

University-Industry Relations in Singapore

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The relationships between the universities, industries and national research laboratories in a country are very much subject to the nation's historical and cultural background. Furthermore, the differences in the economic realities of each country present divergent contexts for university-industry relations.

The wave of globalization has given rise to a common concern: how to ensure rigorous economic growth in the increasingly competitive global market and how to take full advantage of the opportunities provided by the advent of a knowledge-based economy. In a knowledge-based economy, countries can leapfrog to the most advanced stage of development.

What really matters is the knowledge that enables a company to differentiate itself and generate competitive advantage. A large number of new information technologies originated from academic circles and venture businesses rather than from the laboratories of large firms. An increased call for value for money and reduced time to the market added to the pressure on firms to use output from R&D that takes place outside its own walls. All of these forces came together to create growing incentives for firms to work with universities on R&D.

From the perspective of the universities, there is a growing interest to join forces with the private sector. Universities are being called upon to make tangible contributions to society. Many governments are coming under the strain of allocating limited resources over divergent requirements such as providing for the aging population, combating environmental degradation, and maintaining education and social welfare. Working with industry is now a very attractive option for universities, as the laboratories of the private sector are often better funded and better equipped. In addition, students generally wish to attend universities that have close working relations with industry, since such universities offer opportunities for finding good jobs after graduation.

The Singapore experience presents an interesting example. Having its origin as an entrepot, Singapore has been open to international competition from its independence after World War II. By the 1990s, the country had reached a high level of industrial development and its industrial strategy of utilizing cheap labour was no longer feasible. Singapore felt the need to move to an innovation driven economy earlier than its neighbouring countries. Being the country's only two full-fledged universities up to the turn of the century, the National University of Singapore (NUS) and Nanyang Technological University (NTU) have a strong tradition of collaborating with industry. Their graduates continue to find employment readily in the diverse manufacturing and service sectors in the country. The culture of interaction with industry has been developed through a range of activities including internships,

research collaboration, technology licensing, adjunct appointments and industry participation in consultative committees of academic departments.

IP Framework

The development and expansion of University-Industry relationships during the recent years have been a result of goal-oriented and deliberate public policy efforts. The areas of focus include defining the legal status of universities and their professors, relaxing or removing regulations that prevented faculty members from working with companies, handling intellectual property rights, creating funding schemes, and ensuring adequate financial resources for R&D activities at universities. While universities, industries, and publicly funded research institutions should be allowed to develop working relations with each other through their own initiative, governments also have a responsibility to establish laws and practices that would give proper incentives to collaborative research activities.

Some type of policy framework, underpinned by laws and government regulations, has been put in place. Ideally, the policy framework serves three purposes: first, to publicly state the intention of the government with respect to the directions universities and industry should take; second, to lay down legal rules for the conduct of universities and industry, particularly in relation to the management of intellectual property rights (IPRs); and third, to secure financial resources and incentives to facilitate collaborations.

In Singapore, the system for protecting IP and other economic properties was developed according to civil laws and other rules governing business practice and contracts. They formed the basis for shaping University-Industry relations. According to a study done by the OECD and the World Bank, Singapore is ranked at the top for its IP protection and University-Industry research collaboration. Singapore's success can be attributed to several factors including its long-standing use of English as a working language, which facilitated adoption of good practice and streamlining of processes. The Intellectual Property Office of Singapore (IPOS), which operates under the Ministry of Law, provides the infrastructure, platform, and environment for the creation, protection, and utilization of IPRs. But the actual handling of the technology transfer is left to the universities.

Funding to encourage University-Industry Activities

In Singapore, the universities have been a major collaborator with industry starting with the first government-initiated Research and Development Assistance Scheme (RDAS) which was introduced in 1981. This was a grant scheme aimed at stimulating R&D in the form of U-I collaboration. But a full-fledged technology transfer operation only began in 1992, when the Industry and Technology Relations Office (INTRO) of the NUS, was formed to handle the entire range of research collaboration, IP management and technology transfer.

While technology transfers through licensing is the most direct approach, NUS, through INTRO employs a variety of approaches to publicize the availability of technologies that they have at hand. They send technologies selectively to companies for evaluation and place them on its "technology offer database" on their website.

Companies thus approached are given opportunities to evaluate the technologies. If they are interested in exploiting the technology, they can submit a business plan for negotiation with INTRO. Companies often seek exclusive licensing, but NUS grants such exclusive licensing judiciously and only when companies are able to be specific on the field of use and geographical application of the technology. INTRO also conducts licensing negotiations to ensure that their IP are licensed to companies who are most capable of exploiting the technologies.

Up to the present, INTRO has facilitated the filing of more than 900 patents, more than 200 of which have been granted. In addition, more than 150 licensing agreements have been concluded, generating total revenue of approximately S\$1.2 million to date. On average, INTRO concludes more about 120 research collaboration agreements yearly with industry funding amounting to an average of \$10 million, which is less than 5% of the total University's research budget. NUS targets to achieve a much higher percentage of industry funding in the coming years.

Singapore is placing a high priority on ensuring adequate levels of funding for the activities of universities and public research institutions. Such research activities create a pool of knowledge and inventions, a resource that can be tapped for the purpose of University-Industry collaborations. In addition, there have been new types of funding in recent years, such as support for incubation facilities, science parks, and soft loans. In some countries, tax incentives have been adopted to encourage companies to utilize technologies developed by universities.

In Singapore, in addition to general funding for research activities at universities, a myriad of government incentives aimed at forging University-Industry collaborations has evolved since the early 80s. Today, schemes are available to cover activities across the entire business cycle, from research, IP protection, support for commercialization, start-ups, business development, investment, tax incentives, and venture developments. The history of government support for University-Industry collaboration dates back to 1981 when RDAS was introduced. The program has now been significantly broadened, with new and enhanced schemes to address different sectors and levels of needs. These special industry technology upgrading and R&D programs are the responsibilities of the Economic Development Board (EDB), and the Agency for Science, Technology and Research (A*STAR). Both EDB and A*STAR are the major sources of government funding. EDB provides R&D grants for companies through a variety of grant schemes. It places special emphasis on supporting start-ups and runs a special program called Startup Enterprise Development Scheme (SEEDS). This scheme offers equity matching funds for early stage startups. So far hundreds of companies have successfully obtained SEED funding. NUS has its own complementary but modest venture support fund to assist start-ups.

Generally, small and medium enterprises (SMEs) tend to be left out from national R&D programs, since their technological prowess is limited. But SMEs are in dire need of technical support from outside. Such support can potentially come from external partners including university research centres, national research institutes and technology management organisations. Their needs are not always in the most advanced scientific fields but rather at more mundane and practical levels. In

Singapore, the financial support for patent filings and for technology capability upgrading are in fact utilized mostly by SMEs.

Policies on IP Management

Universities worldwide are confronted by the very delicate question of how to strike the right balance between publishing their inventions and patenting them. In Singapore, the drive for University-Industry collaboration has put pressure on the universities and public research institutes to shift their priorities toward protecting their IPRs with patents. Even if commercial gains are not always the goal for universities and public institutions, patenting is advisable to maintain control over how their inventions will be utilized. Thus, the management of IP is the central issue in the advancement of University-Industry partnerships. Being members of the World Trade Organization (WTO), and more specifically, its Trade Related Intellectual Property Rights (TRIPs), Singapore has well defined systems to protect the economic value of innovations and has clear policies for managing IP.

Countries and universities differ when it comes to the allocation of ownership among the various entities and individuals that directly or indirectly contributed to the generation of the idea. There are differing views as to how ownership should be distributed between those who conducted the research and those who funded it, or among the research institutions, the individual researchers and the government - both local and central - that offered funding for the research. Globally, this issue of how to allocate ownership is a subject of on-going debate.

In Singapore, ownership and distribution of proceeds generated from the technology are treated as separate considerations. While it would be simple and logical to split the proceeds such as royalty according to ownership, universities and businesses often argue differently. ? Even within a single country, different schemes may be adopted, depending on the policy of the institution. In Singapore, NUS divides net profits (net of costs up to 15 % of income) as follows: 50% to inventor(s), 30% to the department and 20% to the university. On the other hand, at NTU, royalties are split with 75% going to inventor and the balance going to the university for the first \$500,000, with a decreasing proportion going to the inventor as the royalties increase.

The definition of of who owns the IP and the allocation of royalties do not always go hand in hand. Sharing of royalties is common across countries and institutions and increasingly seen as a way to provide incentives not only to individual researchers but also to the groups of people and the On the other hand, ownership of IP generated as a result of research is often vested in the research institution. In practice, this makes sense, since putting all the responsibility of ownership and management on the individual inventor/researcher would discourage the researcher and reduce the likelihood of filing patents. On the other hand, it should not be forgotten that many universities and their technology transfer offices are under increasingly heavy financial stress because of the cost of patent application and maintenance.

Challenges Faced by Technology Transfer Offices

Financial Support

Technology transfer offices all over the world have a common problem: how to finance the cost of operation and staffing. And the technology transfer offices in Singapore are also faced with the same challenge. Due to their youth, the offices in Singapore are not self-sustaining as yet. The constant debate of the external benefit of technology transfer going beyond the income collected by technology transfer offices continues to be a challenge. All technology transfer offices in Singapore believe that the performance of the offices should not be judged purely by their income, but also by the impact the transfer of technology has on Singapore society and business.

Manpower and Training

Singapore suffers greatly from a lack of expertise in various fields of IP and technology transfer. There is a huge shortage of talented professionals who are capable of handling the complex, multidisciplinary and meticulous work associated with University-Industry collaborations. There is an acute need for personnel with a good deal of business expertise who can handle the administrative and business work associated with University-Industry collaboration and technology transfers. Such personnel should have an understanding of science and engineering and knowledge of the law, particularly those concerning the management of IPRs. These individuals must also understand how two different communities, the academic and the business, operate.

Singapore is one of the first countries to become aware of the importance of developing this type of human resource. To help meet the demand of such expertise, in addition to formal courses at universities, Singapore organises many seminars, symposium and workshops for short durations provided by private consulting firms and industry associations.

In 2003, Singapore established an IP Academy to provide professional training in IP and IP management. Complementing its role in training, the IP Academy also promotes IP-related research, with the intent of helping Singapore gain thought leadership in selected IP fields. Tapping upon its faculty of local and eminent foreign IP researchers, the Academy conducts leading-edge research projects and research collaborations with internationally renowned IP institutes and IP organizations. These projects expose Singapore to the latest developments in the global IP arena and represent opportunities for Singapore IP researchers to learn from renowned experts and strengthen the nation's indigenous IP research capabilities.

In addition, structured IP-related programmes that aim to equip scientists and engineers with a formal technology management education are also being conducted by the Centre for Management of Science and Technology (CMOST) at the NUS. However, the availability of training on technology transfer still remains the gap in Singapore.

While the need for formal education is not to be questioned, much of learning must take place through actual practice. Negotiating technology transfer contracts and marketing new inventions are almost impossible to teach except by using actual cases. A growing number of litigation that involve the management of IPRs points to the enormous complexity of using new technologies for commercial purposes, hence the difficulty of conducting training in this field. As technology becomes an ever more

important determinant of commercial success, the risk of mishandling technology transfer will continue to rise. Managers in technology transfer offices and university laboratories must be equipped with professional expertise. The question remains whether or not such personnel should have an engineering background, or, as is often the case in the US, a legal background.

Conflict of Interest

The call for more University-Industry collaboration is well grounded amid trends toward intensifying global competition and the drive towards a knowledge-based economy. But these changes should not take place at the expense of the fundamental mission of universities. It remains that universities must pursue several different, conflicting goals. They must still fulfill their primary mission to teach students, and this goal cannot be compromised. While university professors are given greater freedom to work with the private sector, there should be a separation between their academic and commercial activities. There is a real risk of a conflict of interest. In general, such a conflict is defined as a situation in which a public obligation competes with a financial interest. Research priorities may be skewed towards applied research that tends to produce immediate financial benefit. Universities may inhibit intellectual freedom and thus foster public mistrust and distract faculty members from the university's essential functions of teaching and basic research.

Confidentiality is of particular concern since a joint project may hamper the free flow of knowledge between those researchers who are involved in joint research with a private company and those who are not. Use of students as workers is another widely recognized issue.

The first major conflict of interest occurs in regard to time allocation of university researchers between academic and educational responsibility and commercial interest. It is generally agreed in Singapore universities that, if a university researcher intends to take on commercial responsibility, they should at least notify the university of such intention and obtain approval. In order to be able to deal with such requests for approval, universities must have certain rules. A university researcher should take leave or a sabbatical or at least make a separation in the schedule, so that there is always a line separating the two activities. One example in this connection is the 20% rule, which is widely observed in US universities. Under this rule, faculty members are allowed to spend up to 20%, in other words, one day of the week, outside the university. NUS has a similar guideline of 52 days per year to be spent on consulting activities or for faculty's engagement in a non-executive capacity in a start-up company.

In addition to proper time management, there is also a need for managing the economic gains that may arise. This is likely to occur when a university researcher holds some stake in a business that utilizes the knowledge of the university. A successful start-up may bring about millions of dollars of profit for a single researcher. But, if University-Industry collaboration leads to a situation where university researchers make a fortune by using the knowledge of the university and its facilities, sentiments of unfairness, disappointment or even opposition to University-Industry collaboration may arise. In order to avoid a situation like this, there must be clear rules for them to follow. Whether or not a university researcher can be a

corporate director, executive or non-executive, is a moot point. If, yes, under what conditions should they be allowed to do so? While this can be left to individual universities, it will be in the interest of all universities and businesses to have basic guidelines agreed in advance by the joint association of university and industry.

In NUS, clear guidelines have been established to manage and encourage more entrepreneurial activities. NUS has identified a number of potential situations that are likely to arise: (i) misusing students by hiring them as cheap labour; (ii) transmitting privileged information that is not generally available to the company; (iii) undertaking or changing the orientation of research to serve the need of the company; (iv) using university resources for company activities; (v) purchasing equipment for the university research from the company in which the researcher has an interest; (vi) funding by the company of a project related to the licensed technology. In addition to these, NUS regards consulting, equity ownership, royalty interest and family ties as potential areas for conflict. For each one of these situations, NUS provides certain policies and guidelines to minimize the risk of such conflict.

Moving Forward

There is little doubt that the universities in Singapore have played an important role in advancing the nation's march towards an innovation driven economy. One key factor that has contributed significantly to this is the active efforts that their respective technology transfer offices have taken to establish and promote strong University-Industry relations. In addition, they have learnt and benefited from the best practices of more seasoned players in other countries and adapted these practices to the local context. Moving forward, they will increasingly have to find their own path to help address the country's industry capability gaps and strengthen existing expertises in the areas of IP and technology transfer.