationmaster.com/encyclopedia/Diffusion_of_innovations
22. One is reminded of the cartoon of a university campus physics lecture to dairy farmers in Wisconsin. On the blackboard is a very large, hand drawn circle (more or less). The caption of the wide-eyed professor’s opening remarks is: “First, we will assume a spherical cow.”
23. Determined by the number of equity shares times the price per share.

24. In both the U.S. Steel and the Microsoft examples, I have used market capitalization as the measure of company value. A more complete picture of total enterprise value would use the sum of equity and debt. In the case of Microsoft, debt is negligible compared to its equity value.
25. Robert J. Shapiro and Kevin A. Hassett, "The Economic Value of Intellectual Property," USA for Innovation, October 2005, p. 3. Dr. Shapiro was Undersecretary of Commerce for economic affairs under President Clinton, and has been a senior advisor to Al Gore and John Kerry during their presidential campaigns.
26. www.theglobalipcenter.com/NR/rdonlyres/ebynkgugywgpb7i6tclq3qotsjqu3xsguy4dj6jx xuyw2iys2uarb7yjteg52qka4ax4kxv63cyvt246w45knudcoh/gipc_ipbook.pdf
27. Testimony of Kevin Sharer, CEO and Chairman of the Board of Amgen Inc., before the Subcommittee on Courts, the Internet, and Intellectual Property, Committee of the Judiciary, U.S. House of Representatives, April 26, 2007.
28. Filed by the United Inventors Association, on Petition for a Writ of Certiorari, in the matter of KSR International Co., v. Teleflex, Inc. et al., October 16, 2006.
29. Press Club Speech, by Senator Orrin G. Hatch, given March 18, 2009, published <http://legaltimes.typepad.com/files/03182009-press-club-speech.pdf>.
30. "The 2003 Fortune 500," *Fortune Magazine*, March 30, 2003, based on an analysis by Merrill Lynch.

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