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Licensing and Business Strategy in the Chemicals Industry

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INTRODUCTION

Licensing is playing an increasingly important role in the development and commercialization of innovation in many industries. Licensing has long been a component of business strategy, but in the past its use has often been restricted to areas away from the firm's core business. Out-licensing has been used to earn residual value from unused or mature technology, or to provide access to foreign markets or product markets the innovator has no plans to enter directly. While this remains a predominant approach to licensing, there has been a gradual increase in the volume and extent of licensing activity, especially over the past decade, making it more central to firms' strategies. Facing stronger innovation-based competition, often on a global scale, firms have become more aware of the value of licensing, and are more likely to include it as a component of their competitive strategy. Firms have broadened their licensing objectives with a greater variety of commercialization methods and partnership structures. They may also be more willing to license-in technology as an alternative to in-house development.

There are several different objectives for technology licensing, which reflect underlying business strategies. These in turn depend on the nature of

the innovation, the competitive conditions in the industry, the relative strengths of the parties, the quality of intellectual property (IP) being transferred, the strength of IP protection, and other concerns. Based on the analysis of a number of case studies, including the current study of the chemicals industry, four basic objectives of technology licensing have been identified: efficient commercialization, technology exchange, strategic interaction, and strategic misfits. For each of these objectives there are various forms of licensing structures, according to what is included in the license, how the agreement is organized, and how the license is integrated into a broader strategic relationship, if any. Structures range from simple arms-length licenses for patent rights, to turnkey technologies combining IP rights and know-how, more complex structures involving licensing intermediaries, joint ventures for commercializing and/or developing technology, and finally to several forms of alliances and partnerships.

Categorizing licenses around strategic objectives serves at least three purposes. First, understanding the strategic objectives underlying the license can help licensing managers structure agreements in the most appropriate way. Objectives and structures are interrelated, and the form of the agreements is likely to be different in each case. Experience has shown that licensing attempts often fail because of the inability of the parties to resolve issues that are primarily strategic. Shifting the focus of licensing negotiations from, say, a unidimensional concern about royalty rates to a broader focus on the terms and conditions needed to make licensing agreements work greatly increases the chance of licensing success.

Second, this links licensing more securely to the overall innovation management of the firm as part of the development and commercialization process. Strategic choices may be needed to make licensing more effective (for example, through the development of in-house capabilities in technology transfer or the introduction of a focused patenting strategy), and, conversely, the inclusion of licensing options at an early stage in strategic decisions should enhance innovation performance (perhaps by deciding which products to develop or which markets to enter).

Third, from a legal and policy viewpoint, it is important to inform the debate about the impact of licensing on competition. Fuller understanding of licensing procedures, including the links between licensing and strategy, the efficiency rationale, and reasons for certain terms and conditions, may help allay antitrust concerns.

The purpose of this chapter is to review the different ways in which technology licensing is used as part of innovation strategy in the chemical process industry. We review the different objectives of firms for licensing in different segments of the industry, and we look more closely at the different structures of the licensing agreements, focusing primarily on the use of licensing in commercialization, the predominant motivation for licensing in the industry.

The chemicals industry has a number of attractions as a case study. The first is that licensing is a widespread and important feature of the industry.

Although technology is primarily developed in-house for use in manufacturing products, licensing is used extensively to acquire specific technologies and to access international markets.

A second attraction is that there is a broad range of types of licensing, including examples of each of the categories listed above. The main licensing activity is in the area of commercialization, where several strategic variations are evident. License agreements range from small to very large-scale complex projects, and may include alliances and joint ventures.

Third, licensing involves complex issues of IP protection and technology transfer. The emphasis in the industry is on process technology, and all but the simplest licenses involve a mixture of patents and know-how. Significant resources are needed to effect transfer, and there are special competitive concerns about the area of use of the technology and the ability to contain the leakage of know-how. These call for sophisticated valuation procedures and license negotiations with closely defined licensing conditions and restrictions.

Finally, there are currently a number of changes taking place in the industry's attitude to licensing as a source of revenues and of complementary technologies. Licensing in the past usually has been incidental to the firm's main goals. Firms are now more likely to use out-licensing and joint ventures as part of their commercialization strategies. They are also less able to develop all their own technology in-house and are turning to alliances and in-licensing of technology as a means of reducing innovation costs.

The case study bears on these issues by illustrating, for this particular industry, the range of licensing behavior in the different business divisions of the firms, as seen in the different objectives and structures of licensing agreements. It also shows the efficiency and strategic concerns guiding licensing behavior, and their impact on the structure of the agreements. This includes the role of license restrictions in enabling the firms to license out in ways that do no compromise the value of their IP or damage their competitive position. It illustrates some specific institutional arrangements that help overcome some of the problems facing a licensor. These include methods of negotiating licenses, valuing technology, alleviating the leakage of know-how, isolating legal and business risks, efficiently organizing the transfer of technology, and providing the resources and skills required. In particular this includes the use of specialist engineering firms as intermediaries in the licensing and construction of new process plants, which is an important feature of the industry.

More generally, the study illustrates some aspects of integration between a firm's licensing behavior and its innovation strategy, including the broad management of research and development, and the firm's intellectual capital. It shows current trends in an important, representative industry towards more active licensing policies and the closer management of the firm's IP portfolio.

The study is based on a series of interviews with licensing executives from a number of leading firms in the chemicals industry. We have also re-

lied on a review of the relevant literature. We are most grateful to these executives for the time and effort they have devoted to this project. The study focuses on general licensing behavior in the industry, rather than the specific conditions facing a given firm. The analysis and opinions expressed here are those of the authors and should not be seen as necessarily reflecting the views of any of the companies involved.

LICENSING OBJECTIVES

Licensing is undertaken for a variety of reasons. The main strategic objectives that may be met through licensing are categorized as efficient commercialization, technology exchange and cross-licensing, strategic interaction, and licensing of strategic misfits. (These objectives are discussed in Chapter 5.) In this chapter, we report on licensing activities of several large firms in the chemicals industry and how their activities serve the strategic objectives. Although a given agreement tends to focus on a certain type of objective, there are many overlaps. All licenses are strategic in some sense, and all are ultimately involved in commercializing innovation. The categories reflect the main aim of the agreements, which in turn determine how they are negotiated and structured.

Efficient Commercialization

Innovation can lead to a range of commercialization options, from storage to integrated production. All the alternatives but the extremes, storage and fully integrated in-house commercialization, involve licensing. Efficient commercialization is the use of licensing to combine technology with the complementary assets, such as quality manufacturing, marketing, distribution, and continued product improvement, needed to succeed in the marketplace. The aim of this type of licensing is to supplement a company's own complementary assets by accessing those of other firms, whether they are production know-how, distribution, or capital. In the chemicals industry, complementary assets accessed by licensing are often in specific geographic or other markets that the innovator either cannot reach alone or can reach only at high cost. As described by several licensing professionals, licensing as a major component of technology commercialization has been steadily on the rise.

Up to 5 years ago, as claimed by several licensing professionals from a large diversified chemicals firm hereafter referred to as Firm A, licensing activity was mostly incidental to technology sales of mature processes and equipment. Licenses sometimes went along with these technology sales. Today, global competition is driving changes in the use of licensing. The increasingly rapid pace of technological change means that even if Firm A had the money to develop needed technology it could not afford to take the time to develop that technology internally. Competitive pressures extend to the en-

tire commercialization process—developing new complementary assets such as distribution needed to commercialize a technology may require such large amounts of time and money that the choice of integration is an uncompetitive one. Indeed, time to access needed technology or complementary assets has become critical to profitable commercialization in a global economy.

Licensing is especially likely to serve strategic purposes when used as a means of entering foreign markets. Earlier studies in the literature have shown that the preferred method of international commercialization is often direct investment, because of the higher profits that can usually be earned by direct investment and the greater strategic control this gives the parent company. However, there are good reasons why a firm may prefer licensing to a noncontrolled foreign entity. Entering foreign markets can be a costly and long-term proposition, especially in terms of developing local production and distribution channels. Even a joint venture may involve too many risks (Contractor, 1985; Telesio, 1979).

Our study confirms many of these observations. Firm A's executives choose licensing when it is a more economical commercialization vehicle than internal development and commercialization would be. Licensing in this context may be a component of an interfirm relationship such as a joint venture, subsidiary, partnership, and so on, and it is seen as a necessary activity for meeting today's global competition by providing the most efficient way to commercialize technology rapidly. In response to this view, Firm A has been increasing its out-licensing activities to gain access to world markets.

Another large diversified chemical company, hereafter referred to as Firm B, has had a similar experience. It typically enters into commercial licenses to gain access to geographic markets that it does not and plans not to serve. Out-licensing technology is the only way that Firm B can profit from these geographic markets. Firm B also uses licensing to commercialize technologies that serve markets the firms considers to be too small to support its investment. Other firms, especially smaller ones, may be able profitably to address small markets, which would otherwise be too costly for Firm B to serve.

The strategic choice by Firms A and B to increase out-licensing is resonant with the objectives of two out-licensing programs that have received notable attention (Royse, 1993). Union Carbide and BP Chemical have actively licensed their production processes for polyolefins (hd/lldPE and PP) as a means of efficient commercialization since 1977 and 1983, respectively. With large capital expenditures needed for each plant, neither firm had the capital resources needed to commercialize the technology on a worldwide basis. Carefully timing the introduction of new processes was also important—there were advantages in being first to license extensively by preempting processes developed by competitors, and this also meant that intermediate products used in the process became more readily available earlier (*Business Week*, 1993; Evans, 1993). Today, licensees of the two firms

combined account for more than 50 percent of the world's supply of these chemicals. The success of Union Carbide's licensing programs is emphasized by estimates of revenues from polyolefins in 1992 at $300 million (Royse, 1993, p. 4). In essence, out-licensing allowed Union Carbide and BP Chemical to commercialize their innovations efficiently worldwide by accessing other firms' capital and local capabilities.

Although many chemicals firms have a newfound interest in out-licensing, using out-licensing to commercialize a technology efficiently is not a new activity for BP Chemical. As a recent and small entrant into the chemicals industry in the late 1950s, BP America (then Sohio) was relatively unsophisticated and had no international experience (Evans, 1993). After commercializing a new low-cost process for acrylonitrile in the U.S., it engaged in an aggressive out-licensing program that continues today. With the licensing revenues it received, BP was able to invest heavily in research and development—an investment that has led to its position today as a leading chemical company.

Our examples thus far have focused on out-licensing activities, but in-licensing activities are also on the rise. Although licensing practices differ by business segment, Firm A has a corporate mandate in the chemicals area to acquire more outside technology through in-licensing rather than invent all technology internally. Firm A's agricultural products business provides an example. Licensing, it claims, is used primarily for the purpose of accessing technology to develop products or businesses. In-licensing is undertaken because it is often not profitable to develop technology internally. Internal development is not a timely development alternative when technology can be licensed in. Indeed, a recurring theme throughout our interviews was that accessing technology in a timely manner has become critical to commercialization success and that in-licensing is a way to save time.

Our interviews suggest that in the chemicals industry licensing activities for the purpose of efficient commercialization are on the rise. Firms A and B are exploiting in-licensing and out-licensing activities to achieve more efficient commercialization by getting to market faster, and by entering markets in which—for geographic or other reasons—they otherwise would not have participated or would have done so at high cost. Indeed, the success of Union Carbide and BP Chemical have shown the value of licensing activities. Changes in the global business environment have increased pressure to get to market quickly. Efficient commercialization has become an increasingly important strategic objective and may be the dominant motivation for increased licensing activity in the chemicals industry.

Technology Exchange

Technology exchange includes the cross-licensing of technology and intellectual property rights and the reciprocal exchange of complementary tech-

nologies. It can serve a number of specific objectives. The most widespread use of cross-licensing in other industries, especially electronics, is the mutual licensing of patent rights, within a field of use, to achieve freedom to operate by avoiding potential infringement litigation. Exchange is also used as a means of technology acquisition, as a resolution of litigation, and as technology leverage in licensing negotiations. Cross-licensing in general is used relatively sparingly in the chemical industry. This is primarily because the main technology content in the industry is in process technology, which tends to be specific to the individual firms and based on know-how and trade secrets. Nonetheless, exchanges of technology and intellectual property rights do occur, as highlighted by the following examples.

Freedom to Operate. Cross-licensing of patents is rare in the chemicals industry, and when it does occur it is much more focused than in the electronics industry. Cross-licensing typically is not undertaken in a proactive way. Whereas semiconductor firms, for example, enter into cross-licensing agreements prior to running into commercialization difficulties, firms in the chemical industry often wait until actual problems occur. Only then do they try to access bottleneck technologies or intellectual property rights through cross-licensing. Cross-licensing is the preferred mechanism for accessing technology and rights to patents because it requires neither cash expenditures nor running royalties.

Firm A provides an illustration. It prefers to exchange patents and technology for cross-licensing rather than to pay royalties, because such exchanges conserve cash. But cross-licensing depends on the particular business and circumstances. Firm A's bottom line is to avoid paying money up front for other firms' patents and technologies because cash payments are viewed as costly.

One circumstance that has lead to cross-licensing is when a firm becomes involved in new fields that are already crowded with patents. Firm A's medical products division, which is a relatively new line of business for the firm, A developed a new technology for detecting a type of bacteria. It was discovered that commercializing the technology required complementary technologies for which many patents already existed and designing around them was not economically feasible. In fact, it is not unusual that three of four inlicenses owned by other firms may be needed to commercialize products in Firm A's medical products business. Cross-licensing was the least costly way of gaining freedom to commercialize the innovation.

Technology Acquisition. The most evident form of cross-licensing in the chemicals industry in trading technology, or reciprocal licensing, in which a firm will give a license in order to receive one. In some cases this is an informal understanding that a future license is expected to balance a current license, in other cases there is a direct link between the licensing agreements.

Firms often choose to make a license agreement as an exchange of technologies. One reason, noted above, is a preference for noncash transfers, as the uncertainties surrounding a new project may make it difficult to justify a cash outlay at an early stage. Reciprocal licensing agreements are a feature of the chemicals industry, but these may be implicit rather than parts of a single agreement. Each is negotiated separately, with a cash value attached to it. Payments then may be netted out. The main problem is that it is very difficult to negotiate a double agreement, especially as separate business units may be involved on both sides.

The grain business offers one illustration from the current cases. A large diversified chemicals firm created a new biological product that requires a seed as a commercialization vehicle. Rather than enter the seed business, the firm has entered into a cross-licensing agreement with seed companies in a complex relationship that allows the seed companies to sell seeds containing the innovation to farmers who contemporaneously contract with the chemicals firm for growing the advanced grain or take out a license so they can sell the grain to end-customers. Without cross-licensing to gain access to seed technology, commercialization may have taken many years at much higher costs or, perhaps, might not have occurred at all.

More generally, reciprocal licenses include the exchange of unrelated technologies between firms that do not compete in the exchanged technology's particular market segment. Cashless cross-licensing agreements such as the one just described are more likely between firms that have an ongoing history of noncompetitive relations. Even when the exchange is between firms that are not competitors, reciprocal licenses face organizational obstacles. Firm B, for example, has been unable to complete any reciprocal licenses in the past four years. One executive suggested that the limited use of cross-licensing at his firm can be traced to two reasons. First, Firm B's reciprocal agreement opportunities are typically for the exchange of two technologies, not multiple technologies. He claims that both parties have the incentive to exchange patents of little value in an attempt to receive patents of high value, which makes valuation of intellectual property difficult. Second, negotiations and, in particular, agreement on a technology's value, are made difficult because of the organization structure and intellectual property management approach of most large chemicals firms. In most instances, a chemical company's intellectual property is managed by business units instead of at a corporate level. Cross-licensing agreements are likely to involve out-licensing technology from one division in exchange for in-licensing technology for another division. Each division's goal of profit maximization encourages them to overvalue out-licenses, undervalue in-licenses, and argue over internal transfer prices for splitting net gains from the cross-license.

As a result of these problems, licensing executives often will treat reciprocal licensing as two separate agreements where the monetary value of the

technology in question is determined separately. Only when the monetary value of each technology is determined can they be exchanged on a cash equivalent basis without additional fees.

Litigation Resolution. It is not uncommon for intellectual property infringement issues to arise in the chemicals industry. Cross-licensing is one way for chemicals firms to resolve such litigation. In general, cross-licensing may take place at any point in the litigation process, either in the preliminary stage before the case has gone to trial, in the midst of a trial, or as part of the post-trial settlement. One company explained that once litigation has started, and costs escalate, it may resort to cross-licensing to end litigation, typically before trial or the completion of a trial. Executives from several firms with whom we spoke view cross-licensing as the most cost effective way to resolve litigation without the use of cash payments. However, cross-licensing is often viewed as a means of last resort for ending a dispute.

Leverage. Although it is perhaps the least frequently mentioned strategic use of licensing, cases of using licensing to gain leverage on competitors or suppliers were reported by our interviewees. A prototypical example that was offered by one firm described the use of licensing to solve what in the economics literature is called a bilateral monopoly problem. Firm A decided to exit from the market as a supplier of a certain intermediate product and to out-source its needs instead. It contracted with the largest remaining supplier and became that supplier's largest customer.

In this situation the risk is that Firm A may try to use its size to obtain a lower price from the supplier and the supplier may try to use its position as the only firm capable of supplying Firm A's needs to obtain a higher price. Partly to guard against these bargaining difficulties, Firm A, when it exited the intermediate product supply market, did not disband the associated research and development team. The team developed a technology of high value and importance to the supplier. Using its technology as leverage, Firm A was better able to negotiate a low-price long-term contract for the intermediate product in exchange for a license covering the new technology. Although such opportunities are rare, this example suggests that leverage opportunities in the chemical industry do exist and that at least some firms take advantage of them.

Strategic Interaction

Another use of out-licensing is to influence strategically the decisions made by customers, competitors, and suppliers. This can serve three specific objectives: to help establish a new product or process in the market by reducing the risk of adopting the innovation and building up the supply of intermediates, to help establish new product standards; and to deter other competitors from developing matching technologies. Important illustrations

of these objectives can be found the strategic motivations of the licensing programs undertaken by Union Carbide and BP Chemicals.

In a recent article about Union Carbide's licensing activities, Richard Sol, director of licensing sales, explained how licensing was used to influence customers strategically as well as to provide for efficient commercialization. Customers, he states, might have been resistant to having only one supplier. So Union Carbide "had to invest in [its] own resin business to help stimulate the market" as well as simultaneously to license major US competitors such as Exxon and Mobil (Royse, 1993, p. 4). Reducing customers' perceptions of the risks involved in adopting the final product was clearly one of the strategic objectives that guided Union Carbide's decision to license in addition to commercializing through integration.

BP Chemical used licensing and the sequence of firms that it licensed as the means of getting its acrylonitrile technology adopted throughout the industry. After being rejected as a partner by one of the U.S. chemical giants in the early 1960s, BP began licensing Japanese manufacturers. Only then, a former director of BP America's Patent and License Division claims, did American manufactures recognize that BP Chemical (then Sohio) really had something, and that in order to compete with it and the Japanese, they must also take licenses. Over the next decade, companies in western Europe, eastern Europe, and, eventually, developing countries around the world took licenses. BP's process has become a de facto industry standard. Had the Japanese firms not been licensed when they were, the former director believes, they would have found a way to produce acrylonitrile without a license, and that would have made them a substantial competitor today. Furthermore, it is unlikely that U.S. firms would have taken licenses so quickly, and perhaps not at all, if the Japanese firms were not licensed.

The BP experience also provides insight into how licensing is used for strategic deterrence. Not licensing the technology would have encouraged other firms, in this case the Japanese firms, to invent around a technology. Licensing may keep potential competitors from investing in research and development to get around patents. Licensing for the purpose of strategic deterrence, however, is highly dependent on the license's royalty. Larry Evans, former Director, Patent & Licensing Division, BP America, Inc. argues, a royalty rate must be set "so that licensees will not be encouraged to expend significant effort to develop alternative processes that fall outside the license" (Evans, 1993, p. 77). Such strategic deterrence, while often considered anticompetitive, can have important social benefits if the licensee expends its resources improving the existing technology instead of designing around it.

In sum, licensing has been used in the chemicals industry for the purpose of strategic interaction. Reducing customer risks, creating standards, and strategically deterring competitors all provide important reasons for licensing. Licensing for the purpose of strategic interaction typically is only one

of a set of objectives that also include efficient commercialization. Indeed, as is the case with many activities, a single license may serve multiple strategic objectives.

Strategic Misfits

Strategic misfits are those technologies that have no place in the firm's strategic plans. These nonstrategic technologies are either innovations developed to a certain point but not used, or generic competences with no particular strategic value that have been developed by the firm. At one level, the category of strategic misfits overlaps with the commercialization strategy for innovations that for various reasons a firm decides not to pursue, but from which it may earn some residual value by out-licensing. They may also be technologies in areas ancillary to the firm's main business, such as in information systems to support a service function within the firm.

All of our interviewees reported increases in their activities for out-licensing and nonstrategic technologies, but chemicals firms are proceeding with caution. For example, Firm A decided that it no longer relied on a set of paint-related patents so it attempted to out-license those nonstrategic technologies. One firm that wanted to license the technology also wanted the right to sublicense to one or more unnamed firms. For fear that the technology might be passed into competitors' hands, the licensing agreement was not executed.

Although this example suggests restraint in out-licensing strategic misfits, the opportunities from out-licensing misfits is large. Executives from Firm A believe that strategic businesses are supported by only 3 to 5 percent of the firm's patent portfolio, which consists of many thousands of patents. Even if only a small percentage of the remaining portfolio has commercial value for other firms, the opportunity for capturing value from these unused patents seems large. Still, so long as chemicals firms can recover their costs from attempting to license nonstrategic technology, it is likely that they will continue to pursue the out-licensing of strategic misfits.

STRUCTURING LICENSING AGREEMENTS

Definition of Licensing Structure

The strategic objectives that define major licensing categories depend on what the firms expect to achieve from the license, and consequently on the relationship between the parties. Thus a cross-license of patent rights is significantly different from a license for the transfer of know-how to build a new process plant. The aims, the information needs, and the relationship between the parties are different in each case. The licensing agreement itself is

also likely to be different, with varying degrees of complexity and different requirements, restrictions, and guarantees built into the license.

Within these broad categories, there are specific characteristics of the organization of the license. We refer to these as the license structure, meaning the more detailed technical and legal content of the license agreements and the nature of the alliance between licensor and licensee. At one extreme the license may be a simple arms-length out-licensing of rights to use a patent in return for a fee. This is essentially a market transaction with few links between licensor and licensee, with the relevant terms of the agreement defined closely within the license itself. At the other extreme, the license may be part of a broad technology-sharing partnership. It may define the legal basis for technology exchange in the partnership, but necessarily it may be expressed in broad terms so that the true basis for the partnership lies in the informal relationship between the two firms. In between there are a number of alternatives with varying degrees of integration between licensor and licensee, including turnkey technology transfer agreements, licensing intermediaries, joint ventures, and strategic partnerships.

One of the aims of this chapter is to give a better understanding of the different licensing structures and how they are related to the nature of the agreements. In so doing we concentrate on commercialization licenses, which are the most prevalent and varied type of license in the chemicals industry.

Role of Licensing Department

The firms we are concerned with in this chapter are major chemicals producers. Their main objective is the manufacture and sale of products. Research is performed to obtain a proprietary position in the market, not to sell technology. For example, in the words of Robert Kline, chief patent counsel for DuPont, "[the firm] is not in the business of licensing technology. [It] does research to obtain a proprietary position" (Spalding, 1986, p. 31). The aim of licensing is to maximize commercial revenues from IP available for licensing. In our interviews, Firm B noted that licensing is undertaken as a cost center not a profit center; that is, it performs a service function for licensing technology developed for the primary goal of integrated production. This is mainly an opportunistic approach to licensing to extract value from existing IP.

However, it is also clear that today firms are using licensing as a more central part of their commercialization strategies, and that this is a continuing trend. This has gone further in some firms than in others. For example, the Union Carbide and BP Chemical licensing programs for major new production processes for polyolefins, discussed above, have placed licensing of particular technologies as a leading means of commercializing innovation. In Union Carbide's case a separate division has been set up to manage the transfer of technology. Interestingly, Union Carbide's strategy of out-

licensing its Unipol polyethylene process was partly motivated by earnings pressure in the early 1980s (*Business Week*, 1993, p. 88). Licensing began in 1979, and in 1983 the company brought 4,000 of its engineers and technicians together into a new Engineering and Technology Services Group (ETS). This group licenses technology and provides catalysts, engineering services, process design, and project management to chemical and other process industry customers. In some cases Union Carbide markets the product as well.

Most of the corporations described in this chapter are taking a more active licensing and IP management stance. As a first step in this direction some firms have centralized licensing at a corporate level, which standardizes the licensing treatment across the corporation and enables a coordinated corporate strategy. It also facilitates a more proactive role in seeking licensing opportunities and in providing inputs into the broader problems of reducing the costs of maintaining the company's IP portfolio. This may take the form of reviewing the corporation's patent portfolio for licensing opportunities and weeding out unworked patents of no strategic value to the company. In some firms there is also interest in broader IP management, involving licensing and IP protection considerations in some way in technology development decisions. However, as yet there is little agreement on the best way to tackle this. The companies are primarily interested in developing and manufacturing product, and are cautious about letting licensing opportunities, often still seen as only of secondary importance in commercializing IP, influence development decisions.

A result is that the role of the licensing department differs between firms. In some firms it may have primarily an administrative or support role, whereas in others it may be more actively involved in seeking and negotiating licensing agreements. In Firm A, licensing decisions have in the past been primarily the responsibility of the business divisions, although a centralized licensing department is generally involved in formalizing agreements. There is limited uniformity in the structure of the agreements across divisions, and an opportunistic approach to licensing. In some cases conflicts of interest between divisions have been hard to resolve without an overseeing department, for example if one division wishes to license to a competitor of another. In Firm B, the licensing function is more centralized. Negotiations and agreements are more standardized, and the firm appears more likely to seek licensing opportunities on its own initiative. The firm has also instituted forms of communication channels across divisions to help coordinate IP management.

The sources of licensing opportunities vary, with many initiated by external inquiries but with some licensing departments taking more responsibility for finding business. This is most successful with targeted licensing—a rifle shot approach rather than scattershot mailings. The more successful licensors are those who are most active in seeking opportunities, who have an

overview of the IP position of the firm, and who understand what the industry may need. The most advanced licensors have set up their own licensing subsidiaries to handle the effort needed to effect transfer. The less advanced are in response mode and have more limited activity.

Range of Licensing Structures

Commercialization of innovation may use a range of methods, from arms-length licensing to joint ventures and direct investment. The best mode depends on a balance of many factors. Some characteristics of potential markets, as noted in our survey, which favor licensing are that the market may be too small to justify investment, the market may be one in which the licensor does not normally compete, there may be strong established companies that might make entry difficult by opposing the entrant or by inventing around the innovation, or there might be an opportunity to get residual value from a mature technology, an unfavorable investment climate (one in which it is difficult to raise funds, or, in foreign markets, a liability to expropriation), and restrictions on foreign ownership. Reasons mitigating against licensing are the lack of strategic control over the use of the technology, the separation of the innovator from customers (and hence the inability to ensure high quality, or to invest in market development), potential exposure to litigation, and the fear of IP leakage.

At Firm B, commercialization licenses are seen as falling into three main types: nonstrategic (generic technology and capabilities), developmental, and commercial. This is a simplification of a range of licensing structures, as the innovation moves from the research stage up through development, prototype, pilot plant, and finally to commercialization. As the technology becomes more developed, what starts out in the research lab as a pure idea, and mainly protectable by patents, gradually becomes more complex and accumulates know-how, as knowledge about how to put the idea into practice is built up. For a process innovation, the final technology may be mostly know-how about how to build and operate the new plant, and there may be only a core of patents. This progression is accompanied by an increasing expenditure on the innovation, from the small amount in the initial laboratory stage, through the increasingly expensive development as it moves to pilot plant, to the even more expensive investment in plant and equipment as it moves into production. The progression also corresponds with the increasing value and strategic importance of the innovation. A critical point is where the new technology moves from an R&D cost center to a product profit center, when its development into production becomes much more expensive and it becomes a component of the firm's strategic business plans.

This progression is shown in Exhibit 7.1, which relates the development of an innovation to the combination of patent rights and know-how at the different stages. Embryonic technology in the research laboratory stage is

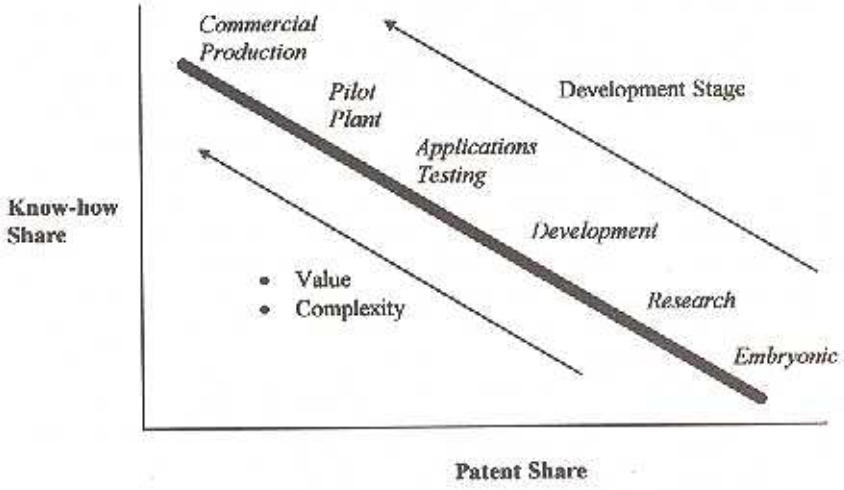

Exhibit 7.1. Patent/Know-How Mixture and Development Stage

defined mainly in the patents surrounding it. As it moves up through development stages, in the sequence from research, process development, applications testing, pilot plant and finally to commercial production, the share of know-how, shown by the thick center line, increases. It also becomes more valuable and complex. In the end, process innovation, when it is fully commercialized in production, is mostly defined by the large amount of accumulated know-how. The importance of this relationship from the licensing point of view is that development can be stopped at any time. This can happen for any number of reasons. The firm may decide that the technology is not workable, or that though technically workable it is not commercially viable. Thus the firm may have a number of unused technologies held at different stages of development, with different combinations of patents and know-how.

Firm B is prepared to license incomplete technologies that it does not expect to pursue further. The purpose is mainly for residual revenue earning on innovations that are not expected to have much strategic importance now or in future, and have been abandoned. These may be at various stages of development. Some have not been taken beyond the research laboratory stage, others have been developed towards production.

The firm may also license fully developed commercialized technologies that have been put into production, although the strategic considerations are more complex. It will license mature generic technologies that are in widespread use and are not a source of competitive advantage. It is unlikely to license innovations that could become a significant competitive threat in its markets. Firm B, like the other firms mentioned in this chapter, including

Firm A, generally is unwilling to license fully developed technologies that are central to its business and in which it has a significant leadership position. There are few cases in which firms are willing to license out their core technologies, although this is occasionally used for major innovations too large for the firm to commercialize alone, and it is becoming less unusual to license leading-edge technology. In such cases, more elaborate relationships may be involved, such as joint ventures or partnerships, which reduce the strategic risks. The more central the technology is to a firm's strategy, the less likely it is to license it out, and if it does do so the terms for granting a license are likely to include restrictions on how the technology may be used.

The structure of a license agreement depends to a first approximation on the stage of development. An embryonic technology consists mainly of patent rights and is likely to be covered by a patents-only license. These are usually simple agreements, covered by a relatively standardized contract. However, there may be only a limited market for such licenses, as the licensee must have the technological competence to use the patent, and royalty earnings other than for the occasional key patent are likely to be modest. Licenses for developmental innovations tend to be simple boilerplate agreements for patent rights, although the terms of the grant are closely specified.

The bulk of licenses in this industry combine some level of know-how with the patent rights to enable the licensee to use the innovation without further development. The process technology tends to become quite firm-specific, so often a comprehensive package of know-how is needed for a turnkey license; which supplies all the necessary know-how and IP rights needed for a complete and ready to operate process. These combination licenses are more valuable to the licensor but are also more expensive to use, because rather than simply granting rights, they allow the transfer of technology. Transferring know-how is time-consuming and costly. The licensor usually must provide technical and management assistance and training and engineering support to complete the transfer. Although these licenses necessarily carry higher royalty and engineering fees, managing the transfer involves significant resources. These licenses also usually have greater strategic significance than pure patent licenses, because the agreements may essentially create competitors, supplying a licensee with all the capabilities needed to compete in the market with the licensor. Both these concerns may be enough to make out-licensing unattractive unless ways can be found to reduce their effect. These concerns contribute to the rationale for using licensing intermediaries, discussed below, and for restricting such transfers to those involved as part of more extensive agreements (for example, for joint product development or marketing).

Agreements typically are for a combination of patent and trade secrets. Protection of know-how by trade secrets is likely to be more complex than for patents, and contributes to the risks and greater resources needed. Patents, though sometimes covering only a small part of the technology

being transferred, are extremely important in being able to protect the innovation. The value of the technology may lie mostly in the know-how, without which the patents cannot be worked effectively, but the patents provide the core for protecting the innovation from imitation, and preventing the licensee from licensing-on the technology to others.

Licensing is not the only way to obtain value from technology that the firm is not pursuing. As noted previously, Firm A estimates that as few as three to five percent of patents are actively involved in current products, but many more have strategic value to the firm. The firm may put technology into storage for possible future use, possibly for use as a bargaining chip or as support to future innovations. Because much of the IP is in fact know-how, storage often means keeping the knowledge as a trade secret within the firm.

Licensing Terms and Conditions

A license is the grant of positive rights to use proprietary IP. As such, both parties need to define the circumstances in which the IP can be used. The terms and conditions include restrictions on the use of the IP, as well as the definition of what is being transferred, the duration of the agreement, the fee structure, legal guarantees and warranties, and other information. Even in the simplest license there are a number of items needing close specification, such as the geographic and market areas for which the right is granted and if fees are to be paid as a lump sum or a running royalty.

The restrictions serve at least three main purposes. First, they help protect the IP, to ensure that the firm does not lose control over its technology as a result of licensing it out. Second, they enable the licensor to maximize the revenues from its technology, and ensure that licensing does not adversely affect the firm's competitive position. If these constraints were not included in the license a firm might not be able to license its innovation, and would be limited to commercializing it in-house. Restrictions are particularly important when the licensor is using a dual approach to commercialization, using the technology in-house to produce products for its home markets, and licensing it out for use elsewhere, either abroad or in other product markets. In such cases a firm is especially concerned about the competitive consequences of licensing. Third, the license contract is a legal document, and should attempt to limit the exposure of both parties in the event of litigation.

Firm B identifies the key terms and conditions to be negotiated as part of individual agreements to include the following: the definition of the license grant, exclusivity, field-of-use, territorial rights, duration of the license, patent coverage, payments and fees (royalties, know-how payments, service fees), technical assistance, definition, and improvements/grantbacks. There are also a number of more standardized terms and conditions, such as patent liability issues, guarantees and warranties, and other technical conditions.

The field-of-use and territorial restrictions define the market in which the IP can be used.

The terms are related to the firm's business interests for the technology. Thus a priority interest is in ensuring an aggressive licensee commitment to commercialize the technology. This is connected with the terms specifying an upfront fee and resource commitment by the licensee, which constitute an effective pledge of commitment. An exclusive license, for a given territorial market or field-of-use, may maximize licensee commitment and produce maximum returns—if this is the preferred commercialization strategy. Similarly, the scope of the grant depends on the nature of the global commercialization program. For example, if the aim is to maximize commercial activity—if one of the strategic interaction objectives is to establish a new process as broadly as possible in the market—than a nonexclusive license may be preferred.

In designing the license structure, the licensor is anxious to limit the resources it must devote to completing the transfer, which if not controlled could make the license uneconomic. This requires careful balance of estimated costs and revenues, so that the cost to license is kept within bounds. This affects the content and terms of the license.

There are a number of conditions associated with the protection of the technology. The license should include a provision to preserve the validity of the trade secrets by requiring the licensee to take reasonable steps to maintain the confidentiality of the secrets, such as requiring non-disclosure agreements from personnel in contact with the technology, keeping confidential documents in secure storage, and limiting access to trade secrets to those with a need to use them. It is unusual for a license to include sublicensing rights, in part because of the difficulty of maintaining the desired level of control over the IP with licensing at second or third hand. The terms of the warranties and guarantees are also an important part of the agreements, limiting the licensor's potential liability.

Many licenses for new technology also contain provisions for improvements exchanges, or grantbacks, of rights to use improvements to the technology made by the licensee, and vice versa. For experiential technology, such as a manufacturing process, many improvements are developed as part of using the technology in production—of learning by doing. For the licensor the risk is that a licensee, in using the licensed technology, may develop improvements to which the licensor might need to have access if it is to continue to exercise its technology competitively. For the licensee, the risk is that over time it may cease to have access to the most up-to-date technology. In either case, to guard against being blocked from the market in future, a grantback clause may be included allowing one party rights to use such developments by the other. Typically these agreements are optional and reciprocal. Discussing the out-licensing of a major process innovation, BP's licensing director at the time explained, "It is important to note that licensees

were not required to exchange improvements. . . . On the other hand, all licensees want some limited exposure to the licensor's improvements. Sohio [later BP] insisted that, to the extent the licensee received Sohio's improvements, it must be willing to reciprocate" (Evans, 1993, p. 76). The details of a grantback in a particular case are a matter for individual negotiation.

Once a contract is agreed upon there is still the major task of contract administration. The licensor must ensure that the terms and conditions of the license contract are met, and that the speed and quality of commercialization maximizes the timeliness and size of the generated royalty revenues. This includes monitoring the adherence to the terms and conditions, assisting and encouraging the commercialization of embryonic technologies, and enforcing the terms of the contract.

Licensing Intermediaries

A distinctive feature of the chemicals industry, as of other process industries such as petroleum refining and petrochemicals, is the use of specialized engineering firms (SEFs) responsible for building and installing complete process plants. These firms consolidate core process technology from a chemicals firm with other technologies and capabilities needed to build a plant, to offer their customers a complete turnkey package. The SEFs work on many projects and become experts in their specialized field (Landau and Rosenberg, 1991).

Specialized engineering firms offer a range of styles of involvement in the licensing agreement. Often the SEF acts as the single contact point for the customer, and the chemical licensor provides technology via the SEF. In a typical agreement, the chemicals firm licenses its technology to the SEF, and the SEF licenses a complete package of technology to the customer, along with construction and installation. This is the structure followed by Firm B, whether the source of the license is a direct contact with the customer or via an SEF. The chemicals firm identifies the customer and performs initial negotiations on the technology to be transferred. It recommends a list of approved contractors to install the technology, from which the customer selects one. The chemicals firm provides a precisely defined package of technology, comprised of patent rights, know-how, and possibly trademarks. This is contained in a specification book, which might be a binder of procedures, engineering drawings, or computer files.

Other firms may use variations on this approach. This depends partly on the source of the agreement. At Firm A, the single contact structure is the norm if an SEF approaches the firm with the licensing opportunity. If the firm develops the licensing opportunity itself it may license directly to the customer, with an engineering and construction contractor involved in a separate agreement made by the customer. There are a number of other forms of licensing partnerships in the industry (Reilly, 1994). As we have seen, other firms have

set up their own licensing subsidiaries for major innovations, and these subsidiaries take many of the roles of the SEFs.

The structure of the agreement in this case is for the chemicals firm to license to the SEF and the SEF to have a separate license with the customer. The first license covers the technology—what it is, and where and how it can be used. In the second license the SEF is acting as sublicensor, including the technology and all the other components and services needed to provide a working plant. Warranties and guarantees are a major part of the second license, which are the responsibility of the SEF. This arrangement performs several functions, discussed below.

Determining the share of royalties with the SEFs is an important part of the negotiation process and license structure. It is calculated according to the relative contributions of the partners to the final plant installation, and the degree of risk sharing. A key feature is whether the SEF has exclusive sublicensing rights for its territory. However, it is unusual for the SEF to have rights to sublicense independently of its chemicals partner.

The use of SEFs has a number of efficiency advantages over direct licensing. First, it may provide a single contact point for the customer. The SEFs become expert in project management by accumulating experience in different circumstances across the industry. Also, by using an approved supplier list of several SEFs, there is competition between intermediaries, benefiting both licensor and licensee. This may also allow more efficient negotiation of royalty rates, reflecting the experience of the SEFs in repeated bargaining.

Second, it allows the SEFs to handle licenses that would be too small for the chemicals firm to attempt on its own. The SEFs have developed their own specialist complementary skills in broad areas of technology (in the first place transferred from the petroleum industry) to a far greater extent than an individual chemicals firm, with its firm-specific technology, could manage. This provides the resources for licensing technologies that may be too minor a business prospect for the chemicals firm to support by itself. The SEFs reduce bottlenecks in plant construction, speeding up diffusion.

Third, this helps protect the firm's IP. Although the SEFs sometimes work for a number of chemicals firms, generally they are associated with a single firm in a given market. The chemicals firms each have approved lists of SEFs, which typically do not overlap with competitors' lists. This ensures that confidential information does not leak out to competitors via the SEF. This is expressed by BP as follows: "The core contractor approach safeguards the value of our technology. . . . BP has a deliberate policy to limit the exposure of our core contractors with their agreement and commitment to other similar and competing technologies" (quoted in Royse, 1993, p. 5). This also means that the SEFs provide an efficient means of information transfer by reducing the risks of leakage. The SEF provides a control over the transfer of know-how from the chemicals firm to the customer, who may

be a competitor. The chemicals firm may be more open in transferring the required know-how for a project via the SEF, because it acts as a buffer between the chemicals firm and its licensees. It reduces strategic withholding of information, because the SEF is not a direct competitor and can evaluate the validity of an information request.

Fourth, one of the most important roles of the SEFs is in providing warranties and guarantees for the performance of the license. This essentially confines the liability of the chemicals firm to the technology itself, with other guarantees associated with the rest of the technology supply contract being borne by the intermediary. Thus the license structure from chemicals firm to the intermediary may be relatively simple and concentrated on the technology itself, while the license between the intermediary and the customer is a more elaborate agreement, including guarantees for the timely construction and performance of the new plant embodying the technology.

While functionally separate from the generator of technology, the intermediary need not always be a separate company. In some cases it may perform may of the functions of an intermediary as a division of the innovating firm. Thus, Union Carbide's licensing subsidiary, ETS, functions like a specialized engineering firm although it is focused mainly on a particular technology.

Trends in Licensing and IP Management

Most firms intend to increase their licensing activity. In the first instance this is mainly as a means of increasing revenues with which to offset the costs of maintaining the IP portfolio. However, there are also long-term aims to improve the management of the IP assets of the firm and help focus the firm's innovation effort in those areas where it has highest competences. This may involve increased use of in-licensing as well as out-licensing. Global competition means that even the largest chemicals firms can no longer develop all their technology themselves, and licensing will become a necessary way of accessing technology. Also, firms are more likely to need to consider out-licensing, perhaps included in joint ventures and alliances, to commercialize technology.

Part of the rationale behind this is the generally increased stress on IP in corporate strategy in many industries over the past decade or so. With the increased strength of IP protection—both in the United States, following the policy changes during the 1980s (especially the establishment of the Court of Appeals for the Federal Circuit in 1982 to hear all patent appeals in a single court, which increased the likelihood of patents being upheld), and throughout the world, with moves towards harmonization of international IP treatment under the Uruguay round of the GATT in 1994—IP has become more valuable and more important as a competitive tool. It has become more worthwhile to protect IP, to use it for out-licensing or strategic leverage.

Thus there has been a significant increase in the volume of patenting—for example, the number of U.S. patents by the top ten firms increased by 33 percent, from 8,800 to 11,800 between 1990 and 1994. This is set against a background of increasing global competition, in which well-financed and technologically able competitors can challenge worldwide markets, making IP an increasingly important means of protecting the ability to earn value from innovation. The result is that firms have more opportunity to earn rents from their IP portfolios by out-licensing, but this is partly offset by the higher costs of maintaining larger IP portfolios for defensive reasons, and of in-licensing technology.

So far out-licensing is mainly concerned with technology that has been developed for the firm's internal use. The role of licensing in overall firm intellectual capital management—the broad management of the knowledge capital of the firm—is indirect in most firms, as its primary aim is to extend the commercialization of existing technology. There are cases where it is more likely to contribute to a more direct strategic role—for example, negotiating cross-licensing for design freedom for development areas, helping define patenting policy (including what to patent, patent maintenance rules, portfolio monitoring), and ensuring negotiation leverage. There are also strategic differences between the way IP is managed in different firms. Patenting is still often pursued as a matter of course in some R&D departments, with limited consideration of the maintenance cost or strategic value of the patents. In part this may reflect traditional differences between firms in their IP policies.

SPECIAL LICENSING CONCERNS

There are number of concerns facing the potential licensor that reduce its ability to license its technology as widely as it may wish. In many cases licensors are able to alleviate these problems, either by structuring the license agreements or by the evolution of institutional arrangements such as the SEFs.

Control Over Know-How

Perhaps the most critical concern for the licensor is the control over what proprietary know-how is transferred to the licensee, and the risk of losing what, in a process industry, is a primary source of competitive advantage. Part of the problem is that the licensor must be sure that the licensee will not license-on the technology—otherwise the licensor may decide it is unable to grant a license. This depends largely on the patent protection. Most licenses are for a combination of patents and know-how, which helps ensure

that the technology is protected and also is valuable enough to earn revenues. A paradox is that patents provide strong protection, but much of the value of technology is contained in the know-how, which is protected as trade secrets. Patents have the advantage that they protect an innovation from imitation even if it is invented independently. Even if the licensee develops improvements in its know-how in using the licensed technology, these may not be usable without the original patents, hence protecting the original know-how.

There remains the problem that know-how transferred with the patents may be useful to the licensee in other areas than those intended in the license. There are also the problems that more may be transferred than intended as the parties work closely together to effect the transfer, or that know-how licensed to a noncompeting customer may leak to a competitor. There are no easy answers to these problems. They may be reduced by careful drafting of license agreements to specify the know-how to be transferred and the field-of-use for which rights are granted, and by close management of transfer procedures. It may be possible to follow policies limiting the know-how available for licensing, offering more patent-only licenses or incorporating only mature know-how. The use of SEFs as licensing intermediaries may limit leakages, as noted above. Yet the use of licensing intermediaries may have its own problems. In the case noted earlier, Firm A decided not to pursue an otherwise attractive licensing proposal for paint-related technology via a licensing intermediary, as it could not ensure that sublicensees would not be its competitors, and it could not be certain that they would not allow know-how to reach its competitors.

Resource Requirements for Transfer

For technology to be useful to a licensee, significant human resources may be needed to transfer the know-how and to be able to work the patents. The licensor must be able to spare these people from its own development and manufacturing needs, and should allow for the opportunity cost in calculating the value of the license. If the requirements are not major then consideration of what is needed to transfer technology may be scheduled in as early as possible. An alternative for supplying these resources is via the SEFs, or the firm may develop specific capabilities in transfer. Similarly, the licensee usually wants a complete package of patents and know-how, so that for developmental technology the licensor may have to devote further development effort to bring the technology to the point where it is licensable. This takes additional resources, which the firm may not wish to spare. The SEFs may help here also. Another solution is the selection of licensee candidates. If these candidates have the complementary capabilities needed to use the embryonic technology then a license is possible. Identifying such candidates is a role for the licensing manager or consultant.

Legal Risks

A further concern is the legal exposure, such as for various forms of patent liability (including patent infringement, indemnification, and warranty) and performance guarantees needed for complete installation of the technology. Partly this is a task for the appropriate drafting of the licensing contract. Risks may be reduced via the use of intermediaries with the necessary specialized capabilities, who can guarantee those elements they provide that are not associated directly with the technology.

SUMMARY AND CONCLUSION

Licensing activity in the chemicals industry is widespread and increasing, in an environment in which the main objective for the firms remains to manufacture and sell products. The different types of licensing behavior observed align with a strategic framework of licensing objectives and structures. Indications of the trend towards greater use of licensing include the increased activity and size of licensing departments and the increasing revenues generated by out-licensing. For the longer term, there is also greater willingness to consider in-licensing. Although royalty fee earnings may still be small compared with the overall scale of operations of the corporations, licensing is seen as a significant contributor to corporate earnings. Perhaps more significantly, licensing is seen as part of a generally increased importance attached to IP strategy, of which licensing is an integral part, and to some degree, a motivator for a more complete approach to intellectual capital management.

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