COLLABORATIONS

Why University-Industry Partnerships Matter

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Basic research, much of which emanates from the outstanding academic laboratories located in the United States and abroad, is the foundation for the innovation that has created the new therapies, materials, and processes that benefit humankind and generate wealth for companies that successfully translate discoveries to commercial success. This is not a linear, one-way process; optimizing the process of discovery to innovation demands dynamic and multifaceted approaches to teaming at the university-industry interface.

The American higher education system has long been the envy of the world and has produced the discoveries that gave rise to innovations resulting in many of the products that improve our lives (*1*). Although universities are outstanding at creating the base knowledge (discovery) used in the creation of new products (innovation), companies are relied on to take these inventions and develop them into usable products. This process has worked well for an extended period, but there are opportunities to expand the level, number, and depth of university-industry collaborations and bolster the creation of new products (Fig. 1). Some trends are also worthy of consideration. Large pharmaceutical companies are reassessing their investments in internal research and development (R&D) and looking to "purchase" promising inventions by partnering with universities (*2*) and small businesses [many of which rely on government funding, such as the small business innovation research (SBIR) and small business technology transfer programs] (*3*). Governments (federal and state) have increasingly recognized the value of university-industry partnerships and are starting to make investments that fund these efforts; one can look at the Clinical Translation Scientist Award from the National Institutes of Health (NIH) as an example of the federal government's investment to spur and catalyze the discovery-to-innovation process.

A 2008 report prepared by the President's Council of Advisors on Science and Technology titled "University-Private Sector Research Partnerships in the Innovation Ecosystem" (*4*) provides an overview of the U.S. R&D enterprise and focuses on the critical role for university–private sector research partnerships, their potential to improve research and innovation, and the obstacles standing in the way of further progress.

Small businesses play an increasingly important role in innovation and the health of the U.S. economy; the linkages of universities with those businesses to support their R&D activities can be extremely valuable. That is why more than two-thirds of companies receiving SBIR support had at least one founder who previously served in the science/engineering academic sector. These companies often contracted and employed universities (17%), faculty (27%), and graduate students (15%) to support their work (*5*).

GUIDING PRINCIPLES FOR UNIVERSITY-INDUSTRY ENDEAVORS

In April 2006, the National Council of University Research Administrators and the Industrial Research Institute issued a joint report on guiding principles for university-industry endeavors (*6*). This project was dubbed the University-Industry Partnership and was the precursor to today's University-Industry Demonstration Partnership (UIDP). In the report, three guiding principles were identified: (i) Successful university-industry collaboration should support the mission of each partner. Any effort in conflict with the mission of either partner will ultimately fail. (ii) Institutional practices and national resources should focus on fostering appropriate long-term partnerships between universities and industry. (iii) Universities and industry should focus on maximizing value resulting from collaborations by streamlining negotiations and measuring results. These guiding principles provide an important foundation for university and industry representatives who seek to develop high-return relationships.

BENEFITS OF UNIVERSITY-INDUSTRY COLLABORATIONS

In an increasingly complex and multidisciplinary research ecosystem, universities and industries can benefit from partnering.

For universities, there are a number of financial and nonfinancial motivations. For large research-intensive universities, industry-sponsored research serves as an important piece in the overall external funding mosaic. According to the most recent data from the National Science Foundation (NSF) (*7*), universities in the United States expended $2.87 billion of industry research funding in fiscal year 2008; this represent-

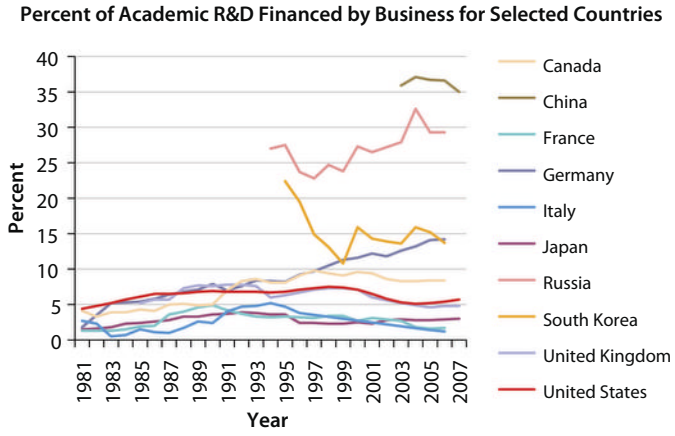

Fig. 1. Opportunity awaits. Although business funding of R&D has increased in the last 10 years in the U.S. (*16*), the percentage of academic R&D financed by business has decreased in the U.S. as well as in a number of other countries (*17*). With industry's increasing reliance on external alliances to bolster its product pipeline, academic research is a likely place to seek partners.

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ed approximately 5.5% of all R&D expenditures but nearly 7% of external funding. Put in the context of a research university with $200 million of annual expenditures, industry support would represent $14 million, a tidy sum that can support a large number of talented researchers and the purchase of a substantial amount of supplies and relevant equipment. In order to effectively compete for federal grants (especially large, multiyear awards) in today's ultracompetitive environment, universities are asked to address specifically the relevance of the proposed research as well as how industry will be engaged with the proposed project. This engagement can come in the form of direct cash investments or support via cross-fertilization of research teams who can work at the university-industry interface. In response to recommendations from the Committee of Visitors, the NSF's Engineering Research Center (ERC) program clearly articulated the goals of the Generation Three ERC program to place greater emphasis on innovation and speed the translation of knowledge to technology through partnerships (*8*). A number of state programs also directly support university-industry collaborations; some of these, such as the Maryland Industrial Partnerships (MIPS) program, have funded more than 400 Maryland companies since 1987. Worth over $160 million, these MIPS projects have led to the creation of MIPS-supported products that have generated more than $19.5 billion in sales and added jobs to the region. Some newer programs, such as the South Carolina Centers for Economic Excellence program, similarly provide matching funding (as much as $5 million) and create centers to support the economic development interests of the states in targeted research areas of universities and companies.

There are also important, nonfinancial motivations. Universities want to ensure that they can recruit and retain the best talent to their campuses. Contemporary faculty and students seek greater relevance to their scholarly pursuits and want to work deftly in both the academic and corporate environs. Some academic institutions have excelled at creating a supportive environment, and many more institutions are embracing this approach. For example, Texas A&M University claims to be the first public university to officially consider technology commercialization in tenure and promotion decisions; since implementing the policy in 2007, the school has seen an increase in invention disclosures from tenure-track professors (*9*). Universities also seek to establish workforce pipelines from their institutions to companies. The ability to promote the successful placement of students in industry supports high-caliber undergraduate and graduate student recruitment.

The benefits afforded to industry parallel those to academia. Foremost, universities are the greatest source of future workers who possess contemporary skills to help companies achieve their business objectives. Additionally, as more companies have reduced their financial commitment for internally supported R&D, especially basic research, universities are one area in which companies can make an investment in early-stage technology development and potentially realize future benefits if commercial applications can be identified. Access to facilities and specialized equipment also fosters collaboration. For startup firms or firms with fewer resources, the benefits can be much greater and can range from bolstering the company's cash flow and access to investment-grade funding to providing substantial expertise to complement the employee pools found in these firms.

CHALLENGES TO UNIVERSITY-INDUSTRY COLLABORATIONS

University-industry partnerships can provide both parties substantial benefits, but there are challenges (some obvious and some more surprising) that can considerably affect the ability of these parties to partner.

Intellectual property. The most common issue has to do with intellectual property (IP) rights and who should "own" the results that emanate from an industry-sponsored research project. It is appealing to want to treat all projects (and the background and foreground IP rights) the same for each negotiated agreement. However, agreements vary a great deal as a result of the differences in industry, the university lab's overall financial support and the percentage of the project being covered by an award, the origination of the project scope, and the likelihood for commercialization. The UIDP has invested substantial resources to help provide education on this topic; some of the fruits of this work are found in the Contract Accords booklet produced by a UIDP-supported working group (*10*).

Budget. Project cost and, specifically, indirect cost rates can also lead to challenges—especially when universities work with companies that have limited experience engaging universities. Some universities have moved away from detailed budgets that separate indirect costs and instead are using budgets that show the overall costs of the project.

Regulatory. Because of the poor decisions made by some researchers to engage in criminal activities, violating laws as well as institutional conflict of interest and disclosure policies, the pendulum is moving toward greater regulation surrounding the topic of conflict of interest. The NIH has released draft guidelines (*11*) for consideration that recognize the general public's concern about these university-industry collaborations while also acknowledging that if these regulations go too far, they will substantially deter collaborations. In a recent Institute of Medicine report on the subject, the opening sentence asserts, "Patients and the public benefit when physicians and researchers collaborate with pharmaceutical, medical device, and biotechnology companies to develop products that benefit individual and public health" (*12*). Regulations should not unduly limit collaboration.

There are also Internal Revenue Service (IRS) rules that reduce the options universities possess when negotiating sponsored projects with industry. These rules severely restrict the ability of universities to value IP that may result from the work funded by companies, reducing the willingness of some firms to fund university research (*13*). Recently, organizations such as the Association of University Research Parks have commented on the negative impact of these IRS regulations.

RECENT EFFORTS TO EXPAND PARTNERING OPPORTUNITIES

The rest of the world is making concerted efforts to close the innovation gap and make their academic systems more attractive to industry collaboration. Fred Moavenzadeh, president of the Masdar Institute of Science and Technology in Abu Dhabi, United Arab Emirates, has stated that the institute (built with strategic input from the Massachusetts Institute of Technology) will become the premier energy research university in the Middle East. The Abu Dhabi government has clearly stated its commitment to building a top-tier school and an energy-efficient emirate—

and its belief that corporate partnerships will be vital for the school's success.

The state of Queensland in Australia has adopted a "Smart State" strategy with a goal of having knowledge-based industries account for 50% of all business activity across Queensland by 2025. To accomplish this aim, the government is making substantial investments in world-class research infrastructure in collaboration with higher education and private organizations, facilitating the exchange of ideas between members of the research community and supporting the development of the Queensland research base by targeting human capital. For the most recent stage (2008–2012), the state government is spending over $23 million to attract and retain some of the brightest minds in science and industry to solve Queensland's challenges of the future, an additional $25 million for a Health and Medical Research Program (*14*) to attract world-class clinical researchers to translate research into better health services for Queenslanders, and $60 million to support collaborations between Queensland's researchers and industry. These investments are part of a well-thought-out strategy for increasing the economic well-being of Queensland and address many of the most pressing R&D challenges.

One U.S. university employing a new approach to collaboration is the Rochester Institute of Technology (RIT), which has created an industry engagement program to complement its traditional approaches for working with industry. The Corporate R&D program is designed to bring together business and academia to enhance company development goals while giving business access to university expertise and student talent. The terms of this program provide sponsoring companies ownership of any IP, providing that all parties agree up front. RIT will retain the right to publish and use research results for educational and internal research purposes. It is important to note that this program complements and retains traditional mechanisms and was implemented with the arrival of a new president, Bill Destler, who gave a clear vision for how the university should seek better strategies for partnering with industry.

Some companies have turned to government-styled requests for proposals to seek proposals from nonprofits and small businesses. This step is perceived by many companies as a cost-effective way to learn about the assets at these organizations and bring new and innovative approaches for addressing their commercial interests. General Mills recently issued a request for information seeking new ways to develop food products and packaging that support the company's sustainability goals.

These examples are illustrations that complement existing, more traditional approaches and increase the options for partnering.

A CALL TO ACTION

I offer a few suggestions for bolstering increased university-industry linkages and catalyzing the discovery-to-innovation process.

Recognize that there is less "dating" occurring and a greater emphasis on longer-term relationships. Putting into place a university-industry transaction can be extremely difficult and time consuming. More companies are seeking to work with fewer universities and develop deeper and more comprehensive relationships. This change lowers the transaction costs and increases the return on investment. Research performers in the nonprofit sector must develop strategies for establishing these long-term, high-value partnerships that transcend research, education, philanthropic, and service efforts. In these instances, two parties can work across the entire "partnership continuum" to support each party's mission (*15*).

Reduce the uncertainty and make longer-term commitments. Too often, companies and universities make public pronouncements that they want to have better relations and that they will make financial and nonfinancial investments in expanding these partnerships. Unfortunately, external pressures (from Wall Street, state legislatures, boards, or the public) or changes in influential personnel (provost, dean, or chief technology officer) can disrupt well-developed plans by shifting priorities or political pressures. Research is a long-term investment and must be supported over a reasonable period of time to yield results. This anticipated return on investment can be the most difficult aspect for industry to accept.

Get to know the people you work with. It is very difficult to work with people you don't know, like, or trust. This doesn't mean that faculty researchers or university administrators need to vacation with their industry collaborators, but having some level of rapport is exceedingly important if you want to move beyond a single project.

Get buy-in at the right level. Faculty researchers run small businesses (their labs), and industry support can be a very important piece of a lab's funding mosaic. In order to develop the long-term relationships that maximize yield, the institutional leadership must recognize this support as important to their organizations. Big pharma has made many announcements stating that external alliances are important to its commercial success, and universities are logical partners for these efforts. Clear statements and actions from the institutional leadership (presidents, chief executive officers, provosts, and chief research and technology officers) regarding the importance and value of these linkages will enhance faculty enthusiasm and industry interest in partnerships.

Remove regulatory hurdles. IRS regulations and other regulatory (for example, conflict of interest) policies can put a large damper on university-industry relations. Reasonable regulations should be encouraged, and many organizations have called for a review of some of the more troublesome policies that negatively affect these partnerships.

When working collaboratively in thoughtful and meaningful ways, industry, academia, and other research organizations such as independent academic research centers and national labs can advance their goals by leveraging their collective intellectual and physical assets. These types of high-reward collaborations require work, but the payoffs for all participating parties can be substantial.

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18. **Disclaimer:** The opinions expressed are those of the author and not necessarily those of Government-University-Industry Research Roundtable or the National Academies. **Competing interests:** The author declares that he has no competing interests.

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