

# MAKING INDUSTRY—UNIVERSITY PARTNERSHIPS WORK

*A study of relationships between industrial firms and university research centers shows how to form partnerships that benefit both parties.*

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**OVERVIEW:** *University research centers have proven to be beneficial partners for industrial firms seeking new ideas and new technologies. The centers, especially those with flexible and creative policies for intellectual property rights, patent ownership and licensing, are attracting large numbers of industrial partners. While many firms initially seek out centers with the most lucrative policies, others are beginning to take an active role in shaping center policies that can meet their specific needs. An empowered I/U champion at the firm can be especially effective in facilitating this process, particularly when he or she focuses on each organization's unique contributions and the possibilities they afford for complementary synergies.*

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Industry—university partnerships offer a potentially powerful alternative to the inter-firm collaborations that successful companies routinely undertake in today's competitive environment (1,2). In the past, I/U partnerships were primarily "sponsorship" relationships, in which industrial firms provided university researchers with resources and financing. In this model, many firms valued university research principally for solving specific problems or for building basic knowledge when the horizon was long-term.

The shift to today's knowledge-based economy has also brought about a shift in I/U relationships from "sponsorship" to "partnership," with ongoing interaction the major focus (3). Although many industrial firms still think of universities as simply a source of basic knowledge and highly trained students and graduates, and while the partnering process is not always managed properly, universities can be valued partners providing complementary expertise, knowledge and resources that are often unavailable within the industrial community (4).

For example, corporations often hire former students who worked on joint industry—university initiatives before they graduated. These graduates are valuable employees when their research, training and prior university experiences are leveraged to facilitate current and future industry—university relationships. Beyond this, university partnerships often come without the conflicts of interest that occasionally go along with inter-firm collaboration.

Based on a continuing study of relationships between industrial firms and university research centers, we find industry—university partnerships can be beneficial in helping firms generate knowledge and new technologies, i.e., tangible outcomes that include patents, licenses, and non-patented and non-licensed new products and processes.

## Conducting the Study

Our focus in the research reported here is largely on the National Science Foundation (NSF)-supported Engi-

neering Research Centers (ERCs) and Industry–University Cooperative Research Centers (IUCRCs). These centers were chosen because they have an explicit mission to work with industry on technological innovation through an array of technology-focused relationship alternatives. Over 20 university research centers affiliated with prominent research-oriented universities participated by providing lists of their partnering firms along with the key contacts at each firm. Survey questionnaires and in-depth interviews were used to obtain data from senior R&D managers and technology executives at over 200 large and small firms in 20 different industrial sectors. To update our data, interviews have been conducted continuously during the past three years with research center directors and senior industrial firm executives.

From this research, several interrelated factors surface as being especially important to industry. We find the factor of greatest importance to industrial firms to be the university's posture on intellectual property rights (IPR), patent ownership and licensing. Closely intertwined are two additional items: 1) A firm's willingness to work with a university research center in shaping creative and mutually beneficial incentives for IPR, patent ownership and licensing; 2) The presence of an empowered I/U champion at the industrial firm who serves as the pivotal player in assessing the complementarity of each organization's skills, knowledge and resources, and in formulating meaningful incentives that satisfy both organizations' needs. These three key factors are discussed in detail in the following sections.

### **IP, Patent Ownership and Licensing**

Because of the potential revenue implications, IPR, patent ownership and licensing agreements are important to both industrial firms and universities. Beyond the equitable distribution of revenue, industry and universities have different goals, philosophies, missions, and reward systems related to IPR, patent ownership and licensing. Moreover, while the Bayh-Dole Act has stimulated industry–university research by promoting additional investments from the private sector, many legal constraints exist. For example, state laws often bind public universities with guidelines for intellectual property ownership and disclosure of research results through the Freedom of Information Act, while federal laws still loom large in governing patent ownership (5). As a result, issues surrounding IPR, patent ownership and licensing remain contentious in industry–university collaborative ventures.

Generally, universities prefer not to grant exclusive rights to their industrial partners largely due to the potential loss of revenue, which for some universities can be significant. For example, Rutgers University's royalty income in 1997 totaled \$6.5 million, eighth highest among all U.S. public research institutions. Moreover,

that same year, Rutgers disclosed 109 inventions, was granted 25 patents, applied for 68 additional patents, received 191 licenses for royalty income, and formed 7 start-up companies (6).

Beyond the revenue implications, granting exclusive rights to firms can seriously affect the university's ability to freely disseminate knowledge, which, of course, is their principal mission and responsibility. Also, a university's prestige and reputation are in large part created, sustained and enhanced by the research it conducts. Finally, promotion and tenure for university researchers and faculty are usually predicated on publication productivity.

Unfortunately, by insisting on full disclosure, universities signal the industrial community that academe is overly self-centered, rigid and unresponsive to industry's needs. Additionally, firms often feel that full disclosure of research can give other firms an opportunity to incorporate this knowledge into their own products and processes.

Another potential stumbling block to I/U alliances arises when research intended to prove or disprove claims by a corporation ends up conflicting with the sponsoring corporation's expectations. For example, Boots Pharmaceuticals, sole manufacturer of Synthroid (\$600 billion market), enlisted the University of California–San Francisco (UCSF) to prove that no other competing preparations of Synthroid were bioequivalent. When UCSF completed its study and concluded that Synthroid was bioequivalent with competing preparations, Boots Pharmaceuticals attempted to discredit the research (7). After a multiyear struggle, the research was eventually published, to the chagrin of Boots. Although relatively rare, this situation exemplifies the necessity for firms and universities to fully discuss expectations and possible contingencies up front.

Because of the potential pitfalls, many firms remain reluctant to collaborate with universities. However, the changing competitive landscape is beginning to shape a new dynamic, especially with knowledge becoming increasingly more important to achieving competitive advantage. This shift pushes the industrial firm toward the university as a source of that knowledge, while economic changes (e.g., reductions in federal funding) have put pressure on universities to look to industry for support (8).

Universities have responded by offering firms a variety of new relationships specifically intended to help them generate new technologies. Illustrating this is the close relationship between UCLA and Broadcom Corporation, maker of a wide spectrum of broadband communication integrated circuits (9). Broadcom founders Henry Nicholas and Henry Samueli both have strong ties to UCLA; Samueli was a full-time professor at UCLA and Nicholas was his first Ph.D. candidate. These ties continued with many UCLA students joining Broadcom

after their degrees were earned and their research was published. The experience and knowledge gained through the research on complementary metal-oxide semiconductor (CMOS) circuits performed at UCLA helped create many of the building blocks in Broadcom's communication integrated circuits. The research also led to Broadcom's introduction of the first digital cable TV communication chips. Although the early research was not funded by Broadcom, it was funded by both industrial and government sponsors. Today, Broadcom, as part of a wide consortium of industrial sponsors, funds specific research at UCLA because of its significance, impact and value to the communication integrated circuit industry.

Beyond such synergy, a university's willingness to offer incentives that meet specific industry needs is important. For example, we find that university research centers with many industry relationships carefully balance knowledge dissemination with the need to withhold certain information in order to protect their corporate partner. A recent study showed that a majority of long-standing university research centers allow their corporate sponsors to delay publications. Moreover, a large percentage of these same centers also allow their corporate sponsors to delete or modify selected information prior to publication of research results (10). University research centers that skillfully balance these conflicting tensions are able to attract those "movers and shakers" in the corporate community who often work with research centers to help bring high-risk, high-reward technologies to market.

### Shaping Mutually Beneficial Incentives

A number of universities still offer policies for IPR, patent ownership and licensing that do not meet industry's needs. While this can serve as a major obstacle to I/U relationships, many firms have taken the initiative to develop agreements that satisfy both parties. The key for the industrial firm is to know the university's prevailing position on IPR, patent ownership and licensing and how this might affect the firm's own unique circumstances. The Table (next page) outlines the prevailing university position on IPR, patent ownership and licensing as it relates to exclusivity, timing and revenue sharing. It also suggests when the firm should consider accepting each position, as well as when more creative approaches might be warranted.

Even a university's insistence on non-exclusivity can work in the firm's favor, for instance, when a new technology requires a technology infrastructure based on a socially accepted dominant design. This is the case with interrelated technologies like computer hardware and software, or highly-linked electronics technologies such as CD players and CDs. In these cases, it becomes important that others have access to certain aspects of the technology in order to create, solidify and extend the

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technology's market acceptance. Moreover, with certain technological knowledge in the public domain, ancillary and enabling technologies can more easily evolve, further extending the technology's life cycle.

Beyond the issue of exclusivity of IPR and patents, there is the issue of time periods for licensing, which often vary substantially. Creative approaches are warranted when time to market is long and shelf life is anticipated to be relatively short.

With respect to revenue sharing of patents, firms often receive in the range of 1–3 percent of sales, although this depends upon the technology and the industry. While these percentages may not appear substantial, a firm's yield from sponsored industry research and its subsequent share of revenue can be significant. The relationship between Monsanto and Washington University illustrates one such beneficial I/U relationship. Monsanto sponsored over 50 pharmaceutical research projects at Washington University between 1986 and 1993. This collaborative effort resulted in 16 patents, 24 patents pending and 5 commercialized products that generated sizeable revenues for the firm by 1995 (11).

Even though revenue from patents can be significant, firms often decide not to pursue certain technologies themselves. Instead, they give patents and the rights to technologies away to their university partners. While this action may initially appear foolhardy, it can be advantageous to the firm in the long term.

Consider the case of Air Products and Chemicals, Inc., which recently donated five patents to Lehigh University. The patents were related to technologies for strengthening asphalt and concrete and increasing the fire retardance of plastic and asphalt-based construction materials. According to Air Products CEO Harold Wagner, the patents were donated to Lehigh University because of the excellent, mutually beneficial relationship between the two organizations spanning more than five decades. More important, the patents were in technological areas outside those now being concentrated on by Air Products (12). By giving away patents in non-core tech-

*Guidelines for IPR, Patent Ownership, and Licensing Agreements*

Issue	Prevailing University Position	When Firm Should Accept	When Firm Should Develop More Creative Approaches
Exclusivity of IPR and patents.	Firms usually not given exclusive rights.	1) When a socially constructed technology infrastructure is required. 2) When the technology is ancillary or enabling to an existing dominant design.	When the technology is central or core to the firm's business, products or services, and to defend against the introduction of next generations by the firm's competitors.
Time period of license.	Can vary substantially. 3–5 years not uncommon, often without options to renew.	Under most conditions.	If time to market takes several years and technology has limited shelf life.
Revenue sharing of patents.	1%–3% of sales.	As long as consistent with prevailing industry norm.	If current industry norm is significantly higher.

nological areas, Air Products could now focus its attention and resources on areas more closely related to its core business. Moreover, with Lehigh's strong research acumen in these areas offering the best promise for technology commercialization, the firm could have a more cost-effective avenue to these technologies down the road. As a result, both organizations gain.

### **Creative Agreements**

University research centers in the United States are working hard to come up with innovative ways to attract more industrial partners. One such center is The Photonics Center at Boston University. Created in 1994, this center has grown quickly through a variety of initiatives, including taking an equity position in one start-up company instead of licensing out the technology to other firms (13).

While taking equity positions in exchange for cash is a relatively new phenomenon for academe, other research centers are using similar approaches. For instance, a materials science and engineering center affiliated with a large, state-supported university in the eastern U.S. convinced the university's trustees that the university should take stock in a small, financially-strapped company that wanted to advance a new technology related to specialty powders for drill bit and mining tool surfaces (14). This action was unconventional for this state-supported university since it had never taken an equity position in a small, start-up firm in lieu of collecting licensing fees. In doing so, this respected academic institution's action helped to make this small, relatively unknown company attractive to other outside investors. As a result, the university gained even more financially than had it simply licensed the technology, since the value of the firm's stock grew more rapidly than the expected revenue from licensing.

An agricultural biotechnology center affiliated with the same university offers yet another example. This center

worked closely with a start-up biotechnology firm to obtain seed money to fund the firm's patenting and initial research expenditures for a new bio-remediation technology for the removal of toxic materials in former dumpsites. With \$3 million from private venture capitalists, the firm plowed over \$1 million of those dollars back to the university research center to help fund additional research. Consequently, the firm was able to commercialize its bio-remediation technology and develop a wide network of users while the university research center brought new jobs and added revenue to the state, as well as research opportunities to many of its faculty and students.

A software firm wishing to develop a financial software package offers another example. This small firm had the programming knowledge, marketing expertise and physical resources to design, develop, produce, and distribute the new package, but it lacked detailed knowledge about specific requirements in the field of finance. A university research center with an affiliation to its university's business school had access to finance faculty with superior knowledge of the feature–functionality needed for this software. Combining resources, skills and knowledge from the firm, research center and business school made for a powerful alliance. However, creativity was required to adequately reward the key players from each of these organizations. In addition to paying royalties to university researchers, the research center also received a percentage of the revenue in exchange for the firm's exclusive right to produce and distribute the software product. The university's faculty, students and staff also received use of the software program. By giving the university free use of the software program, the firm's product received much needed legitimacy and familiarity in the marketplace.

### **Importance of an I/U Champion**

A firm's I/U champion is uniquely positioned to ensure that industry–university relationships properly leverage

each organization's skills, knowledge and resources. Through an appreciation and focus on the complementary nature of I/U relationships, the champion is often the key player in formulating mutually beneficial IPR, patent ownership and licensing policies.

Our findings support a growing literature pointing to the importance of champions, especially for driving technological innovation. Effective champions are influential, sensitive to changing market conditions, and serve as the chief liaisons and key communication links between partnering organizations. In their role as inter-organizational liaisons, effective champions function as scouts who seek external information important to inter-organizational partnerships, and as ambassadors who maintain good relations between partnering organizations (15). Effective champions also seize the opportunity to assess the situation and determine which university policies are acceptable, which policies need to be modified, and where creative solutions are needed.

We found a number of instances where effective I/U champions at the firm influenced and directed synergistic "increase the pie" and "win-win" approaches for intellectual property, patent ownership and licensing, despite the philosophical and cultural differences between industry and academe. For example, we found that a large U.S. chemical firm's I/U champion was instrumental in negotiating a beneficial agreement between his firm and a chemical engineering research center affiliated with a large state university. Here, the chemical engineering research center eventually agreed to delay the publication of its research findings on a new chemical additive for a popular consumer product in order for the firm to obtain patent protection. In return for delaying publication, the university was rewarded with a higher-than-normal percentage of revenue from the product. After the firm obtained its much-sought-after patent protection, the collaborating university researchers then published their findings in a leading academic journal.

This is but one example of how empowered I/U champions at the firm can be especially effective in formulating mutually beneficial IPR, patent and licensing agreements, particularly when they focus on each organization's unique contributions and the possibilities they offer for creating complementary value-added synergies. ●

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