The Wealth of Knowledge:

Converting Intellectual Property To Intellectual Capital

In Co-opetitive Research and Technology Management Settings

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Abstract

The emerging global trends in intellectual property (IP) commercialization and intellectual property rights (IPR) enforcement and harmonization such as technology globalization, "niching", and licensing strategies, the diffusion of IPR standards and the divergence of IPR enforcement practices, are components of an emerging view of the importance of intellectual capital in corporate and national competitiveness. This paper presents the role of IPR enforcement and harmonization and IP commercialization strategies in a global, intra- and inter- firm and industry context. IP management is examined from the perspectives of the knowledge management and technology management fields, paradigms which facilitate rather than impede research collaborations in co-opetitive, technology-driven environments.

Intellectual property rights (IPR) are shown to be the emerging currency of the global, knowledge-based economy and the intellectual property (IP) audit is a key strategic competitive "weapon" for firms.
**Keywords:** intellectual property rights, intellectual capital, knowledge management, knowledge economics, co-opetition, trust, technology management, technology strategy, research collaboration, harmonization of intellectual property rights protection standards.

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1 Introduction

"You can not overtake the runner in front of you by following in his footsteps."
Mao tse-Tung

Economics since Adam Smith identifies three chief productive factors in any economy: land, labor and capital. The shift in the West from an agrarian economy to one based on manufacturing was marked by the shift from land as the most important factor to physical capital—factories, machinery, and resources which composed these assets—and the financial capital to acquire those assets. The rise of a “post-capitalist” society as described by Drucker suggests that other assets are approaching ascendancy as contributors to economic productivity [1]. The manufacturing-based economy appears to be giving way to a “knowledge-based” economy.

In an era of globalized, highly-mobile financial capital, multinational corporations can essentially "arbitrage" across national borders to find the best firms to integrate into their mode of production. The increased velocity of commerce (especially through electronic commerce) and competition demands multi-faceted expertise from a firm. Only through the judicious and experienced application of knowledge can firms hope to outperform their counterparts and achieve sustained competitive advantage [2].

In post-capitalist economics, wealth flows not to those who control financial capital, but to those who can acquire and direct intellectual capital. The term “intellectual capital” refers to intellectual assets (i.e., skilled workers, scientific knowledge, and business information) which create knowledge into the future through their utilization. Intellectual capital has been defined by analysts at Ernst and Young as “intellectual material that has been formalized, captured and
leveraged to produce a higher-value asset” [3]. Brooking views the enterprise as a collection of tangible assets and intellectual capital, with intellectual capital composed of market assets, intellectual property assets, human-centered assets, infrastructure assets (see Figure 1) [4].

The post-capitalist knowledge-based economy operates with dynamics which differ radically from those assumed by neo-classical economics. Unlike other forms of capital, intellectual capital is not only unevenly distributed, but it tends to grow without physical limits. A firm which captures and exercises unique knowledge capabilities will tend to attract more expert employees, thus exhibiting "increasing returns to scale". According to Arthur, this dynamic leads to a new form of economics—knowledge economics—that is very different from traditional, process-oriented economics. The rules of this new paradigm “call for different management techniques, strategies, and codes of government regulation.” The task of management becomes “a series of quests for the next technological winner” [5].

The core activity of firms in increasing-returns markets is research: the generation of new knowledge which leads to products with competitive commercial value. The strategic goal of the firm is to establish a stream of innovations, each capitalizing on the success of its predecessor. Intellectual capital is thus the primary source of wealth creation, since it enables the generation of new knowledge within the firm to establish and maintain technological leadership.
Intellectual Property and Intellectual Capital

“To steal a book is an elegant offense”
Chinese Proverb, Anonymous

“We possess all things. I set no value on objects strange or ingenious, and have no use for your country’s manufactures.”
The Qianlong Emperor to King George III of England, October 3, 1793

Over the last twenty years the impact and scope of technological change and innovations in diverse areas such as information technology, media, telecommunications, software, electronic commerce, biotechnology, advanced materials, entertainment, and health care, have built a global infrastructure for the exchange and combination of assets which exhibit explicit and implicit, and individual and social, features (see Table 1). Firms can add value by leveraging these assets through competitors and complementors alike in a “co-opetitive” context [6]. Instead of viewing all players as competitors, this approach can reveal that some opponents are in fact ‘complementors,’ who may add value to others. Co-opetition is exercised through the formation of "value nets," where the firm interacts with suppliers, customers, competitors and complementors to maximize its own added value, in turn raising the returns to the other players in the net. Brandenburger and Nalebuff argue that by turning apparent zero-sum situations into positive-sum games, firms achieve the greatest gainsharing among all players [7].

Intellectual capital encompasses the intellectual property rights defined under law, but the concepts are very distinct. Intellectual property laws attempt to map traditional systems of diminishing returns onto knowledge. An intellectual property right, like a real property right, is a legal construct which enables an entity to claim ownership of an asset which might otherwise disseminate out of control. In this case, the asset is an invention or other creative act which the
firm wishes to use to generate revenues. The value of an intellectual asset is assumed to depend primarily on its ingenuity, but also on its scarcity. An intellectual property right grants the holder of that right sole power to determine who can exploit an intellectual asset.

Due to their nature and the structure of the law, intellectual property is a highly-stylized form of knowledge. First, most knowledge is not limited by scarcity. Information and other codified knowledge can be observed, copied and applied by others without diminishing the knowledge held by the originator. This makes it difficult to detect or prevent the misappropriation or illegal imitation of proprietary firm knowledge [8].

Second, intellectual property must be codified in some recordable form so that it can be identified, defined and protected under law. But knowledge often cannot be recorded for documentation. Following the concepts introduced by Polanyi, many writers categorize knowledge into two types: tacit and explicit [9]. Tacit knowledge is gained through “learning by doing;” it is knowledge which is internalized through practice. This knowledge is not easy depicted in words, diagrams, or other forms of communication, and may in fact not be verbalizable at all. In contrast, explicit knowledge is knowledge which can be identified, codified, and isolated more easily. In one conventional view, these two forms of knowledge are distinct and exclusive [10]. Intellectual property rights are capable of protecting explicit knowledge, but not tacit knowledge.

A new view of knowledge proposed by Tsoukas holds that “tacit and explicit knowledge are mutually constituted...the two are inseparably related” [11]. From this perspective, the artificial representation of knowledge in explicit form distorts that knowledge. It ignores the tacit component of knowledge, consisting of intangible elements such as expertise, judgment, and intuition which are necessary for the proper application of the explicit component. More
importantly, tacit knowledge is necessary for understanding the dynamics of knowledge creation. Hence, reverse engineering, which focuses mostly on extracting the explicit knowledge embodied in products, is of limited value in terms of intellectual capital because it does not contribute significantly to the capture or generation of critical tacit knowledge.

If, as Tsoukas states, the firm is a “distributed system of knowledge,” then firms can exploit individual knowledge only when transformed into organizational knowledge. Organizational knowledge can be classified in three general categories: tacit, rule-based, and background (see Table 2). Tacit knowledge concerns intuitive aspect of knowledge. Rule-based knowledge concerns the behavior and functioning of the organization, and can be both tacit and/or explicit. Finally, background knowledge provides the proper context for understanding other forms of knowledge.

While explicit knowledge may be easily appropriable, the significant tacit component of organizational knowledge makes transfer difficult. Some tacit knowledge can be transferred across and between organizations through the movement of individual employees. However, since organizational knowledge is the aggregation of individual knowledge, in most cases a single employee will not possess all the tacit knowledge needed to reconstruct the core competence of a firm.

Implications of Intellectual Capital for Firm Strategy

Past experiences show that competitors may find ways to reverse engineer products and “design around” existing patents. Alternatively, competitors can subvert the patent system to block the effective protection of existing intellectual property rights. This is particularly true in the present global economy, where lack of international harmonization of intellectual property
laws allows multinationals to arbitrage across nations and exploit weaknesses in national IP systems. One example of this is the well-known case of the Kilby patent on the integrated circuit, which Japanese corporations successfully delayed in prosecution in Japan until they after they used the technology in their own products. By the time the patent issued, the Japanese firms had overtaken U.S. chip manufacturers in the market, making the legal protection virtually moot.

While explicit knowledge is not scarce and is easily replicable, tacit knowledge is scarce and difficult to appropriate. While information about a given technology or innovation may be easily stolen, the knowledge on how best to apply that knowledge in a given situation tends to reside within the inventing firm. As the application of technology is the basis of its added value, firms should concentrate on the protection and exploitation of tacit knowledge as the basis for their corporate strategy. While the legal protection of intellectual property should be exercised to the greatest extent appropriate, by nature they cannot be used to protect knowledge which is predominantly tacit. Tacit knowledge, the internalized “know-how” of the firm, is best protected through organizational mechanisms; for example, by ensuring that such knowledge is dispersed among employees so that few employees are in a position capture corporate knowledge for their personal gain.

The analysis of intellectual capital produces two immediate implications for firm strategy:

- First, the firm must recognize that explicit knowledge is inherently difficult to protect, even under well-developed regimes of intellectual property law.
- Second, to leverage the full benefits of a firm’s IC, it must manage its stock and flow of both explicit knowledge (intellectual property) and tacit knowledge (other intellectual assets).
By controlling and directing the idea migration and the osmosis of knowledge across firms through IPR enforcement and through appropriate organizational configurations, one can maximize the wealth of the firm-specific knowledge and know-how that is captured by the firm. The practice of designing mechanisms to improve the generation, intra-firm diffusion, and inter-firm protection of knowledge is the subject of a new field of theory and practice called “knowledge management.”

3 The Concept and Practice of Knowledge Management

“Bill Gates is the perfect symbol of the new centrality of intellectual property. For more than a century, the world’s wealthiest human being has been associated with oil - starting with John D. Rockefeller in the late nineteenth century and ending with the Sultan of Brunei in the late twentieth century. But today, for the first time in history, the world’s wealthiest person is a knowledge worker.”

Lester Thurow (1997), p. 96

If we accept that the knowledge held by organizations and their employees is the primary source of innovation and market advantage, then the organizations should develop mechanisms to ensure that knowledge is being utilized effectively and efficiently, and distributed appropriately to all potential users. Hence, much as financial management and human resources management address the optimal allocation of those resources within the firm, knowledge management consists of the practices and policies for deploying intellectual assets to support key business objectives. The need for knowledge management arises from the failure of traditional financial and accounting practice to recognize the value of intellectual capital.

Knowledge management deals with knowledge as a corporate resource which “if properly managed, can improve a whole range of organizational performance characteristics by
enabling an enterprise to be more ‘intelligent acting’...Thus, knowledge management has a key role in determining the competitiveness and business performance of many organizations” [12].

Knowledge management is rapidly gaining credence in major corporations. The first industry conference focusing on knowledge was organized by Digital Equipment Corporation and the Technology Transfer Society in 1987 [13]. Companies now have executives with the title of “Chief Knowledge Officer” to coordinate their knowledge management efforts. Interest in this area has been catalyzed by the well-publicized practices of pioneering companies, such as Dow Chemical Company with its effort to manage its intellectual property, and the intellectual capital management initiative of Skandia, a Swedish insurer [14]. Accounting firms including Ernst & Young and Arthur Andersen Business Consulting now have knowledge management practices, which develop metrics and evaluation tools for measuring the accumulation and use of intellectual capital.

The first task for knowledge management is to capture the tacit-based knowledge held by individual employees and collect it in a shared, corporate knowledge pool. This is the basis of the distinction between two components of IC: human capital and structural capital. While the human capital component of IC leaves the company when its employees go home at night, structural capital is a true corporate resource which endures even as employees come and go.

The task of knowledge management is to recognize that not all knowledge has equal importance to the corporation’s core competencies. Knowledge must be prioritized in terms of business relevance. For example, Dow Chemical uses “intellectual asset management teams” composed of cross-disciplinary employees “to identify the ‘key technology know-how,’ or expertise that gives Dow a competitive advantage in the production of key products” [15]. The process of determining relevance is very qualitative and subjective. In practice, it is difficult to
know ex ante which knowledge will be most useful to particular individuals at any given time. The best strategy for knowledge management is to codify and categorize the knowledge of the corporation and to ensure that it is available throughout the firm. This can be accomplished through two mechanisms. First, companies need to create appropriate information systems which provide widely-distributed access to the “knowledgebase” of the corporation, using sophisticated database architectures [16]. Second, companies need to foster a “knowledge-sharing culture” to encourage employees to disseminate their tacit individual knowledge throughout the organization (but preferably no further).

A key challenge for knowledge management is the identification of the fundamental intellectual assets which drive firm performance. To date, most solutions have attempted to use new accounting methodologies to quantify explicit and tacit knowledge and to develop metrics for IC. As an alternative, the practice of technology management can help companies to better understand the importance of particular intellectual assets, and to manage those assets in ways which support their core business. Specifically, the integration of knowledge management and technology management will produce a theoretical framework that improves the description and explanation of new trends in intellectual property generation and transfer, and that provides better prescriptions for how firms should manage and share intellectual property.
4 Concepts in the Management of Technology

Technology is a Greek word derived from the synthesis of two words: “techne” (meaning art) and “logos” (meaning logic or science). So loosely interpreted, technology means the art of logic or the art of scientific discipline. Formally, it is defined as “a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome. A technology usually has two components: (1) a hardware aspect, consisting of the tool that embodies the technology as a material or physical object, and (2) a software aspect, consisting of the information base for the tool” [17]. Although technology is often embodied in a product, technology in general should instead be conceived of as a process, as dynamic rather than static and as social rather than disembodied. It is a combination of both creative and structured tangible artifacts, codified knowledge and tacit know-how embedded in individual, group, and organizational routines. Thus, technology is systematic knowledge, which from an information theoretic and meta-cognitive/linguistic perspective emphasizes the role of knowledge stocks and flows in linking technology management and technology strategy with business strategy [18].

Technology management is the set of policies and practices that leverage technologies to build, maintain, and enhance the competitive advantage of the firm on the basis of proprietary knowledge and know-how. The U.S. National Research Council in 1987 defined Management of Technology (MOT) as linking “engineering, science, and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization” [19]. While technology management techniques are themselves important to firm competitiveness, they are most effective when they complement the
overall strategic posture adopted by the firm. The strategic management of technology tries to “build advantage on the basis of technology”, or “bring the potential opportunities that technology creates to bear on the formulation of corporate strategy” [20].

The practice of technology management and the development of technology strategy must include an understanding of the different forms of innovation and the features of each form. Knowledge is one input in innovation; therefore, knowledge management must also integrate definitions of innovation and identify the types of knowledge and styles of knowledge management appropriate to each form of innovation. Technology management is important to knowledge management because it defines a firm’s technology “in a way that clarifies what the technology does for the business instead of just stating what the technology is” [21].

For intellectual capital, technology management helps in prioritizing knowledge by business impact. The management of technology is also an analytical tool for identifying the proper management practices for exploiting innovations. One area of this practice is the development of a strategy for prioritizing, coordinating and integrating a firm’s intellectual property and its technology.
As discussed above, the knowledge components of a technology can best be protected through organizational modes which isolate the tacit knowledge from outside misappropriation. Intellectual property management can protect and exploit firm-specific technologies and knowledge through legal mechanisms.

Intellectual property is one kind of intellectual asset which technology-based firms transform into competitive advantage. There are four generally recognized forms of intellectual property in industrialized nations:

- patents, dealing with functional and design inventions;
- trademarks, dealing with commercial origin and identity;
- copyrights, dealing with literary and artistic expressions; and
- trade secrets, which protect the proprietary capabilities of the firm.

Under U.S. law, a patent is granted only by the federal government and lets the patentee exclude others from making, using, selling or offering an invention for a fixed term, currently 20 years from the date the patent application is filed [22]. A trademark, as defined under the Trademark Act of 1946 (The Lanham Act) is

...any word, name, symbol, or device, or any combination thereof (1) used by a person, or (2) which a person has a bona fide intention to use in commerce...to identify and distinguish his or her goods, including a unique product, from those manufactured or sold by others, and to indicate the source of the goods, even if that source is unknown. [23]
A copyright seeks to promote literary and artistic creativity by protecting, for a limited time, what the U.S. Constitution broadly calls "writings" of "authors" [24]. The general rule in the U.S. for a work created on or after January 1, 1978, whether or not it is published, is that copyright lasts for the author's lifetime plus 50 years after the author's death. The copyright in a "work made for hire," or in an anonymous work, lasts for 75 years from publication or 100 years from creation, whichever is shorter.

A trade secret is information that an inventor chooses not to disclose and to which the inventor also controls access, thus providing enduring protection [25]. Trade secrets remain in force only if the holder takes reasonable precautions to prevent them from being revealed to people outside the firm except through a legal mechanism such as a license.

The integration of knowledge management with the recent work in technology management identifies a new focus for corporate strategy: the creation of a technology IP strategy. This represents a profound shift from previous views of IP in corporations. Historically, intellectual property rights were viewed as a means of maintaining an archive of a firm’s creative output, with no value beyond simple record-keeping. As a result, firms’ patent portfolios grew through R&D, but the portfolios themselves were not viewed as productive assets.

There are several reasons why patenting was not considered an important activity. Most U.S. corporations in the post-war period were not terribly concerned with the productivity of their R&D facilities. There was little analysis of the management of R&D, so most firms simply assumed that more research is better. This belief reflected a general lack of integration between a firm’s technical activities and strategy; U.S. firms display a weak link between top-level corporate strategy and technology [26].
More importantly, patents themselves did not have a substantial amount of value. First, since licensing was relatively rare (except in international expansion), there was not a developed market which assigned values to patents. Second, patent litigation was relatively rare, because patents were difficult to protect in court. However, in 1980, the U.S. established the Court of Appeals for the Federal Circuit (CAFC) in Washington, D.C. This became the ultimate forum for resolving all U.S. patent disputes. The CAFC made the protection of patents easier, and its rulings also helped to establish clear definitions of patent infringement. This made patents by themselves more valuable to firms.

Until recently, firms viewed the management of their intellectual property as a cost center. New inventions and other assets were only protected if they added a key product or service to the firm’s lines of business. A number of pioneering new companies take a completely different view of intellectual property. These companies view their intellectual property as true assets, resources which should be exploited fully if the firm is to operate at peak efficiency. This new view shifts the patent and IP tracking function from a cost center to a profit center. It explicitly recognizes that all of a firm’s intellectual property has some value (see Table 3), and that the job of the IP office is to maximize the leveraging of that value by the firm. Value generation is measured and promoted through the IP technology strategy.

**Constructing an IP Portfolio**

The first issue to be addressed in developing an IP technology strategy is the formation of a portfolio of intellectual property rights appropriate to the firm’s intellectual assets and competitive capabilities. For the technology-based firm, patents and trade secrets are the primary forms of protecting the intellectual property embodied in their most strategic products
and services. (For software firms, copyright also protects their products; however, court
decisions during the 1980s weakened the protection of software by copyright and in turn made it
possible to patent software technologies.) Therefore, it is natural that any IP management system
focus on these two types of intellectual property.

By law, both patents and trade secrets are explicit forms of knowledge in that they must
exist in codified form. For patents, the knowledge is embodied in a product or process and is
made publicly available in the patent, while trade secrets protect explicit knowledge from public
dissemination. If, as Tsoukas proposes, all knowledge has a tacit and explicit component,
patenting makes more sense for competitive reasons if the explicit knowledge described in the
patent has significant accompanying tacit features which complicate its exploitation. The degree
of tacitness provides a degree of practical protection against appropriation by competitors which
reinforces the legal protection afforded by the patent. In contrast, trade secret protection should
be used for knowledge which is predominantly explicit, since publication would reveal the
essentials for using that knowledge.

The need for significant tacit knowledge to utilize a patent also provides a mechanism for
maximizing non-royalty revenues from licensing. A significant part of value-added to the IP
licenser is derived from consulting, training and other fees by the licensee to the IP owner for
utilizing effectively the IP in the context of the licensee’s business activities. This creates new
business areas for licensers to exploit. For example, a licenser may earn additional revenues by
assigning personnel to work with the licensee in using the licensed technology, a practice
sometimes called “wet licensing” (derived from the terminology that the licenser is renting out
the internalized knowledge or ‘wetware’ of its employees).
To determine when and how to use intellectual property laws to protect knowledge, the firm must consider the importance of the explicit component of that knowledge and the degree to which the invention is important to the firm’s competitive advantage. The contrast between knowledge type and competitive status for an invention is illustrated in Figure 2.

As illustrated, patents are most effective in protecting technologies which are exploited only with complementary tacit knowledge. Also, since patents provide imperfect protection, they should not be used to protect knowledge which is central to a firm’s competitiveness. Technologies suitable for trade secret protection tend to be easily replicated once the core technology has been revealed. Therefore, patenting (which requires public disclosure) is not suitable for such technologies. The relatively greater protection afforded by trade secret laws means that this form of intellectual property can provide a level of security suitable for the core technologies of a firm. This accounts for the increased use of trade secrets rather than patents among U.S. firms as a formal means of intellectual property protection.

Trade secrets carry two potential problems, however. First, companies are not protected in cases where a competitor independently develops and uses the same technology [27]. In the case of patents, the first party to file the patent application (under the prevailing international patenting standards negotiated under the Uruguay Round of the GATT) would have exclusive use of the technology.

Second, since trade secrets are explicit and codified, they can easily be misappropriated by employees who switch firms. This has led to an increase in trade secret litigation in the U.S. and abroad [28]. "Given the increasing value of intangible assets like know-how in the information age, there has been a significant amount of recent litigation where corporations -- which are vitally interested in protecting their trade secrets—are willing to take their cases to
court," according to a counsel to Dow Chemical in a recent trade secret dispute with General Electric. A particularly notable case was the dispute between General Motors and Volkswagen over the defection of a key GM Europe executive, with privileged knowledge about GM procurement practices.

Evaluating Appropriate IP Strategies

An IP technology strategy also encompasses the choice of mechanisms used to protect the company’s existing intellectual property portfolio and to defend against competitive actions by other firms. The offensive component of the strategy involves the aggressive pursuit of IP litigation against patent infringers, copyright pirates, and others who seek to devalue the company’s IP through imitation or misappropriation. It also addresses the use of increased licensing to generate royalties from previously unused technologies, thus creating new profits. Texas Instruments, for example, has used the offensive IP approach to make its patent litigation and licensing practice the most profitable function in the firm.

Companies must also pursue a defensive IP strategy to prevent disruptive action by competitors. For example, the firm must continually scout out blocking patents held by others in order to avoid potential infringement litigation. If blocking patents are identified, the firm should arrange cross-licensing or other agreements to resolve the conflict. Also, the firm itself can file blocking patents to foreclose the strategic technology options available to competitors.

The key organizational tool used by companies as the foundation of their IP technology strategy is the IP audit. Like the technology audit described by Ford, an IP audit is both a one-time exercise and a periodic routine [29]. It seeks to identify all of the actual or potential intellectual property held by various parts of the firm, including patents, copyrights, trademarks
and trade secrets, and compiles these in a central database. This is accomplished by interviewing company researchers, marketing personnel, and other staff to find out what IP they have generated or used. This also provides an opportunity to examine the company’s IP practices, and to encourage staff to protect all relevant IP through legal tools (patents, trademarks, etc.) and through policy and practices (e.g. ensuring adequate security measures to protect trade secrets).

Perhaps the most important goal of the audit is to raise awareness throughout the company, especially among researchers, of the strategic value in identifying, protecting, and exploiting all available intellectual property. It also can be used to encourage the development of the “knowledge-sharing culture” dictated by knowledge management principles.

The IP audit is generally conducted by an IP law firm, which then recommends changes to both procedures and facilities at the company to encourage IP protection. However, law firms may be limited in that they focus primarily on the explicit intellectual property which is protectable by law, and often do not understand the variation in the significance of different pieces of intellectual property or the role of knowledge in competitive strategy. It may be more appropriate to form an internal team to conduct an IP audit, especially one which includes staff trained in the technology management field who can link technology, knowledge and business.

Companies which do not use IP audits often have peripheral inventions which are unprotected or, if protected through a patent filing, are left unexploited by the firm. One consequence of the IP audit is the identification of technologies which should be licensed out. The new awareness of the value of IP fostered by an IP technology strategy will have a reflexive effect on the field of knowledge management, and on corporate approaches to IC. In a static analysis, IP technology strategy dictates that a firm know at any given time what key knowledge it possess, and how well that knowledge is utilized. However, IP technology strategy also
introduces a dynamic aspect to knowledge management, since future revenues can only be gained through the generation of new knowledge. This requires companies to establish more effective learning routines in addition to mechanisms for knowledge sharing and diffusion.

The concept of strategic technological learning demands that corporations develop their organizational intelligence, defined as the creation of knowledge in addition to the possession of knowledge. Rather than simply isolating and measuring discrete intellectual assets, true knowledge management must include practices for ensuring that the company continues to produce new knowledge and absorb additional knowledge through external linkages. The organizational intelligence/learning process is a continuous cycle if activities that include: environmental sensing/scanning, remembering, perceiving, interpreting, and adapting and produce tacit and explicit knowledge and know-how (see Table 4) as a result of strategic, tactical, and operational technological learning [30].

Referring back to Figure 2, the boundaries of the areas where patents and trade secrets are most appropriate reveal that there is also a class of technologies for which strict protection is not clearly advantageous. Several environmental changes are leading firms both to license out certain technologies, and to license in as an important mode of technology acquisition.

*Increased Licensing Activity in the United States: Motivations and Implications for Technology Management*

Intellectual capital is created “through two generic processes: combination and exchange...New intellectual capital can be created through incremental or radical change but both involve either combining elements which were previously unconnected or the development of novel ways of combining elements previously associated. When resources are held by
different parties, exchange is a pre-requisite for resource combination.”[31]. The exchange of knowledge assets to create intellectual capital sets the stage for the discussion of licensing and cross-licensing as components of the business and technology strategy of the firm.

Anecdotal and quantitative data show that over the past decade, U.S. firms have increased their licensing activity. According to data from the U.S. Department of Commerce, international technology licensing between firms has risen by 18 percent per year, and domestic licensing has increased at the rate of 10 percent per year. The decision to license technologies in or out should be guided by the technology strategy of the firm. Ford breaks down technology strategy into three components: technology acquisition, technology management, and technology exploitation. The corporate strategy combined with strategic technology management factors drives the decisions of licensees and licensors to increase their use of licensing (see Table 5).

Table 5 reflects how the firm’s strategic position at the industry and market levels drives decisions on the purchase or sale of firm technologies via licensing, thus forming the basis of an IP technology strategy. The firm could use technology licensing in conjunction with strategic objectives, such as to:

a) grow more quickly or increase profitability
b) maintain or defend its current position
c) diversify out of its current position by acquiring a technological "foothold" into more promising markets

For example, a firm in a defensive position is less motivated to license out its core technologies. As an example, Apple Computer licensed out the Mac OS in 1995, but in 1997 reversed that decision and acquired the Macintosh operations of its major licensee (Power Computing) when it perceived that licensing had eroded its own share without significantly
expanding the market for Mac-compatible machines. Table 5 also shows how prevailing environmental conditions (such as intensity of rivalry, etc.) affect strategic technology decisions. This analysis enables a firm to deal more explicitly and effectively with the following strategic technology management questions:

- “Is the firm currently falling behind vis-a-vis current and emerging competitors?”
- “Could licensing allow the firm to play “catch-up” with its competition?” and
- “What is the best licensing strategy given a certain rivalry intensity and market and industry turbulence?”

In this context, the key conditions that need to be fulfilled for the productive combination and exchange of knowledge assets through for instance licensing agreements are [32]:

a) accessibility of objectified and collective forms of social knowledge,
b) anticipation of the creation of new valuable knowledge,
c) motivation of the parties to combine and exchange knowledge seen as beneficial to them,
d) capability to execute the knowledge exchange or combination in question, and
e) development of a co-opetitive relationship between the source and acquirer of knowledge.

The Licensee Perspective: Licensing for Technology Acquisition

For licensees, the decision to enter a licensing agreement involves the technology acquisition phase of strategy. At this stage, companies face the classic transactions cost “make vs. buy” decision. Under a transactions cost framework, the problem of whether or not to license in technology would be resolved by balancing the administrative costs of the licensing agreement against the costs of acquiring the same technology through R&D. This analysis is
highly idealized; it assumes that the firm knows in advance how much it would cost to “invent” the technology by itself, and also knows the exact value of the technology being licensed.

In practice, no licensee has this level of omniscience. Instead, the increase in licensing can be explained through an analysis of changes in the nature of innovation and research in industry:

- **Increased costs of R&D.** As successive generations of technologies grow in complexity, the costs to develop new technologies exceed the resources of individual firms. Licensing provides a means to acquire needed component technologies without spending corporate funds on in-house research.

- **Ferocious competition from current and emerging competitors.** The globalization of research capabilities and the speeding flow of information means that companies can sustain technology-based competitive advantages for shorter periods. This also drives firms to find the most efficient means of acquiring the technologies needed to generate new products.

- **Decreased product life-cycles and pressure to shrink time-to-market.** Related to the above point, technologies have much shorter lifespans than in previous eras. Scientific and technological progress renders products obsolete in short order. Firms therefore need to source technologies in ways which are the least time-consuming.

- **Demise of the “not-invented-here” syndrome.** U.S. firms have historically frowned on technologies developed externally. Increased competition and other factors have now convinced that these old prejudices serve only to reduce the flexibility and responsiveness of firms in the face of new market challenges.

These factors are driving companies to consider acquiring technology via licensing in rather than internal R&D. In addition, the firm’s own technology position can affect the
licensing decision, in regards to its relative standing in the technology, the urgency of the acquisition, the commitment or investment acceptable to the firm, the position of the technology in its overall life-cycle, and the technology’s importance to firm survival (see Table 6).

Some examples of technology acquisition strategies including licensing can be found in the publishing, financial services, and software industries. The Web-based book retailer Amazon.com entered the electronic information market using technology developed internally. In contrast, Barnes & Noble has caught up by acquiring existing Internet commerce technologies from various firms, and applying it to their business. Similarly, Microsoft has traditionally acquired companies to fill gaps in its technology portfolio (e.g. the purchase of WebTV to gain a foothold in the emerging digital TV/cable data market, and the purchase of VStream to enter the Internet video streaming area).

Another perspective uses options theory to explain licensing in as a “platform investment” for companies, particularly in uncertain, high-technology industries. Licensing in a technology can serve two functions. It can provide strategic technological capability options: by licensing in given technologies, firms create opportunities or 'options' for themselves which can be "exercised" to reduce the cost of adopting subsequent, more advanced technology vintages [33]. It can also provide a growth option, giving the firm “the right to expand in the future into new product or geographic markets” [34]. Since a firm cannot predict all future technologies or pay to develop all such technologies internally, licensing is a viable means of protecting the company in times of high technological uncertainty: for example, in the early stages of a technology before a dominant design has emerged.
Companies (and especially large corporations) are more actively seeking to license technologies out to other firms. Licensing out has been traditionally viewed as a mechanism for market entry, particularly into overseas markets, but not as a mode of competition. Other reasons for more recent licensing activity include rapid market penetration, the creation of standards, and the amortization of R&D costs [35].

Another emerging trend is the rise of cross-licensing to avoid the threat of infringement, as seen in technologies such as Digital Video Disk (DVD) and High-Definition Television (HDTV). Cross-licensing or license pooling, particularly among competing firms, also reflects the rise of a new perspective on firm interaction, called “co-opetition.” Co-opetition draws on game theory analysis to show how, under certain circumstances, a perceived competitor might be a candidate for cooperation to transform a zero-sum situation into a positive sum game. Cooperation means engagement in joint activity toward a shared goal [36]. In the case of the Digital Video Disk, cross-licensing represented a form of cooperation to create a common user platform (the shared goal), which could then be used by the members of the license pool to create competing products.

The most recent change in licensing practices is the increasingly aggressive licensing strategies adopted by such firms as Dow Chemical, Xerox and Texas Instruments. These firms have taken to licensing out a wide range of technologies held by the firms, even in areas unrelated to their major business. For example, Xerox has created a new chemical company based around chemical technologies it has developed as a byproduct of other research. Licensing out is now recognized as an option for technology exploitation, referring back to Ford’s framework (see Table 7).
Firm Size and Licensing Practices

While large firms have generally only licensed in technologies related to their core business, for the express purpose of expanding their existing business lines, licensing out has been one of the major activities of small firms in the U.S. These firms often lack the “complementary assets” needed to take their technologies to the commercial market [37]. Examples of such assets are marketing skills, distribution systems, and manufacturing. Therefore, it is common for small firms to license their technologies to large firms which do possess these assets. In biotechnology, this is particularly common, with biotech start-ups licensing their discoveries to the large pharmaceutical firms who can sell the resulting products worldwide.

Attempts to license out technologies by small firms are not always successful, however. Such firms face some disadvantages in licensing to large firms. The large companies may already have sunk investments in assets which are incompatible with the new technology. More often, the small firm simply does not have the business expertise to market their technologies effectively to large firms. Lack of capital and skills for marketing are the major reason why small firms are unable to bring their technologies to the market, thus leaving their patents unutilized.

The prospects for licensing out of technologies by small firms has several advantages [38]:

- The small firm can access and leverage the large firm knowledge and competencies in other segments of the value chain;
• The small firm can, through the large firm, exercise control or influence over a larger portion of the market;
• The small firm can gain new product knowledge;
• The small firm has control over the risk profile of the transaction;
• The license provides a more secure financial reward than independent marketing;
• The license is the first step in forming an alliance with the large firm, which could protect the small firm against environmental uncertainty;
• The small firm can ensure its survival by becoming an indispensable resource for training, installation, and other services.

The primary decision drivers for increasing licensing activity are summarized in Figure 3.

6 Knowledge Management and Intellectual Capital in Collaborative Settings: Trust and Co-opetition

The management of knowledge as intellectual capital in the context of strategic technology partnerships facilitates the pursuit and achievement of the following strategic corporate objectives of the partners:

(1) Maximize the effectiveness and efficiency of higher-order technological learning processes with both internal and external foci (with respect to its partners), namely the organizational intelligence/learning processes and especially the rate of technological learning.
(2) Facilitate and foster the development of a current and dynamic evolving portfolio of strategic technological capability options in a more effective and efficient manner from a technology and market risk perspective.

The above discussion yields some important implications of the knowledge management paradigm for the management and development of research collaborations. In any collaboration, and particularly in research involving joint government-university-industry research, negotiations over the appropriate division of intellectual property rights (generally focusing on patents) are often cited as the most problematic issue in securing a collaborative agreement. In such negotiations, the parties are generally taking a “zero-sum” approach, completing for exclusive control of the most promising inventions from the collaboration. The knowledge management paradigm suggests three important issues which challenge this perspective.

First, intellectual capital involves knowledge beyond that captured by patents. For many participants in collaboration, the knowledge which is patented may end up being the least valuable product of the partnership. The exchange of tacit knowledge needed to capitalize on the technological opportunities created by collaboration is much more significant. In this sense, disputes over the allocation of patents may be irrelevant and counterproductive to the goals driving the formation of collaborative research ventures [39].

Second, the knowledge management approach argues strongly for a “co-opetitive” approach to the treatment of intellectual capital in research collaborations. To achieve a “win-win” outcome, a collaboration should produce knowledge of benefit to all participants. In this sense, the practice of knowledge management within a collaboration is the union of the knowledge management policies of all participants, rather than the intersection of those policies. Partners in research should direct their efforts toward ensuring that all other partners receive the
knowledge most suitable to their strategies and needs, rather than simply focusing on their own requirements.

Third, economists are now exploring the idea of "social capital" as enabling people to cooperate towards a common goal beyond purely financial motives. “To form and lead the kinds of hybrid, cooperative organizational forms...companies must command substantial social capital. Clearly, just as knowledge is the lever of intellectual capital, trust is the lever of social capital. Fukuyama defines trust as "the expectation that arises within a community of regular, honest, and cooperative behavior, based on commonly shared norms, on the part of other members of that community" [40]. Building trust in such networks requires the sharing of intellectual capital to build social capital. In other words, knowledge exchange forms the foundation for trust in corporate alliances, linking intellectual capital with social capital [41].

For research collaborations, encouraging knowledge sharing at the individual level benefits the cooperative venture in two ways. First, it can guarantee that knowledge will flow efficiently to those employees who are in the best position to utilize that knowledge at a given time. Second, however, it bonds individuals together in a collaborative mode to ensure that they work toward common goals, which in turn will drive firm innovation.

*License and research collaboration*

The development of a “co-opetitive” approach to strategy leads firms to rely less on exclusive licensing in collaborative settings, and toward more creative solutions which ensure that all partners extract useful knowledge from the collaboration. Collaborative ventures should develop a more global approach to knowledge management, encompassing explicit knowledge plus the three forms of organizational knowledge cited in Table 2:
• Tacit knowledge, which can be manipulated and managed through face-to-face meetings, collaborative work settings, personnel rotation, and mentor-apprentice relationships;

• Rule-based knowledge, which can be transferred as firms directly observe each other’s organizational policies and processes and adopt those which lead to improved efficiency and effectiveness;

• Background knowledge, which becomes shared as corporate cultures converge over a term of close interaction and collaboration between organizations, and as a collaborative venture develops its own unique history and identity.

Since partners generally enter collaborations with different goals and expectations, knowledge management is a tool which can be used to track the intellectual capital which is contributed to the collaboration, identify and classify the knowledge produced by the venture, and then develop a more equitable distribution of the knowledge based on the individual needs of the participants. Firms are now formalizing their internal knowledge management processes through the use of information systems; research collaborations should also involve the integration of those systems so that the collaborations are governed by common knowledge management policies transparent to each partner. These practices and policies are more constructive than formal licensing arrangements, since members can still track their return on knowledge investment without obsessing over the equal distribution of formal intellectual property assets.

The shift toward this kind of knowledge management paradigm will promote future research collaborations, since this approach helps to make the benefits of collaboration more explicit and more accessible to all partners [42]. In fact, the same economic and technological forces which drive increased licensing activity are leading firms to partner with other firms and
organizations for technology development. The knowledge management paradigm helps to inform the analysis of collaborative activity and management of research cooperation. If intellectual capital is the primary source of future wealth, then firms will need to gain access to that capital by whatever means are necessary. At the same time, the simple acquisition of IC through the purchase of firms is not always appropriate, because it may result in the flight of the human capital component of firm IC. This argues for the extension of a firm’s IC through the use of strategic alliances and other inter-organizational configurations to maximize the opportunities and abilities of the firm to generate new knowledge.

7 Implications of the IC Perspective for International IP Protection and the Global Dynamics of Knowledge-Based Economics

Due to its sophisticated system of IP law and the size of its market, the U.S. is the primary target nation for patenting. The centralized filing procedures under the Patent Cooperation Treaty and the European Patent Convention have made multinational protection of IP more feasible. Still, many foreign countries charge patent maintenance taxes that increase annually to high levels and/or require the local working of a patent or compulsory licensing, which makes overseas patenting less attractive.

The globalization of commerce and the global distribution of technological competence makes international IP protection more imperative for U.S. firms. International harmonization of IP laws, effected through the General Agreement on Tariffs and Trade (GATT) talks and the related negotiation on Trade-Related Intellectual Property (TRIPS), is designed to facilitate the
global protection of IP. For example, signatory nations are standardizing their national patent protections as follows [43]:

- Both product and process patents will be recognized and protected;
- Nations will limit the use of compulsory licensing;
- Patent terms are standardized to 20 years after the date of filing;
- Additional guarantees are made to protect pharmaceutical and agricultural patents.

The U.S. has already begun to modify its patent system to conform to these standards. Now that IP laws are being harmonized, international negotiations are focusing more on standardizing enforcement of those laws across countries. Lester Thurow identifies four factors which make protecting intellectual property a key competitive issue for firms and national governments [44]:

a) the centrality of intellectual property rights

b) the decline of public knowledge

c) the emergence of new technologies

d) the globalization of the economy

Some nations are noticeably more lax in attacking patent infringement or copyright piracy, particularly in rapidly industrializing countries such as Taiwan, China, India, and Brazil. In part, this is due not to some concerted effort to “steal” technologies from companies of developed countries, but because different IP regimes are more appropriate to the level of development of those countries [45]. Also, national courts vary in their views on IP protection. Harmonizing IP protection enforcement is highly problematic, because enforcement practices are often not codified in law in the way that national IP legal systems are. Also, while governments tend to change IP laws under threat of exclusion from global trade and investment activity,
enforcement agencies are less susceptible to such threats. Therefore, while IP law harmonization was achieved through multilateral action, enforcement harmonization is predominantly a bilateral process.

Rushing & Brown make the following conclusions and recommendations in shaping global intellectual property regimes and growing and leveraging intellectual capital using such facilitating legal and trade contexts as the WTO charter [46]:

1. Trade-oriented policies to enhance protection should target specific countries and industries,
2. Care should be taken that efforts to enhance the protection of technology world-wide do not diminish the flow of scientific knowledge across borders,
3. Trade strategies must recognize the linkages between intellectual property protection and technology investment and trade flows,
4. Protection efforts must emphasize that the benefits to organizations from protection are more broad-based than economic returns from their research and development efforts,
5. The needs and advice of business and academic communities in all countries must play a strong role in developing an international regime for protection,
6. Strategies to advance protection should take a long range approach, namely a five to ten-year time frame,
7. An international agreement should recognize that new technologies enable the development of new protections,
8. The entry of new nations into the global economy such as the former Soviet block countries and China, requires an expansion of the negotiating framework to stress multilateralism.

Hence, emerging global techno-economic trends that impact the international IPR regimes can be distilled in the following processes of convergence between technology and
knowledge management, global trade and IPR issuance, protection and licensing and knowledge-enabled global competition:

- **Technology globalization and “niching:”** While IPR regimes across the world are becoming harmonized, specialized “niches” of expertise are developing in particular nations. These pockets of expertise will need to link to each other through licensing and other mechanisms to mobilize their collective intellectual capital for global competition. This will contribute to the organization and merging multinational networks of firms which will form the basic unit for global competition.

- **Diffusion of IPR standards.** Standards for intellectual property are being spread across the world through multinational harmonization. This means that the IPR policies and practices of the West will become more widely adopted, especially as non-Western firms develop sophisticated intellectual assets which require protection.

- **Divergence of IPR enforcement practices.** At the same time that IPR legal regimes are converging, there is the remaining threat that enforcement practices will diverge, with each nation choosing to enforce IPR protection in ways which favor their national champions. Thus, international trade negotiations must move from the establishment of a common legal regime to the more specific task of standardizing the way in which those regimes operate in practice.

- **Knowledge-based global rivalries.** The identification and management of IC will enable firms to understand their own intellectual capabilities and assets with more accuracy, which in turn will enable them to identify appropriate partners with whom they can combine their common capabilities with gainsharing outcomes. This will create new
globe-spanning alliances which compete specifically through their knowledge capabilities, not simply through manufacturing or other competencies.

The implications of knowledge sharing for the new knowledge-based economy are substantial. Knowledge-based competition is generally assumed to require that firms have different knowledge which they then use to create sustained competitive advantage. But knowledge sharing allows firms to access the same basic knowledge to cooperate and compete simultaneously for greater productivity. This, in turn, changes the way that firms must operate, and the mechanisms for governing transactions in the new economy.

Intellectual property is thus emerging as the essential “currency” for global trade in strategic capabilities for market-based competition, whose use continues to grow (see Figure Four). As a result, firms increasingly view their intellectual property as their primary asset or form of capital which can be leveraged into future advantage in technology and products and in this context, the intellectual property audit is becoming an important tool to transforming firms from traditional storekeepers of intellectual capital to firms which strategically utilize and grow their intellectual capital and tap into the wealth of their proprietary and shared knowledge.

Moreover, there is a double paradigm shift process afoot, in terms of re-defining both the knowledge management as well as the technology management paradigms as a result of the emerging role and significance of intellectual capital and the increasingly dynamic and virtual nature of the knowledge-based economy. These shifts are especially manifested in the transition of the ways in which intellectual property is commercialized from large firms and formal interactions to entrepreneurial start-ups linked by informal networks and other virtual business enterprises that thrive on knowledge and zero overhead [47].
References and Notes


[22] There are different kinds of patents, e.g., design, utility and plant patents. Whether an invention is made by a flash of genius or painstaking research, to be patentable it must meet all of the following hard to satisfy criteria:

(a) "novelty" in that it was not previously known to others or in public use in the U.S., or patented or described in a printed publication anywhere, more than 1 year before the U.S. application's filing date;

(b) "nonobvious" to a person having ordinary skill in the relevant art; and

(c) "utility" in that it has a useful purpose, actually works, and is not frivolous.

A patent in essence grants permission to hold an exclusive monopoly over the exploitation of a technology. Complementary to a patent is the Statutory Invention Registration (SIR), which gives the holder the right to use the invention but does preclude others from using or selling it; these are frequently used for registering government inventions. Contrary to a patent, this is a right to use a technology rather than to prevent others from using it. SIRs are cheaper to register than patents as they are not normally subject to examination.

[23] Trademarks include brand names identifying goods ("Pepsi-cola" for a soft drink), service marks identifying services ("The Four Seasons" for a restaurant service), certification marks identifying goods or services meeting certain qualifications ("UL" for appliances meeting the safety standards of Underwriters Laboratories, Inc.) and collective marks identifying goods, services, or members of a collective organization ("AFL-CIO" for union locals). In the United States, unlike many other countries, the first user of a mark is normally considered its owner even if someone else has been the first to apply to register
the same mark. Federal and State trademark law protects a mark whether or not it is registered, and protection endures as long as the mark is in use and the user takes steps to prevent others from using the same mark.

[24] Copyrightable works include: literary, musical and dramatic works; pantomimes and choreographic works; pictorial, graphic and sculptural works (including nonutilitarian design features of useful articles); motion pictures and other audiovisual works; sound recordings; computer programs; and also compilations of works and derivative works. Copyright only protects particular expressions of ideas, not the ideas themselves. Also, a protectable work must be "original", i.e., not copied from another source (although two separately protectable works theoretically could be identical by coincidence), and the work must not be so elementary that it lacks sufficient creativity to be copyrightable (the standard for creativity is minimal).

[25] One notable example of a trade secret is the formula for Coca-Cola. Trade secrets are defined and protected under individual state laws in the United States, and thus may be subject to different enforcement standards

Research-Technology Management, January-February, pp. 44-56.


[32] Nahapiet & Ghoshal, op. cit..


[41] Given that firms are unable to protect their knowledge absolutely, they may be able to pre-empt the misappropriation of their knowledge by sharing it with their competitors. This, in turn, can create the expectation that the competitor will in turn share its knowledge with the donor firm. Thus, knowledge becomes an object of barter between firms towards the development of a new form of economic relationship. The equal exchange of knowledge constitutes a "quid pro quo" which, in turn, reinforces a growing trust between the parties to that transaction. As long as the knowledge exchanged between the firms is perceived by the recipients to be of equal value, trust can be built. See Carayannis, E. and Alexander, J. (1997) ‘The role of knowledge exchange in trust, co-opetition and post-capitalist economics’, paper presented at the European Institute for the Advanced Study of Management, Belgium.


Tables

Table 1
Different Types of Organizational Knowledge
Spender, 1996, p. 52

<table>
<thead>
<tr>
<th></th>
<th>Individual</th>
<th>Social</th>
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<tbody>
<tr>
<td>Explicit</td>
<td>Conscious</td>
<td>Objectified</td>
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<tr>
<td>Implicit</td>
<td>Automatic</td>
<td>Collective</td>
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Table 2
Three Types of Organizational Knowledge:
Tacit, Rule-based, and Background Knowledge
Wei Choo, 1995

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<tr>
<th>TYPE</th>
<th>FORM</th>
<th>EXAMPLES</th>
<th>USE</th>
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<tbody>
<tr>
<td>TACIT KNOWLEDGE</td>
<td>Procedural, Embedded in Action</td>
<td>Know-how, Heuristics, Intuitions</td>
<td>Ensures Task Effectiveness</td>
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<td>RULE-BASED KNOWLEDGE</td>
<td>Declarative, Encoded in Programs</td>
<td>Routines, Standard Operating Procedures, Record Structure</td>
<td>Promotes Operational Efficiency and Control</td>
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<td>BACKGROUND KNOWLEDGE</td>
<td>Contextual, Expressed in Texts</td>
<td>Stories / Metaphors Mindsets / Worldviews Visions / Scenarios</td>
<td>Instills Commitment Through Shared Meaning</td>
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### Table 3
Methods for Evaluating Intellectual Property Assets
from Brooking (1996), p. 107

<table>
<thead>
<tr>
<th>INTELLECTUAL PROPERTY ASSETS</th>
<th>Survey for Market Pull</th>
<th>Competitor Analysis</th>
<th>Determine ROI</th>
<th>Audit Agreements</th>
<th>ROI Legal Fees</th>
<th>Survey for Know-how</th>
<th>Analyze Payments</th>
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<td>Trade Secrets</td>
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<td>Service Marks</td>
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### Table 4
Typologies of Technological Learning Content:
Strategic, Tactical, and Operational

<table>
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<th>TYPOLOGY OF OPERATIONAL TECHNOLOGICAL LEARNING</th>
<th>TYPOLOGY OF TACTICAL TECHNOLOGICAL LEARNING</th>
<th>TYPOLOGY OF STRATEGIC TECHNOLOGICAL LEARNING</th>
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<tbody>
<tr>
<td></td>
<td>INDIVIDUAL</td>
<td>GROUP</td>
<td>INDIVIDUAL</td>
</tr>
<tr>
<td>TACIT</td>
<td>Know-how, Expertise</td>
<td>Group Texture, Work Practice</td>
<td>Common Sense, Good Judgment</td>
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Table 5
Effect of Corporate Strategic Posture and Market Conditions on Modes of Technology Acquisition and Technology Exploitation

<table>
<thead>
<tr>
<th>Strategy Conditions</th>
<th>Technology Acquisition Model</th>
<th>Technology Exploitation Mode</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Internal R&amp;D</td>
<td>License In</td>
</tr>
<tr>
<td>Growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defend</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Exit</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Intense rivalry</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Rapid change</td>
<td>↑</td>
<td></td>
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Table 6
Licensing In and Other Technology Acquisition Mechanisms from Ford (1988)

<table>
<thead>
<tr>
<th>Acquisition Methods</th>
<th>relative standing</th>
<th>Urgency of acquisition</th>
<th>Commitment/ investment to acquire</th>
<th>Technology life cycle position</th>
<th>Categories of technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal R&amp;D</td>
<td>High</td>
<td>Lowest</td>
<td>Highest</td>
<td>Earliest</td>
<td>Critical</td>
</tr>
<tr>
<td>Joint Venture</td>
<td></td>
<td>Lower</td>
<td></td>
<td>Early</td>
<td>Distinctive/ basic</td>
</tr>
<tr>
<td>Contracted R&amp;D</td>
<td></td>
<td>Low</td>
<td></td>
<td>Early</td>
<td>Distinctive/ basic</td>
</tr>
<tr>
<td>License-in</td>
<td></td>
<td>High</td>
<td>Lowest</td>
<td>Later</td>
<td>Distinctive/ basic</td>
</tr>
<tr>
<td>Purchase of Product/Part</td>
<td>Low</td>
<td>High</td>
<td>No commitment or investment</td>
<td>All Stages</td>
<td>External</td>
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</table>

47
Table 7
Licensing Out and Other Technology Exploitation Mechanisms
from Ford (1988)

<table>
<thead>
<tr>
<th>Exploitation Methods</th>
<th>relative standing</th>
<th>Urgency of exploitation</th>
<th>Need for support technology</th>
<th>Commitment or investment</th>
<th>Technology life cycle position</th>
<th>Categories of technology</th>
<th>Potential application</th>
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</thead>
<tbody>
<tr>
<td>Employ in own production or products</td>
<td>Lowest</td>
<td>Lowest</td>
<td>Lowest</td>
<td>Highest</td>
<td>Earliest</td>
<td>Most critical</td>
<td>Narrowest</td>
</tr>
<tr>
<td>Contracted-out manufacture or marketing</td>
<td>Lower</td>
<td>High</td>
<td>High</td>
<td></td>
<td>Early</td>
<td>Narrow</td>
<td></td>
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<tr>
<td>Joint venture</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td></td>
<td>Early</td>
<td>Wide</td>
<td></td>
</tr>
<tr>
<td>License out</td>
<td>High</td>
<td>Highest</td>
<td>Low</td>
<td>Lowest</td>
<td>Later</td>
<td>Least critical</td>
<td>Widest</td>
</tr>
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</table>
Figure 1
Components of Intellectual Capital

Corporate Goals

Intellectual Capital

- Market Assets
- Human-centered Assets
- IP Assets
- Infrastructure Assets

Figure 2
Variables in the formulation of an IPR portfolio
Figure Three: Small and Large Firm Motives for Licensing

<table>
<thead>
<tr>
<th>License In</th>
<th>License Out</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Large Firm</strong></td>
<td></td>
</tr>
<tr>
<td>Obtain external tech for fast product development</td>
<td>Generate revenues from non-strategic technologies</td>
</tr>
<tr>
<td>Exploit technology as a strategic option</td>
<td>Apply strategic technologies in other areas</td>
</tr>
<tr>
<td><strong>Small Firm</strong></td>
<td></td>
</tr>
<tr>
<td>Avoid/settle patent infringement claims</td>
<td>• Obtain access to complementary assets</td>
</tr>
<tr>
<td>Obtain technology needed for commercialization</td>
<td>• Generate revenues when unable to exploit own technology</td>
</tr>
</tbody>
</table>

Figure Four
U.S. Balance of Payments of Royalties with Foreign Residents
U.S. Department of Commerce, Bureau of Economic Analysis

in $millions

![Bar chart showing U.S. Balance of Payments of Royalties with Foreign Residents from 1987 to 1995.](chart.png)