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Towards the (Strategic) Management of Intellectual Property: Retrospective and Prospective

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I. Introduction

The systematic integrated management of intellectual property (I.P.) is a recent phenomenon. This is despite the fact that intellectual property has been around for several centuries. Indeed, in 1421, the Florentine architect Filippo Brunelleschi received a three-year patent for a barge with hoisting gear, that carried marble along the Arno River. In 1449, King Henry VI granted the first English patent with a term of 20 years for bringing the invention of colored glass to England. Historically, inventor's strategies for capturing value from their inventions and innovators were usually simple. They typically involved manufacturing and selling products that used the invention. Occasionally value was captured by licensing the invention. Typically, a product, if protected, had only one patent behind it. Commercialization strategies were relatively simple.

Today, matters are more complicated, and integrated I.P. management is required. By integrated I.P. management we mean not only that the various forms of intellectual property (patents, trade secrets, trademarks, copyright) are managed together, but that intellectual property management is in turn integrated with overall business model design and corporate strategy. Integrated management is more than simply establishing a licensing model, or manufacturing a product which incorporates a new invention. When intellectual property is managed this way, a firm's go-to market strategy become intimately connected with their intellectual property positions. In our assessment, and in the assessment of authors in this special issue, commercial success is more likely when intellectual property is managed in this manner.

There are several themes which run through this special issue of the California Management Review. One is that, unfortunately, intellectual property management is too often left to the firm's legal department. This is an observation about practice, which is no longer viable, if it ever was. Another theme is that is not only important to bring strategy decisions and intellectual property decisions together; one also needs to bring marketing and branding into the picture. There is also a gentle reminder that if the firm is not in a good position through its intellectual property position to prevent copying of its own products, then licensing the intellectual property and/or sale of the intellectual property portfolio… at least those patents which are beyond the current area of strategic interest… should be actively considered.

II. The Global Economy has transformed.

Issues surrounding the management of technology have changed because the global economy has changed, and intellectual property rights have become more salient. The imperative for the integrated management of intellectual property stems from changes in the global economy and changes in business organization. Today's global economy is one that did not exist 50 years ago in quite the same way.

First, multi invention issues are now much evident. Today, most advanced products, particularly in micro-electronics, have a plethora of patents that are implicated. Not only does every product implicate

multiple patents, but such patents are usually owned by a variety of industry participants. This reflects the cumulative nature of innovation in many sectors, but particularly in microelectronics. Complex licensing arrangements are therefore needed… and frequently secured… in order to bring products to market legally.

Second, the sources of inventions are more dispersed. Because of the very success of capitalism, and in particular the development of East Asia, the dominance of North America and Western Europe in invention and creativity… and in the ownership of associated I.P. rights… has declined in the last half century. This has complicated licensing. There has been an associated tightening of intellectual property enforcement and a broadening of the geographic scope of intellectual property as economies that begin to generate invention become persuaded that their interests also lie in creating and enforcing intellectual property rights rather than simply "free riding" on innovations developed elsewhere, a development in many cases due to international treaties such as TRIPS. Copycat economics is on the defensive.

Third, the Internet has created new business model choices which are heavily dependent on I.P., or at minimum have an I.P. component. The Internet likewise has allowed new methods for distributing digital content (e.g. music) and undone traditional models of charging for it (e.g. sale of tapes, compact disks and vinyl records).

Fourth, the set of technologies which can qualify for patent protection has expanded. The courts have allowed new subject matter, e.g. business methods, genes to be patented.

Fifth, the greater significance of technical standards and the emergence of "platform" industries gives special significance to I.P., particularly when such platforms are extensive, and the number of I.P. users is large.

Finally, the market for I.P. has expanded. Not only has licensing increased dramatically; so has the sale of I.P. assets. There is by no means liquid open market for such rights. However, transactions in the market for knowhow and intellectual property have increased in recent years.

These Changes in the global economy, both separately and collectively, are requiring that both innovative and imitative firms place greater importance on intellectual property, and its management.

III. New Dimensions to Intellectual Property Strategy

The above factors have greatly complicated I.P. management. The number of dimensions to I.P. management that are now apparent has correspondingly increased. This includes first, whether and how to use patents, copyrights, and trade secrets in conjunction with each other. Second, the rapid expansion in the sources of invention makes outsourcing or "open innovation" strategies not only viable, but usually to some degree necessary. Third, the development of markets for I.P. renders the commercialization decision a complicated one. The traditional business model (of simply producing a product embodying I.P.) is no longer pre-ordained, if it ever was. The issue now is whether to sell a

product or license the I.P. to others or some hybrid version. Both represent viable business models in many cases. Hence, managers have options not previously contemplated. The proper assessment of these decisions opens possibilities and requires analysis not hitherto commonly practiced. Fourthly, appropriability strategies are not just limited to I.P. They are also a function of the nature of knowledge and the presence or absence of (cospecialized) complimentary assets. Fifth, R & D decisions are no longer just about funding inventions; they are more so than ever about assessing the availability and suitability of a coherent business model likely to enable profitability and the availability of the requisite complementary assets.

The above five factors by no means adequately summarize the plethora of I.P. management issues that managers now face. However, they are significant enough to demonstrate that new finesse must be brought to strategy in high tech industries. This finesse is unlikely to come from traditional business education alone, or from traditional legal education alone. The strategic manager must not just consult with legal advisors; they must become sufficiently savvy about the law to not be blindsided. This requires special education and special understanding.

Issues with respect to I.P. management usually come together under the umbrella of other topics, either in the executive suite, or in the boardroom. They also come together in the academic literature around issues of business model choices, capturing value (profiting from innovation) or appropriability concerns. Indeed, the profiting from Innovation framework first laid out in the 1980's showed, at least for a limited number of variables, how an integrated commercialization strategy could be developed for innovators.

a. The Profiting From Innovation Framework[1]

PFI addressed a puzzle that is not often well explained; namely, why do highly creative, pioneering firms often fail to capture the economic returns from innovation? It presented a framework for the integrated management of I.P., showing how I.P. worked together with other elements of the "appropriability regime" and complimentary assets to determine how profits get divided amongst various industry players. The original framework (Teece 1986) cites several examples (e.g., EMI in CAT scanners, Bowmar in calculators), and the phenomenon does indeed endure. The first-generation PC manufacturers all but disappeared from the scene (and even IBM, a pioneer of the Microsoft -Intel PC industry, exited the business by selling its PC business to a Chinese company, Lenovo, in 2005). Xerox (PARC) and Apple invented the graphical user interface, but Microsoft Windows dominates the PC market with its follow-on version of the same product. Netscape invented the browser, but Microsoft captured more of the market. Apple's iPod was not the first MP3 player, but it has a commanding position in the category today. Merck was a pioneer in cholesterol-lowering drugs (Mercavor), but Pfizer, a late entrant, secured a superior market position with Lipitor.

At first glance, it is tempting to say that these examples reflect the result of Schumpeterian gales of creative destruction where winners are continually challenged and overturned by entrants. Indeed,

[1] This section is based on part of David Teece "Profiting from Innovation" Research Policy, December 1986 and Pisano and Teece, "How to Capture Value from Innovation: Shaping Intellectual Property and Industry Architecture" California Management Review, Fall 2007, p 278-296

entrants with potentially disruptive innovations are almost always waiting in the wings, but many of the cited cases involved mostly incremental/imitative entrants rather than the radical breakthroughs typically invoked in accounts of Schumpeterian competition. Upon closer examination, outcomes weren't simply preordained. They were the consequences of the fair business strategy, intellectual property position, business model choices, and timing decisions.

There is ample evidence that timing matters. First or early movers often, but by no means always, captured and sustained significant competitive advantage over time, irrespective of their I.P. position. Genentech was a pioneer in using biotechnology to discover and develop drugs, and thirty years later was the second largest biotechnology firm (and also the most productive in its use of research and development dollars) right up to its acquisition by Hoffmann-La Roche in 2009. Intel invented the microprocessor and still has a leading market position forty years later. Dell pioneered a new distribution system for personal computers and, despite recent challenges and many would-be imitators, remained the leader until it was bypassed by Hewlett-Packard in 2007. Toyota's much studied "Toyota Production System" has provided the automaker a source of competitive advantage for decades despite numerous and sustained attempts at imitation, with the company finally becoming the world's biggest car manufacturer in 2008. It took the crippling of nuclear power plants by the massive earthquake and tsunami that struck Northeast Japan in March 2011 and the resulting disruptions to dislodge the company from first place.

The Profiting From Innovation framework points to the appropriability regime (in which I.P. plays a major role) along with the business model and organizational design, as the leading factors behind why some innovators profit from innovation while others lose out—often to imitators—and why it is not inevitable that the pioneers will lose. Teece (2006, pp.1140) summarizes PFI's rules by saying that firms should rely on markets unless there are compelling reasons to internalize. Such reasons could be grounded in one of three major circumstances: (a) cospecialization, which would lead to transaction costs if heavy reliance was made externally (i.e., on externally provisioned assets/services); (b) shoring up the appropriability situation by building or buying complementary assets that the innovation would likely drive up in value, or that were otherwise important to getting the job done; Or (c) economics of scope based on the role of complimentary assets.

The Dynamic Capabilities framework (Teece, 1997, 2007) embeds PFI in a broader context and identifies some additional factors; most notably whether the firm's competences/complementary assets are sufficiently advanced to enable it to competitively self-supply the required inputs or services. But in some cases, the component or complement may not exist anywhere in the economy, leaving the firm no alternative. This is most oft en the case when industries are new, and potential suppliers and distributors do not have the capabilities in place to meet the needs of innovators. In such cases, it is oft en most expedient for the developer/manufacturer to integrate upstream and/or downstream, particularly when strategic or time-to-market considerations make it counterproductive to spend time convincing a potential supplier of the value of making the necessary investments.

This is not a new phenomenon. Alfred Chandler (1992, 87) noted that during the Second Industrial Revolution that began in the late nineteenth century, the "initial move forward into distribution and marketing by entrepreneurs . . . was that often suppliers and distributors had neither sufficient knowledge of the novel complex products nor the facilities required to handle them efficiently. This is why so many of the new companies met their needs by building almost immediately a national marketing and distribution network staffed by their managers and workers."

There are also dynamic technology considerations that affect decisions about organizational design (de Figueiredo and Teece 1996). An innovator's ability to pace, direct, control, and guard the development of new products and technologies poses risks to competitors (Chesbrough and Teece 1996). If this innovation is left to a nonintegrated supplier, the downstream firm may then have no choice but to purchase critical components from a supplier who also emerges as a competitor. This occurred with Samsung, a supplier of displays and microchips to Apple, and now a serious rival in smartphones and tablet computers.

The outsourcing of components used in new products also raises hazards of technology leakage to competitors who are not part of the contract. Arrow (1962) first brought to light the disclosure problem in the market for know-how and others have since elaborated on this and related technology transfer problems (Goldberg 1977; Teece 1981, 1985, and 1986). The leakage can occur vertically (upstream or downstream) as well as horizontally (Silverman 1996).

A subtler hazard in such a relationship is the inability to pace or direct the evolution of new products that depend on a supplier's proprietary technology. The software industry provides an illustration of how an integrated firm can pace technological development downstream of its operating system. Microsoft develops its operating systems in-house. It also develops certain applications while relying for additional applications on independent software vendors who in turn rely on Windows for their development environment. Windows acts as a constraint on some of the technological features of the downstream application (e.g., protocols for data exchange). Microsoft's ability to pace its upstream operating system technology and its ability to use its intimate knowledge of that technology in its applications software helped it to become one of the dominant players in applications.

If a firm has no input into a supplier's development process, the supplier might be able to independently shape the trajectory of the technology. This can be mitigated to some extent by close collaboration with the supplier or the requirement that it regularly provide a "roadmap" of its future technology plans. But the downstream firm will remain unable to control the pace of technology deployment unless competing suppliers can be played off each other.

Another reason that a firm faces hazards when relying on an external supplier for complementary innovation is the difficulty associated with accomplishing the coordination of complementary assets and activities. This is related to what Richardson (1960) and Williamson (1975) have called "convergence of expectations." Investment (in research and development) must be coordinated between upstream and downstream entities, and this is difficult to effectuate using contractual mechanisms. Coordination is of greatest concern when innovation is systemic (Teece 1988). Systemic innovation requires harmonized action by all parties (e.g., the development of new cameras and film that instant photography required). When there is asymmetry in capabilities between firms, achieving harmonization is difficult. Boeing discovered this to its cost when it decided to rely on a global array of suppliers to develop parts for its new 787 Dreamliner as a cost-sharing measure; some suppliers lacked the capabilities to develop parts of the necessary quality, and Boeing had cut back its monitoring capability. Deficits in the capabilities of suppliers resulted in years of delay (Michaels and Sanders 2009). The Boeing experience echoes that of Lockheed three decades earlier when the L1011 wide-bodied plane was delayed by the failure of Rolls Royce to develop and deliver on time the RB211 jet engine for the L1011, effectively putting Lockheed out of the civilian aircraft industry. This was not an exercise of opportunism by Rolls Royce; rather it reflected Rolls Royce's inability to achieve ambitious technological goals, its lack of the (ordinary) capabilities needed to develop and deliver on time.

Teece (1996, 2000) and Chesbrough and Teece (1996) have analyzed the difficulties in coordinating the development of complementary technologies when pursued independently and governed by contract. Delays are frequent and need not result from strategic manipulation; they may simply flow from uncertainty, limited capabilities, and divergent goals amongst the parties. In the presence of these hazards, maintaining technological control of the innovation trajectory sometimes requires vertical integration (including heavy investment in R&D). When this is not possible because of time-to-market or other considerations, other strategies for (re)shaping the industry's architecture must be pursued, for example, through corporate venture investments in the supply base to build a competitive market for key complements (Pisano and Teece 2007).

Once the firm's architecture of supply and distribution had been crafted, its managers must provide the orchestration, or "system integration" function. The prevalence of outsourcing has made this integration function a strategic competence of the first order (Pisano and Teece 2007; Prencipe et al. 2003).

b. Business Models and their Imitability

Business models were only narrowly defined in PFI… the main business model issues addressed was in-house versus outsourcing decisions. Clearly, there are other dimensions to business models.

A business model (Chesbrough and Rosenbloom 2002; Teece 2010) defines a product's value positioning for customers and how the firm will convert that to profit. A business model defines an organizational and financial architecture which embraces and integrates (hopefully in a consistent fashion) (1) the feature set of the product or service; (2) the benefit (value proposition) from consuming/using the product or service; (3) the market segments to be targeted; (4) the "design" of revenue streams and cost structure; (5) the way products/services are to be combined and offered to the customer; and (6) the mechanisms by which value is to be captured. One can patent a business method but not a business model. However, various elements of a business model can sometimes receive patent protection.

When a business model is difficult to imitate—or if it is used to pioneer a winner-take-all market—it can be a source of sustained profitability. But in today's high-velocity markets, the period of time before which major new challenges necessitate adjustments to a model can be relatively short[2].
Once established, business models can be difficult to change. For example, American Express and Discover have been trying to adjust their respective models so that they will continue to issue cards themselves while simultaneously looking to persuade banks to act as card issuers for them. Their main competitors, Visa and MasterCard, provide network services. Because they don't compete with banks in issuing cards, they are well positioned to be the bank's preferred partners. Thus American Express and Discover are unlikely to have (and indeed have not had) much success trying to replicate the Visa/MasterCard business model while still maintaining their own internal issuing and acquiring functions.

[2] Consider Apple's iPhone, introduced in 2007, featuring tight integration of hardware and software and supported by an exclusive deal with a major wireless carrier. Apple's entry supercharged the nascent smartphone market. While the iPhone has continued not only to be popular but also profitable, with smart phones from various manufacturers running on Google's search ad-"subsidized" Android ecosystem, which launched its first phones in 2008, grew to be the largest category of smartphones by 2010. While this did not imitate Apple's business model, it is challenging it because Android-based smartphones came from a variety of companies at a range of different price points. Apple responded in 2011 by leaving older iPhone models on the market at prices that made some units free to the consumer after a carrier subsidy.

*See Teece, Managing Intellectual Capital, Appendix B, Oxford University Press, (2000)

To summarize, a successful business model must be something more than just a good or logical way of doing business. It must also be inimitable in certain respects, either by virtue of intellectual property, protection, or simply by being hard to replicate. Sometimes business models aren't challenged because it is unpalatable for competitors to replicate as doing so would disturb their existing customer (or) supplier relationships.

A key business model choice is whether or not to license any I.P. that the firm might have. In theory, an inventor/innovator could simply license its patent(s) to others, then sit back to reap the profits. This may be possible in the rare cases of extremely important, pioneering patents or in situations where the patent holder (e.g. a university) is not in a position to commercialize the innovation, but for most inventions it is not realistic. Most technology requires training to be put into use, and any technology, even one that is relatively modular, is difficult and costly to transfer between organizations (Teece 1981). Patented inventions require complementary assets to be valuable, and these must oft en be provided by the inventor.

Consider the example of ARM, Ltd., a very successful company whose intellectual property is included in the processor chips inside the vast majority of cell phones on the market, among numerous other electronics products. ARM does not just provide a "blueprint" that its licensees turn around and use; it provides the associated software and, in many cases, extensive technical support for using its intellectual property (IP). The point is that naively investing in the development of technological devices without understanding the broader panoply of factors involved in creating and capturing value is unlikely to pay off. Building and deploying intangible assets and shaping ecosystems require access to—and, often, ownership of—complements. Absent the ability to orchestrate complements effectively, management will be hard-pressed to deliver financial success.

The organizational conundrum that managers confront has at least two dimensions. First, the delivery of product/process innovation to the market in some usable form requires combining inputs/components up and down the vertical chain of production. The profitability of the inventor/innovator can be compromised significantly when economic muscle (i.e., scarcity, inimitability, or other isolating mechanisms) is possessed by owners of required inputs/components. One of the prime examples of this is the success of Microsoft and Intel in retaining a substantial share of the profits in the personal computer industry (Dedrick et al. 2009).

Second, most innovations require complementary products and services to produce value in consumption. Hardware requires software (and vice versa); operating systems require applications (and vice versa); digital music players require digital music and ways of distributing digital music (and vice versa); mobile phones need mobile phone networks (and vice versa); web browsers and web search engines require web content (and vice versa); airlines require airports (and vice versa). In short, technology must be embedded in a system to yield value to the user/consumer. Appropriability is at risk if other entities control required elements of the system.

From this perspective, the business model issue is ensuring access to required components and complements at preferential or competitive prices. In some instances, this will require the firm to build or buy the necessary capabilities to avoid a loss of profits to the owner of a bottleneck asset. The firm must also be prepared to change its assessment over time because the identity of bottleneck assets may shift due to innovation elsewhere in the system.

Over the past two decades, our understanding of capturing value by carefully choosing the architecture of the enterprise (especially the boundaries of its ownership and its control of complementary assets) has expanded greatly. This body of work has come to be known as the Profiting From Innovation (PFI) framework.

c. Appropriability and the Role of Intellectual Property Strategies

The profiting from innovation framework shows just how intellectual property impacts strategy choices and likely outcomes (Teece, 2006).

A fundamental conclusion is that unless the inventor/innovator enjoys strong natural protection against imitation and/or strong intellectual property protection, then the innovator's potential future stream of income is at risk. The appropriability regime is critical to shaping possible outcomes. Appropriability regimes can be "weak" (innovations are difficult to protect because they can be easily copied and legal protection of intellectual property is ineffective) or "strong" (innovations are easy to protect because knowledge about them is tacit and/or they are well protected legally). Regimes differ across fields of endeavor, not just across industries and countries.

Appropriability regimes change over time, and the regime applicable to a given innovation can be influenced by firms (Pisano and Teece 2007). For example, a firm with strong downstream complementary asset positions might decide that it is in its interest to weaken the upstream appropriability regime, as in the case of IBM making its server operating system available as a nonproprietary product to gain advantage in the sale of related hardware, applications, and services (Merges 2004). More commonly, firms work to strengthen appropriability regimes by lobbying for stronger intellectual property rights enforcement. An individual firm can improve the appropriability of its patents under some circumstances, such as by having them adopted as a formal industry standard, which may make competitors less likely to work around the patent. Control of key patents in a successful standard has numerous potential benefits, including licensing revenue, privileged access to new technologies, and influence over the technology trajectory.

In some industries, particularly where the innovation is embedded in processes, trade secrets are a viable alternative to patents. Trade secret protection is possible, however, only if a firm can put its product before the public and still keep the underlying technology secret. Many industrial processes, including semiconductor fabrication, are of this kind.

Patents can in some cases be used to slow rivals and generate profits. However, patents rarely, if ever, confer strong appropriability, outside of special cases such as new drugs, chemical products, and rather simple mechanical inventions (Levin et al. 1987). Many patents can be "invented around" at modest cost (Mansfield et al. 1981; Mansfield 1985). They are especially ineffective at protecting process innovation. Often patents provide little protection because the legal and financial requirements for upholding their validity or for proving their infringement are high, or because, in many countries, law enforcement for intellectual property is weak or nonexistent.

While a patent is presumed to be valid in many jurisdictions, validity is never firmly established until a patent has been upheld in court. A patent is merely a passport to another journey down the road to enforcement and possible licensing fees. The best patents are those that are broad in scope, have

already been upheld in court, and cover a technology essential to the manufacture and scale of products in high demand.

Despite the shortcomings of patents as a means of protecting a firm's profits, they have gained salience for value capture because firms in a number of industries are looking to their patent portfolios as a direct source of income. Patents have long been valuable in some industries, such as pharmaceuticals, and they have become a critical competitive tool/weapon in electronics.

In many instances, patent strategies are not just a matter of protecting a particular invention. Developing new commercially viable products increasingly requires the combination of a very large number of inventions, leading to an innovation environment that has been called "multi-invention" (Somaya et al. 2011). In some industries (notably biotechnology), one needs to use earlier patented innovations simply in order to conduct new research.

Multi-invention contexts are not a recent phenomenon. New technologies in the early twentieth century—cars, airplanes, telephones, radios—also combined components, protected by IP rights, from multiple parties. What is different now is the depth and complexity of the IP landscape. At the peak of automobile innovation in the early 1920s, about 400 motor vehicle patents (US patent class 180) were being issued each year by the US Patent and Trademark Office (USPTO). By contrast, in the last few years, in an active area like semiconductor manufacturing (US patent class 438), the USPTO issued approximately 7000 patents annually. Many of these inventions were aimed at building up a large defensive portfolio that overlaps with rivals' sphere of knowledge (Grindley and Teece 1997; Hall and Ziedonis 2001). In other words, the greater emphasis placed by companies on the protection and monetization of knowledge assets has amplified the requirement for protecting and extending one's own assets.

Innovators in these multi-invention settings must craft a patent strategy that covers how they access proprietary (and patented) technology held by others and manage patent rights on their own inventions. That is, an innovator must (a) identify strategies for in-licensing patented technology held by others that it wishes to use in its own products and (b) identify strategies for either out-licensing its own technology to others or choosing not to license use-rights to others (and, if necessary, to take legal action to protect its IP against infringers). Unlike tangible assets, a patent holder cannot physically withhold from others the ability to use its patented technology; it must rely on the legal system to protect its rights. And patents are 'probabilistic' (Lemley & Shapiro, 2005); there is only some probability that a patent would be found valid and infringed in court. In many contexts, parties agree to a cross-license, whereby each party receives a license to use the other's technology to make its own products. The ability to "stake out and defend a proprietary market advantage" is often cited as the primary benefit of patents (Rivette and Kline 2000, 56). However, as noted above, patent protection generally tends to be imperfect and porous. Therefore, to obtain any tangible protection for a key technology, a firm usually must work to fill in the gaps in its patent portfolio.

In considering I.P. strategies, firms need to weigh the benefits of patent protection against its costs. Successfully obtaining a patent through the "patent prosecution" process before the US Patent and Trade Office is not cheap, and broad geographic protection requires seeking protection in at least certain key countries. Pursuing an expensive proprietary patent strategy may be justified for technologies that underlie a core competency, entail high strategic stakes, or are otherwise critical for the company's competitive advantage (Somaya, Teece, & Wakeman, 2011).

However, it must also be recognized that an enterprise may desire the freedom to design and innovate without being constrained by the patents owned—or likely to be owned in the future—by others. Patents held by others can pose a significant challenge to commercializing an innovation, especially in multi-invention settings.

To protect against unwitting infringement, companies need an effective "defensive" patent strategy. One common defensive strategy is to develop a portfolio of patents to offer in cross-licensing settlements.[i] In essence, this means that the company should aim to patent not only inventions important to itself, but also those important to others. Patenting into a rival's domain of weakness is sometimes possible, and may be effective (Merges 2004)[3].

d. Coordinating Intellectual Property Rights for Effective Appropriability: The Case of Pilkington

The analysis so far has shown how other elements of strategy, i.e. business model choices, timing decisions, positioning in complementary assets… impact competitive advantage and competitive outcomes. However, it's also important to understand not just how intellectual property works together with other factors to shape outcomes. It's also important to understand how various types of I.P. and in particular trade secrets and patents interact to shape outcomes. Pilkington used patents and trade secrets in a judicious and effective way to protect its pioneering float glass process.

When it invented the float process, Pilkington was a relatively small UK-based glass maker, without the balance sheet or experience needed to introduce a major innovation world-wide on its own. Pilkington believed there would be more profit in selling glass than in just selling the float technology; to the extent feasible, it therefore wished to expand its own production in the UK and worldwide employing its innovation. It did not have the financial and managerial capabilities to expand in this way immediately, having had its cash drained by the long, expensive development of the float process. Moreover, converting its UK facilities to the new process also would involve the investment of large sums of money. As a practical matter, Pilkington itself did not have the resources, in terms of financial and managerial capabilities to commercialize its float innovation on a world-wide basis using direct investment.[4]

Reflecting these constraints, Pilkington's strategy for commercializing its float technology evolved over time. In the initial stage, Pilkington chose to license its invention. To commercialize the process rapidly and broadly, Pilkington needed the support of the existing plate glass producers, as they had the necessary manufacturing, marketing, and distribution capabilities to rapidly commercialize float. This was in part because the float process replaced only a part of the overall glass production process –

[3] There are data to show that having a patent portfolio that "reads on" a competitor's technologies increases the likelihood and speed of settlement in a patent suit brought by that competitor (Lanjouw and Schankerman 2002; Somaya 2002). However, defensive patent portfolios may be ineffective against patent owners that do not practice their invention, such as individual inventors or universities.

[4] Funds for international expansion were eventually to be provided by a combination of royalty earnings from float licenses, Pilkington's own earnings from float glass production, and a change in the status of the company from a family owned business to a public corporation in 1970. Becoming a public corporation provided Pilkington with the ability to raise money from the stock market on the scale needed for global expansion.

namely, the grinding and polishing stages associated with plate glass production. Existing manufacturers had the manufacturing capacity and skills to implement float production successfully.

Pilkington's decision to grant licenses to existing plate producers created competition that would not otherwise have existed. It benefited consumers by making the technology widely available rather quickly, and this in turn led to prices falling rapidly and significantly. In short, there were advantages which flowed to Pilkington and to consumers because Pilkington chose to license industry incumbents. Without access to Pilkington's innovation, incumbents would have had to compete using inefficient and obsolete plate technology.

Pilkington granted its first license in 1962, to an American firm, PPG, after lengthy negotiations over the terms under which PPG would gain access to this revolutionary technology. By 1970, just eight years after this license, every plate glass producer in the world had obtained a license to practice Pilkington's technology.[5] Indeed, no new plate plants were built anywhere in the world after 1962. Later, after float glass manufacturing costs had fallen sufficiently, glass produced by the float process became economically viable as a replacement for glass produced by the sheet process, thereby making glass of the highest quality available for the same cost as the lower-quality glass produced by the sheet process.

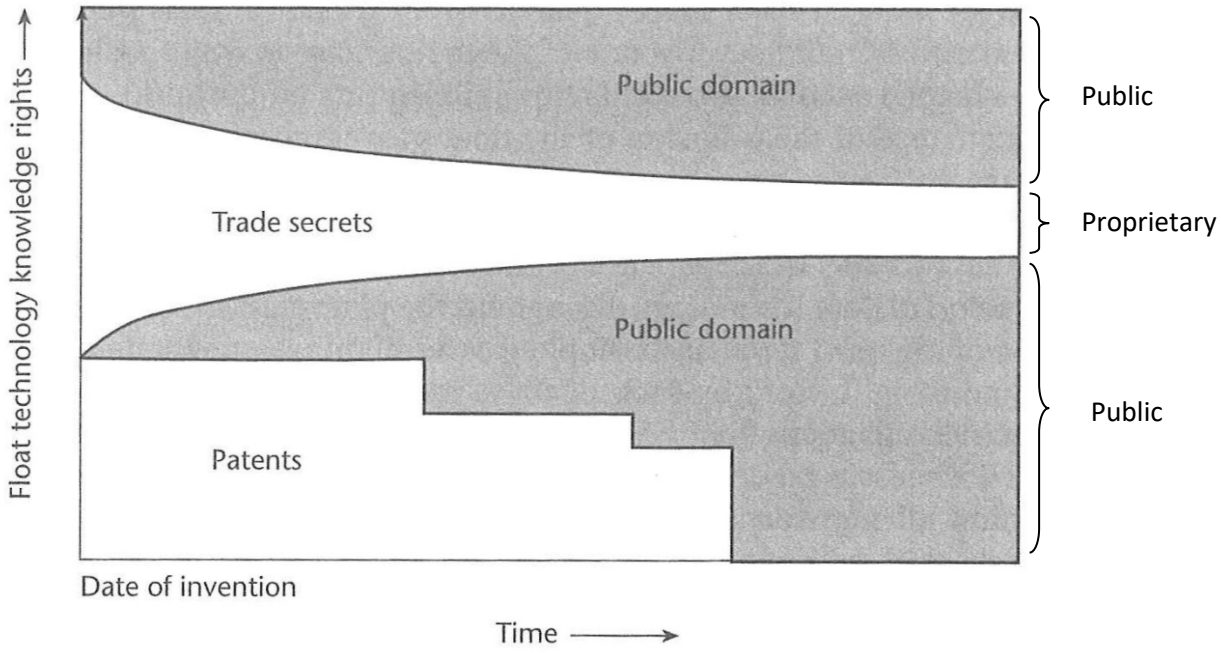
Pilkington naturally granted geographic rights to existing plate glass producers to use its float technology in their home markets, and they generally received the right to sell the resulting glass almost anywhere is extremely common in international business. Indeed, it is quite normal for licensors to grant rights to use the licensor's intellectual property within specified territories or specified technical 'fields of use' (or both). Moreover, territorial licensing was in line with traditional practice in the glass industry. Both the sheet glass process and the twin grinder plate glass process which had preceded float were licensed on a territorial basis.

Without the ability to grant licenses only for specific territories and thereby to preserve to itself the use of its technology in certain other territories, Pilkington's best strategy would probably have been to not license at all, but to use the U.K. as a base to gradually introduce float through Pilkington-owned and operated facilities throughout the world. The ability of an innovator such as Pilkington to license to others less than the full panoply of intellectual property rights associated with its innovation is widely recognized as pro-competitive, since it facilitates wider and more rapid dissemination of the innovation than would otherwise occur. Territorial and field-of-use limitations thus promote the licensor's incentive to license by providing limited protection against cannibalization from licensees using the licensor's own technology.

Pilkington's licenses also provide for the mutual exchange of improvements to the process among all users of the new technology, including Pilkington. This exchange of improvements assured licensees that they would not be stranded with an obsolete version of the technology in the event of rapid movements. And, just as importantly, it assured Pilkington that it was not empowering a competitor to use Pilkington's technology to leave it stranded, an assurance that was crucial to Pilkington's willingness to share its technology with others.

[5] At first, float glass was cost-effective only as a replacement for plate glass and not for the less expensive (but lower quality) sheet glass

Another significant aspect to Pilkington's licensing terms was the form of the intellectual property rights that protect different aspects of technology. Float technology is a combination of patentable and non-patentable intellectual property. Patents covered specific aspects of the process, but there was and is a large volume of know-how in the design and operation of the process which should only be protected by trade secret. Thus the licenses covered both types of intellectual property required to operate a float plant. They included provisions for maintaining the confidentiality of Pilkington's trade secrets, and procedures for resolving situations which might arise if the patents were no longer used by licensees. Licensing terms that remain operative rest on trade secrets that have remained confidential after the expiration of the patents.



[From: Teece, Managing Intellectual Capital, Appendix B, Oxford University Press, (2000) pp 229]

In short, Pilkington's licensing terms reflect the common concerns of innovators endeavoring to capture a portion of the benefit from innovations. The terms of the license grants are 'restrictive', but only in the limited sense that licensees were not granted unconditional world-wide manufacturing and sublicensing rights. Such unconditional grants are an exception and not the norm in technology licensing. It typically makes little sense for an innovator to license its technology *carte blanche*.

V. Conclusion

The management of intellectual property is coming into sharper focus in the executive suite. It is no longer the sole domain of patent attorneys or licensing executives. With globalization, the internet, and more rapid diffusion of technologies, maintaining points of differentiation amongst product offerings

are essential. Intellectual property is important to this endeavor. Both small firms and larger firms are conscious of this. The articles in this special issue have illustrated this new situation and provided helpful insights. Some time ago, the "profiting from innovation" framework laid out how these different factors all worked together to impact the firms bottom line. This special issue has placed an even broader set of factors on the table for management to consider.

References

A. Chandler, "Organization Capabilities and the Economic History of Industrial Enterprise", Journal of Economic Perspectives, (American Economic Association, 1992), vol. 6(3), pages 79-100.

T. Kealy, *The Economic Laws of Scientific Research*, (St. Martin's Press, 1996).

M. Lemley, C. Shapiro, "Probabilistic Patents," *Journal of Economic Perspectives,* Vol. 19, Number 2, Spring 2005, pp. 75-98.

D. Teece, "Profiting from Technological Innovation," *Research Policy*, 15:6 (December 1986), 285-305.

D. Teece, "Reflections on 'Profiting from Innovation'", *Research Policy*, 35:8 (December 2006), 1131-1146.

D. Teece*, Managing Intellectual Capital: Organizational, Strategic, and Policy Dimensions*. (Oxford: Oxford University Press, 2000).

D. Teece, "Achieving Integration of the Business School Curriculum Using the Dynamic Capabilities Framework," *Journal of Management Development,* Vol. 30 Issue 5, (2011), pp. 499-518.

D. TEECE, "Profiting from Innovation", *Sage Encyclopedia of Management Theory,* 2013, forthcoming.

D. Teece, "The New Managerial Economics of Firm Growth: The Role of Intangible Assets and Capabilities, in Thomas (Eds.) *The New Managerial Economics of Firm Growth,* (Oxford University Press, Forthcoming), pp. 278-301.

D. Teece, G. Pisano, "How to Capture Value from Innovation: Shaping Intellectual Property and Industry Architecture", *California Management Review, 50th Anniversary Special Issue on Leading through Innovation,* 50:1 (Fall 2007), 278-296

D. Teece, D. Somaya and S. Wakeman "Innovation in Multi-Invention Contexts: Mapping Solutions to Technological and Intellectual Property Complexity, *California Management Review*, Vol. 53, No. 4 (Summer 2011), pp. 47-49.