Establishing a Technology Transfer Office

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ABSTRACT

Technology transfer does not just happen. Transferring knowledge and innovation from a public research organization to the private sector for commercial application and public benefit requires a formal mechanism—a technology transfer office (TTO)—to protect and license intellectual property. Establishing a new TTO is no trivial matter, and the decision to create one should be made within the context of a long-term plan that takes into consideration the following questions: (1) Does "research commercialization" align with the institution's mission? (2) Do the quality and quantity of research within the institution warrant the establishment of a TTO? (3) Is the institution willing to make a long-term commitment to required institutional changes and to adequately invest in resources and people? If the answer to all of these questions is yes, then it is time to develop a clear TTO business plan. In this effort, a strong dose of patience will help. An often-quoted rule of thumb in professional circles suggests that even under the very best circumstances, TTOs do not become successful for seven to ten years after they are established. This chapter provides practical advice for creating a proactive TTO and also offers historical examples from around the globe of TTO launches.

1. THREE FUNDAMENTAL QUESTIONS

Before initiating a planning process for a new TTO, a research organization must first address three fundamental questions.

1.1 *Does "research commercialization" align with the mission?*

If the institution's primary mission is education, or if its mission does not support research as a primary institutional focus, establishing a TTO may not be warranted. Without a strong research focus, the organization would do well to find alternatives for meeting the occasional need for technology transfer services.

With more than twenty years of experience, the international Association of University Technology Managers (AUTM)[1] has identified four key reasons for public research organizations to advance academic technology transfer:

- facilitate the commercialization of research results for the public good
- reward, retain, and recruit high-quality researchers
- build closer ties to industry
- generate income for further research and education, and, thus, promote economic growth

If these reasons make sense for your institution, then it may be time to set up a TTO.

1.2 *Do the* quality *and* quantity *of research warrant the establishment of a TTO?*

All technology transfer opportunities flow from research. The 2003 AUTM Annual Licensing Survey™ indicates that, on average, one formal disclosure of invention was made for every US$2 million in research activity at research universities in the United States. One U.S. patent application

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was filed for every US$5 million in research expenditures, and one technology transfer or licensing agreement was executed for every US$8.5 million in research expenditures.[2] These statistics indicate that public research organizations review many more innovations (*disclosures of invention*) than are acted upon. Clearly, substantial research is required to generate technology transfer opportunities. Using the above averages, a TTO in a public research organization with a research budget of US$100 million might expect to record 50 disclosures of invention, 20 patent applications, and 11–12 license agreements per year. An institution must therefore determine whether its research volume is sufficient to warrant investing in a new TTO.

The quality of research accomplished within an institution is another critical variable. This may be affected by an institution's ability to recruit and retain world-class researchers who are at the cutting edge of science and engineering advancements. Furthermore, pursuing basic research may generate fewer opportunities than would applied research. If the estimated quantity and quality of research are below the AUTM averages cited above, the institution should use alternative means to address its occasional need for technology transfer services.

1.3 *Is the institution willing to make a long-term commitment to the TTO?*

Time may be the greatest predictor of success for a TTO. In other words, the longer a TTO operates, the better will be its cumulative results and performance measures. This makes sense intuitively: as innovations, patent applications, and license agreements are added cumulatively each year to the institution's portfolio, there is a greater chance that a fraction of these will eventually generate returns. Technology transfer practitioners suggest that it typically takes five or more years for technology that is licensed to an industry partner to result in a marketable product. Thus, according to these practitioners, TTOs require seven to ten years to be successful, regardless of how one chooses to measure success. Institutions should expect similar experiences and be prepared to subsidize the office for many years to come. A commitment to support a TTO is more than a two- or three-year financial obligation.

1.4 *If the institution does not meet the four criteria, then what?*

If the research organization does not, in its initial planning processes, answer yes to the fundamental questions, the following alternative models, which have proven successful globally, can be used:

- An external organization, which can be not for profit or for profit, contracts with the institution to manage the occasional disclosure of invention on an ad hoc basis. There are many examples of these organizations utilized in smaller research organizations globally.
- An individual or small internal office could review, filter, and rank disclosed innovations and an external for-profit company could implement commercialization of the most promising opportunities. Consider the model offered by Baylor College of Medicine Office of Technology Administration and BCMT Technologies in Houston, Texas, both in the United States.[3]
- One TTO could serve a consortium of several public research organizations in a region. The Chinese Northern Technology Exchange Market offers a good example of this approach.[4]
- One office, funded by the national government or a philanthropic institution, could serve as a TTO for several public research institutes. Examples include the U.S. National Institutes of Health Office of Technology Transfer[5] and the Innovation Fund Commercialisation Office in South Africa.[6]

2. ALL GO? DEVELOP A TTO BUSINESS PLAN

When the four fundamental questions have been satisfactorily explored and a TTO has been decided upon, both short- and long-range plans should be developed, much as a for-profit organization would develop its business plan. At the very least, an executive-summary plan addressing the essential elements should be crafted.

2.1. *Developing a mission statement*

First, the TTO should establish a transparent mission statement developed in concert with its constituents (including but not limited to its administration, inventors, and external clients, including potential industry partners). TTO missions may focus upon three primary objectives or combinations thereof: (1) service, (2) economic development, or (3) income.[7]

2.1.1 *Service mission*

The TTO can be considered a service unit to the researcher, similar to an institution's human resources office or a contracts and grants office. In this model, the institution may not share with the office a percentage of the income from successful commercialization. Instead, it fully subsidizes the office—just like any other internal department. Researcher satisfaction typically is high because all innovations receive TTO attention and work.

2.1.2 *Economic development mission*

Institutions inspired by the goal of economic development see their primary mission in terms of creating jobs and economic growth in the local community—and perhaps the region, state, or nation—through spinout companies and through licensing to local companies. A cluster of companies (*centers of excellence*) may be created around a core area of technology. Significantly, a recent Milken Institute study on the high-tech economy concludes that "*research centers and institutions are indisputably the most important factor in incubating high-tech industries.*" The same study found that 29 of the top 30 high-tech clusters in the United States were home to a comprehensive research university.[8]

2.1.3 *Income mission*

As expected, earning income from the transfer of innovations to commercial concerns is nearly always the primary focus of the operation with income as its main objective. Such institutions are very selective, identifying innovations with the highest potential and quickly abandoning others. Not surprisingly, this can lead to overall researcher dissatisfaction; this is not usually the case with institutions that have a strong researcher-service orientation. Institutions with higher income levels from licensing are typically teaching/research hospitals at which the possibility of an outstanding commercial success is more realistic.

Of course, TTOs do not focus on a single mission but combine their vision in ways that best satisfy their own constituents. The mission statement serves as a guide for implementing these goals and sets forth the activities expected from the new TTO. A short and simple mission statement might be: *The TTO serves to assist researchers in the transfer of the institution's research results to industry for commercial application, economic development, and public benefit.* TTOs must be careful to avoid "mission creep." This can occur when TTOs are charged with managing activities not directly related to commercializing innovations (research administration, institutional export regulation requirements, conflict of interest compliance, and other tasks not within its stated mission).

Finally, while TTOs are business offices within academic institutions, the mission statements of these offices increasingly announce a societal role. As the managers of institutional innovations for commercial use, do TTOs also have a social responsibility to improve the well-being of humanity? The answer is a resounding YES! Social responsibility and a contribution to societal wellbeing must fit within the TTO's mission. These can easily be incorporated into the service mission of the office and the institution. Indeed, public research agencies should be in full support of the United Nations' Millennium Development Goals.[9] Furthermore, given that the current debate opposes corporate profit flowing to a range of important social goals—sustainable development, the health of the environment, the indigenous farmer, and free or low-cost treatment of AIDS, malaria, and other diseases in developing countries of the world—public research institutions must make sure to align themselves with societal welfare. The TTO mission statement is a powerful place to announce these aims.

There are many ways to balance these goals with commercialization. One relatively simple way would be to carefully craft license agreements

to ensure that social benefits for developing countries are incorporated into the grant section. For example, a grant for an improved agricultural variety could require the corporate licensee to sell seed for commercial production with royalty or added-value premium pricing but to indigenous farmers in developing countries at cost (or at least without requiring them to pay royalty to the university or the added-value premium charged by the company to commercial producers).

2.2 *Policies and procedures*

The system for managing innovations should be easily understood, and transparent policies should guide the implementation of the institution's mission statement. Defining the *ownership* of intellectual property (IP) resulting from institutional research must be at the very heart of the institution's policy. A disposition of ownership can take many forms, but the disposition must be defined clearly without question or ambiguity. In some countries, ownership is defined by national law. In other countries, each institution holds the prerogative to determine the ownership of research results: the government, the inventor, the institution, or two or more of these parties. In the United States, for example, each research institution is free to determine how ownership is allocated, with the exception (under the U.S. Patent and Trademark Law) that if the innovation is developed with government sponsorship, ownership lies with the institution. Regardless of the approach the institution chooses or is compelled to adopt, technology transfer is impossible without a clearly defined, written policy concerning ownership (including written assignment of title, when required).

Even after more than 20 years of proactive technology transfer practice in North America and throughout the globe, debate continues about the best model of IP ownership for academic institutions and other public research organizations. The inventor-owned model and the institution-owned model both have positive and negative attributes, as seen in the examples of success in both the United States (institution-owned, except for the University of Wisconsin) and Canada (inventor-owned in many institutions). Several countries in various parts of the world have moved recently to the institution-owned model (Japan, Germany, and the United Kingdom, for example). It seems clear that either approach can work well.

However, a disturbing trend has been seen in the recent laws of various countries just entering the technology transfer arena. In some cases, the new national laws require that the ownership of IP arising from sponsored research be *shared* between the research sponsor and the institution. Ownership is shared equally to begin with, but later becomes negotiable (such a provision is stated in Brazil's new technology transfer law of 2005). Such an arrangement is not viable, as these countries will find as they seek to implement a national technology transfer regime. In seeking to be politically correct and not offend the country's corporate sector, the governments have created a situation in which neither party wins: the transfer of research results will be blocked by the inability of either party to maintain exclusivity. This will create an impenetrable barrier that will prevent any corporate partner from investing the energy and money necessary to take an embryonic technology to market. The result will be impasse; the transfer of technology will by stymied.

Obviously, policies should address a multitude of other issues that are critical to the success of technology transfer programs, such as royalty-income distribution, the disclosure process, assignment of responsibility for seeking patent protection, researcher and institutional conflict of interest, dispute resolution, management of licensees' contractual performance, management of equity interests in spinout companies, and many more requirements. As examples, the policies for most research-intensive universities in the United States and in many other countries are found on the AUTM Web site.[10]

2.3 *Financing the TTO*

As previously established, an institution's new TTO will require subsidies for years under the very best of circumstances. However, as different countries have discovered, there are many different funding models.

2.3.1 *Australia's models*

In Australia, public research organizations, within a relatively unregulated environment, are responsible for financing their own technology transfer operations. Two primary models have emerged: (1) the formation of an external company, and (2) the establishment of an internal institutional department or office. Using the company model, the corporation generates cash flow through a variety of related business activities such as consulting, conference management, and professional development courses. The proceeds enable the company to support the organization's technology transfer function. In some cases, a university has provided seed funding to initiate the company's operations.

In the internal-office model, the organization provides funding directly to the TTO, which is then considered one of the organization's central administrative functions. The amount and adequacy of TTO funding depends upon how important innovation management is to the central administration and upon the TTO's ability to demonstrate the benefits it brings to the institution.[11]

2.3.2 *India's model*

No formal legislation for organizing and financing TTOs exists in India. However, during the last ten years, most technical universities and research institutes independently established organizations to interface with industry. Such organizations perform many of the technology transfer activities typically assigned to TTOs in other countries. Some of these autonomous entities were initiated with seed funding provided from state governments or the central government. For example, the Indian Institute of Technology in Delhi established the Foundation for Innovation and Technology Transfer (FITT) with a corpus grant equivalent to US$400,000 from the Indian Ministry of Human Resource Development. In other cases, TTOs were formed by funds appropriated by a governing board of the autonomous university or research institute.

In all cases, such support is provided only for a limited time. These organizations are expected to attain self-sufficiency, working as "profit centers" with a well-managed business plan. As in Australia, income may be derived from service charges levied for business-development activities that may have little to do with managing the innovations from the research institute (for example, industrial consultancies and other business services provided to small and medium enterprises). In addition, each center typically receives a percentage of the royalty income for the technology transfer transactions it manages for the public research organization.[12] In April 2005, the Society for Technology Management (STEM) was formally launched as India's professional technology transfer society, including institutional and individual members.[13]

2.3.3 *Japan's model*

In 1998, the Japanese government enacted legislation to create government-approved university TTOs. Once a TTO was approved, the government would provide two-thirds of its operating cost, up to the equivalent of US$300,000 per year for five years; the universities or other university-related organizations were expected to match government support by contributing one-third of the funding. At the end of the five-year period, the TTOs were expected to be able to sustain themselves without the income streams resulting from commercialization. However, when the Japanese government realized that such expectations could not be achieved, it extended its direct subsidy of a portion of the cost of TTO operations, including the direct allocation of funds to secure patent applications for selected top-tier or so called Super TTOs. Furthermore, in 2004, Japanese law gave all national universities independent legal status, allowing them to participate in these TTO initiatives.

Finally, a number of Japanese TTOs quickly discerned that the funding from the government was insufficient to support their operations. They therefore created associated for-profit companies that facilitated the creation of spinout companies. Faculty members were asked to invest in these companies, which commercialized university R&D. Now, several faculty-owned companies associated with university TTOs exist to assist the commercialization of R&D through spinout companies. This provides incentives for faculty

members to disclose their inventions, because they have a personal stake in the commercialization company. The government and universities realize, however, that this expanding strategy will require new support systems, such as incubators and risk capital, in order for these Japanese institutions to become entrepreneurial universities.[14]

2.3.4 *People's Republic of China*

In 1998, inside China, only Tsinghua University and Peking University in Beijing operated TTOs. Today, most public research organizations in China have a TTO. These were originally supported by the Chinese government, but as China moves from a state-planned economy to one that is more market based, this TTO funding model is changing. Most of the TTOs today operate as associated private companies, solely owned by the corresponding university and initially supported with university funds. As private companies, these TTOs are very active in business-development services, such as setting up incubators, assisting small- and medium-sized enterprises to prepare business plans, helping develop spinout company requirements, investing in new spinout companies with university-based venture funds, and so on. Most often, the TTOs negotiate for significant equity shares in new university spinout companies and may wholly own some spinout companies. Eventually, the TTOs—often called technomarts—are expected to become self-sufficient from their equity holdings and the income received from licensing and other related business-development activities.[15]

2.3.5 *South Africa*

South Africa has made government support for research and innovation a key part of the national economic-development strategy. In August 2002, South Africa's government approved a new national R&D strategy, and discussions continue for implementing the new strategy, including national funding for technology transfer. Funding for commercialization activities and patents is critical, but a major capacity-building and development effort is under way. This effort will build upon capabilities that exist in a few universities and public research councils.

South Africa is seeking to build strong links between its emerging technology transfer system and its research system. This means building a new culture of innovation inside the research community and ensuring that all benefits of research (including noncommercial and social benefits) are understood and exploited. To support this integrated approach, the Southern African Research and Innovation Management Association (SARIMA) was formed in 2002 to assume the lead role in national efforts to build capability in research and innovation. SARIMA is supported by the government, participating academic institutions, and U.S. and European philanthropic donors.[16]

As part of its national strategy, the South African government established its Innovation Fund to promote technology innovation, which has increased networking and cross-sectoral collaboration. The fund has invested South African Rand ZAR650 million in more than 100 projects. Many of these have produced patents and in some cases spinout companies. Most recently, the government established the Innovation Fund Commercialisation Office (IFCO), a centralized office to provide one-stop support for protecting and commercializing intellectual property rights for all of the nation's public research organizations. IFCO complements existing technology transfer offices in South African public research organizations.[17]

2.3.6 *United Kingdom*

Shortly after the 1998 report White Paper on the United Kingdom's Competitiveness, issued by the government of the United Kingdom, many policy initiatives and government funding streams were established to stimulate cooperation between the researchers at universities and the country's industrial entrepreneurs. This cooperation significantly changed the way universities in the United Kingdom organize their technology transfer activities. Several prominent universities created separate companies to commercialize IP, especially innovations that were thought to have potential to serve as foundations for spinout companies (university companies or UNICOs[18]). Nonetheless, the majority of universities also have

internal TTOs that collaborate closely with the sponsored-research office and with the UNICOs to develop industry relationships. The growth and development of TTOs have been stimulated more recently by direct government funding to universities for this *third stream* activity via the Higher Education Innovation Fund in England and Wales (HEIF)[19] and the Scottish Executive Expertise, Knowledge, and Innovation Transfer Programme (SEEKIT).[20]

Initially, HEIF financial support was awarded to institutions through competitive solicitation. Today, the government distributes HEIF funds directly to universities through a *formula funding* process that is based upon numerous criteria, including but not limited to institutional research capacity (quantity and quality) and TTO performance measures.[21]

2.3.7 *Russian Federation*

A major initiative began in 2002 to establish TTOs in leading universities in the Russian Federation. This was led by the U.S. Civilian Research and Development Foundation (CRDF) of Arlington, Virginia, in cooperation with the Russian Ministry of Education. The 19 universities participating in the so-called Basic Research in Higher Education (BRHE) program were identified for R&D development and technology transfer focus. Funding was provided primarily by the John D. and Catherine T. MacArthur Foundation through CRDF and the Russian Federation Ministry of Education. In 2003, CRDF and the Ministry held a joint competition in which BRHE universities submitted proposals to establish TTOs with dedicated funding. Four universities were selected by CRDF to receive funding for TTO establishment, which provides a good example of financing TTOs through a third-party philanthropic source. The awards ranged from US$75,000 to US$150,000 and were paid out over three years. Most recently, the U.S. Department of Commerce and the Russian Ministry of Education and Science executed a bilateral agreement that included establishing the U.S.-Russian Innovation Council on High Technologies. The first meeting of the council was convened in Moscow in June 2005. One of the four focused working groups established by the council will address the role of universities and research organizations in the process of innovations and commercialization. This will include considering how to establish and finance TTO operations in the Russian Federation. Finally, most research in the Russian Federation is conducted by the research centers of the Russian Academy of Science. Many of these centers have extensive technology transfer operations funded internally and directly by government allocations made to research centers at the academy.[22]

2.3.9 *The United States*

No government funding for TTOs is provided to universities inside the United States, and there are no national universities. However, the Bayh-Dole Act of 1980, enacted as PL 96-817 and codified in the U.S. Code of Federal Regulations[23] provides a legal basis for TTO funding. The act states that income recorded from commercializing government-funded-research results can be utilized for *only* three purposes: (1) to fund the administration of the technology transfer function (TTO), (2) to provide a share of income to the inventor as an incentive to participate in technology transfer, and (3) to support education and further R&D at the institution.

The act does not specify the percentages of income to be allocated for these three purposes. Universities are free to determine how to allocate commercialization income as they see fit. Most institutions have set aside a portion of the income stream to fund the TTO: allocations for TTO operations usually range from 10% to 25%. Typically, after allocating a portion of commercialization income to support the TTO, the university directly subsidizes the TTO from internal sources during the first years of its operation. Then, as income is realized from license agreements, the subsidy required from the university for the TTO operations is reduced over time. Eventually, the institution expects that the income stream generated by the TTO will eventually eliminate the need for direct university subsidy. As mentioned above, several years are required for a TTO to become entirely self-supporting from the allocated income. In a few rare cases, a TTO has become

self-sufficient early in its growth from a successful project that immediately generated a large stream of royalty income. Finally, it should be mentioned that other public research organizations in the United States (such as federal laboratories) are funded directly through a *set-aside* of the annual appropriation provided to departments of the executive branch of government, such as the U.S. departments of defense, energy, and commerce (see Federal Laboratory Consortium for Technology Transfer[24]).

2.3.10 *Assessing the options*

The previous examples demonstrate how TTO funding models vary around the globe. Each model has developed to fit the cultural, political, and economic conditions of the corresponding country. Two themes are found in most international models:

1. The TTO typically is allocated a percentage of the income stream from the commercialization of innovations.
2. The TTO is expected to eventually become self-supporting from this allocation of income and perhaps other related income-generating services.

Despite a new axiom (discussed in section 2.5), many countries or regions may have no choice but to establish a regional or inter-institutional model, for the reasons presented, with regard to the costs of establishing a TTO and the quantity and quality of an institution's research results. The greater the distance from the regional office to the institutions the office serves, however, the greater are the challenges for identifying research results with commercial potential, protecting such results, and finding corporate partners for commercialization. Here are a few recommendations that, when followed, can diminish the negative impact of physical distance:

- Within each institution served by a regional office, an individual must be identified to act as the institution's liaison with the regional TTO. (This individual would have other responsibilities as well.) Having a specific point of contact is necessary for coordinating even the simplest administrative tasks. Ideally, this individual should not be a rector, vice president, provost, or dean, but rather a second-tier administrator who reports to such institutional authorities.
- The best communication infrastructure possible must be in place between the regional TTO and the institutions it serves, including, but not limited to, video-conferencing capabilities when possible.
- Key staff of the regional TTO must make regular, frequent visits to each of the institutions it serves in order to have adequate face-to-face contact.
- Transparency in the operations of the regional TTO is essential. Transparency requires: (1) sharing costs between served institutions on a negotiated and equitable basis (if the regional office is not fully government supported), and (2) equal treatment and consideration toward all institutions served by the TTO (that is, no favoritism shown to any one institution).

For 13 years I directed a TTO that served ten academic institutions within the Texas A&M University system. At one time during those years, the TTO sought to serve smaller Texas universities outside the A&M system. The greatest challenge I found in seeking to manage such a broad program was that despite all efforts on the part of the TTO against it, favoritism was perceived by the institutions served. Such perceptions are likely unavoidable and simply must be managed. Once one of the served institutions records a significant success, the other institutions want to know and understand why they have not achieved, or are not achieving, similar success. Individuals who perceive that their institutions have been slighted will frequently blame the "failure" on the TTO and its staff. Over the years, I spent many hours addressing this issue in high-level meetings with institutional officers and system-level officials, even though the TTO office and staff sought to be impartial. Thus, a regional TTO must be prepared to address this critical issue, or the collective approach is likely to fail.

2.4 *Staffing the TTO*

Staffing a new TTO is a major challenge. Engaging the right individual or individuals to operate the office often is the factor that determines failure or success. In the United States, the number of TTOs began to increase in the 1980s, and selected to direct the new TTOs were individuals from various backgrounds including high-level administrators, staff from other departments (contracts and grants staff, for example), clerical staff, scientists, attorneys, businesspeople, and so on. Significant debate went on in the 1980s and 1990s as to which combination of skills was most desirable for directors and licensing associates to possess: scientific skills, legal skills, or business skills? At the same time, many offices evolved from simple one- or two-person operations to complex operations with many different positions to address specific job tasks, such as general administrative management, clerical support, accounting support, paralegal services, and project management (evaluation, marketing, licensing, and so forth).

For the university contemplating a new office, two would be the fewest number of positions to start with:

- **a director/licensing associate.** In an ideal world, a person charged with setting-up a new office should have significant business experience (marketing, management, and business development), combined with a science or engineering education. Generally, neither scientists nor attorneys have the business acumen necessary to establish, organize, and manage a TTO. The director/licensing associate should have excellent communication skills to effectively market innovations and to work successfully with both internal constituents (researchers and administration) and external constituents (potential corporate licensees).

  Unless the new TTO recruits an experienced technology transfer professional, the new director/licensing associate should be trained before operations begin. There are many opportunities for workshops and other training events internationally, through such organizations as AUTM and the Licensing Executives Society International.[25] Additionally, internships are available in numerous countries, for instance, in the United States, the Special American Business Internship Program (SABIT) is offered by the Department of Commerce.[26] AUTM offers scholarships for training, such as the Howard Bremer Scholarship and the Developing Economies Scholarships (five awards). Each of these scholarships is offered annually through a competitive solicitation process.
- **clerical support.** TTO operations require significant clerical and administrative support. TTO activities generate tremendous volumes of paper in the form of patent application drafts, license agreements, project summaries, and marketing materials, as well as daily correspondence with attorneys, potential licensees, and researchers. Project files and docketing systems must be prepared to manage the progress of ongoing work on each innovation, which not only requires clerical support but also appropriate computer and electronic database resources. The telephone rings constantly with calls from inventors and potential corporate partners. Additionally, Web sites must be created and maintained, and incoming e-mails can be overwhelming. Excellent clerical/administrative assistance for the director is essential when establishing a new TTO.

When helping countries and institutions to establish TTOs, I have frequently heard this question: "Should we hire an in-house attorney to file patent applications for the institution?" Generally, in-house counsel retained for the drafting and filing of patent applications is not recommended for the following reasons:

- By and large, the breadth of an institution's research is too wide to be within the technical expertise and knowledge of any one patent attorney. Furthermore, the cost of hiring several attorneys with the relevant technical skills to address this breadth is not cost effective. Exceptions to these conclusions may be Centers of the Consultative Group

on International Agricultural Research (CGIAR) or similarly focused research institutions with narrower institutional research results.

- The claims of a patent application form the basis for products and companies. Especially in human-health research, tens and even hundreds of millions of dollars are spent to bring an embryonic technology to market. Such investments depend upon and are protected by the strength and enforceability of the patent rights to the subject technology. An institution would be extremely shortsighted to cut its patent application costs by using an in-house attorney made to be responsible for too many fields of technology. Given the high stakes, it is far better to secure the best possible patent counsel available to draft the strongest claims possible for the subject invention.
- Corporate licensees prefer to use the best counsel available to back their investments, and they may not have full confidence in the capabilities of an in-house attorney.
- In today's litigious world, use of outside counsel creates a third-party buffer, an entity that must take responsibility for conducting thorough prior art claims, meeting filing deadlines, drafting the best claims possible, and managing the patent prosecution process from start to finish in the most professional manner. If problems arise along the way, as they often do, the institution is best served by having the attorney's firm, and not the institution, be responsible for all of the constituents: the inventor, the institution, and the licensee. It is not advisable, when things go wrong, for the university to be in the position of defending the patent prosecution with in-house counsel.
- Finally, many institutions have legal counsel in an *office of the general counsel* (or similar name) that can offer assistance to the TTO, from time to time, for contractual questions, contract enforcement, and other legal issues.

Many TTOs in the United States—including the TTO of the Texas A&M University system—have hired an in-house *paralegal specialist*, rather than in-house counsel, to manage the interface between the institution and its patent attorneys engaged under contract. The paralegal is responsible for ensuring that all documents are properly executed and filed with the attorney firm, for maintaining "suspense files" or tickler files to provide a backup system to ensure that no filing deadlines are missed at domestic and international patent offices, for filing copyright applications for software and other works on behalf of the institution and its faculty, and for maintaining a relational database of all official project documentation.

2.5 *Organizing the TTO*

During the initial growth of the technology transfer industry in the United States in the 1980s and 1990s, TTOs were located in a variety of administrative units within public research organizations, including (1) offices of general counsel, (2) business administration offices, (3) offices of the vice president for research, and (4) contracts and grants offices. Over time, however, TTOs typically were placed within the research administrative unit of the institution, which usually reports to the vice president for research. In many cases, an individual serves as the organization's officer for research and technology transfer, combining the functions within one administrative unit.

Additionally, as TTO offices grew in the United States and other industrialized countries, the offices diversified to create individual operating divisions to manage focused tasks:

- general administrative office management
- clerical support
- project management services through a licensing associate (responsible for evaluating inventions, marketing, coordinating industry relations, and negotiating license agreements)
- accounting services (responsible for managing general fiscal operations, as well as accounts receivable from licensees, and accounts payable to consultants, patent attorney firms, and other service agents)

- paralegal services (responsible for managing the volumes of correspondence and carrying out discussions with patent attorney firms, executing and notarizing legal documents, and docketing critical dates to ensure filing deadlines are met)
- marketing/public relations (responsible for managing Web sites and producing brochures, press releases, and other marketing materials, as well as organizing frequent promotional events for researchers and industry)

More entrepreneurial offices may even create divisions to establish new spinout ventures, incubators, university venture funds, and the like. Obviously, new TTOs may utilize existing units outside the office to manage some of these activities—such as working with a university communications office to produce marketing materials—until such time as the growth of the office warrants a dedicated person inside the TTO.

As has been suggested, TTOs have taken various organizational forms, in addition to the traditional stand-alone unit or department within the public research organization. These include (1) an external company owned by or closely affiliated with the institution to manage its technology transfer activities, (2) a service or consulting contract with a third-party company to manage occasional innovations disclosed by researchers, (3) one office serving multiple institutions in a region under collaboration agreements, and (4) a government agency serving as a TTO for universities and other research organizations in a region, state, or nation.

How to choose? This chapter suggests a new "TTO axiom" to help guide planners toward the most effective organizational form: *The closer the TTO is physically to the scientists and researchers it serves, the more effective it will be.* The reverse is also true: *TTO effectiveness diminishes the further it moves physically from its customer base.* This latter holds true even in our age of e-mail, instant text messaging, and other video, voice, and digital communication techniques. None of these techniques can replace frequent face-to-face communication needed between the TTO staff and its inventors, or the ability to call, on short notice, meetings between project stakeholders—inventors, TTO staff, academic administrators, potential licensees, and so forth. At times potential corporate partners arrive at the TTO with little or no advance notice, and getting the inventor to join the group for a meeting, lunch, or dinner obviously is not possible if the individual is in a faraway city. Moreover, simple administrative and logistical requirements in managing innovation suggest that physical proximity is important. Consider the example of an inventor receiving a call from the attorney-of-record on a patent application saying that the inventor's signature is needed on an affidavit before the end of the day. Such a situation could only be addressed if the TTO were on-site.

3. OPERATIONS

The degree to which TTOs participate broadly in research, technology transfer, and industry relations varies widely from institution to institution and from country to country. The degree of participation depends upon many factors, the most important being the entrepreneurial culture of the institution and of the region or nation. Institutional culture is determined most often by the attitude and degree of support from the president or chancellor of the institution. Some entrepreneurial chief executive officers have expanded their initial TTO operations to include activities in support of their industry partners. This can create closer connections to the corporate sector, such as the development of spinout-company business plans by a university's college of business administration; the creation of university-based technology business incubators, and/or research and science parks; organizational venture funds, and so on. Constituents of a new TTO, however, expect the following minimal activities:

- **Assist faculty and researchers in identifying research results that have commercial value and document the discoveries through a disclosure process.** The disclosure-of-invention form should be simple and make it easy for the inventor to document the discovery; more detailed information can be obtained through interviews and subsequent

interactions with the inventor. The complexity of the disclosure form should never be a deterrent to faculty participation in the technology transfer process.

- **Evaluate commercial potential of disclosed innovations.** A TTO exists to find commercial applications for technology and partners to realize the commercial potential, not to judge the value of the science. Such evaluations may be the most difficult of all tasks for a TTO. There are many approaches to invention evaluation.[27] The evaluation process lays the foundation for future decisions about IP protection and marketing.
- **Determine whether or not to protect IP rights in the innovation; secure funding for filing patent, trademark, or copyright applications; and manage the protection process.** The challenge of securing funding for protection of intellectual property internationally—especially when seeking protection in highly industrialized countries where the primary markets for the expected products lie—is often overwhelming and perhaps even impossible in many developing economies because of the tremendous expense. Yet, there may be very small or nonexistent commercial markets for the innovation in the country of origin, which can present a serious dilemma. The only solution in many cases is to first secure protection in the country of origin, thereby "buying time" under the requirements of the Patent Cooperation Treaty (PCT)[28] to find a corporate partner to pay the patent costs internationally as a business expense in the license agreement.
- **Conduct market research to identify potential industry partners, and then market the innovations.** Research has shown that in the United States, the primary source for identification of licensees is the inventor. In industrialized countries, inventors typically are familiar with the marketplace[29] in their area of scientific expertise; they may even know their counterparts in industry (potential licensees) on a personal basis through their professional networking activities.
- **Once one or more industry partners are identified for an innovation, negotiate legal contracts (license agreements) with these industry partners to transfer IP rights in the innovation in exchange for royalties or other consideration.** The goal is to negotiate a fair arrangement that facilitates and assists the commercial partner in successfully developing and marketing the product, rather than simply seeking to negotiate the absolute highest fees and royalties in the agreement. Developing industry partnerships can lead to many unexpected benefits, such as sponsored research, student employment opportunities, consulting opportunities, and even philanthropic donations to the institution.
- **Maintain and manage administrative functions in support of the primary functions of IP protection and technology transfer.** These functions can include accounting, royalty distributions, licensee performance management, and patent application management.
- **If the TTO decides not to pursue IP protection and commercialization of an innovation, implement a process to ensure that others have an opportunity to pursue protection and commercialization, if they chose to do so.** The "others" will most often be inventors.

4. EXEMPLARY TTOS AND CONCLUSION

In 2000, Dr. Louis Tornatsky conducted a study for the National Governors Association in the United States to identify the common practices of the most exemplary TTOs in the country. The study highlighted seven characteristics that were common to most exemplary offices:

1. A clearly stated TTO mission
2. Transparent TTO policies and procedures
3. Entrepreneurial staffing and an entrepreneurial environment
4. Customer-friendly relations with both internal and external constituents by TTO staff

5. A highly supportive university administration and community (local, regional, and national)
6. Strong TTO links to potential industry partners
7. TTO access to risk, or venture, capital[30]

TTOs exist in all shapes and sizes around the world, ranging from a part-time individual at a small research organization, to offices with several hundred professionals (such as the University of California system), to a contracted third-party organization that manages an occasional innovation with commercial potential. Furthermore, sources of TTO funding, the organizational structure of the office, the scope of activities, and many other operational factors vary from office to office and from country to country.

The most compelling forces that determine a TTO's characteristics and performance have been a primary focus of this chapter: the volume of research activity within the institution and the quality of the research results. Research is the source from which all innovations and opportunities for TTO management originate. Public research organizations contemplating the creation of a TTO should always first consider whether the research quantity and quality of their institutions justify the endeavor. ■

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4 www.ntem.com.cn/.

5 ott.od.nih.gov.

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23 Another source of the Bayh-Dole act: (i) AUTM offers a description of the Act, with a link to the actual legislation: http://www.autm.net/aboutTT/aboutTT_bayhDoleAct.cfm. (ii) When you click on the AUTM link, it takes you to the actual legislation at: www4.law.cornell.edu/uscode/html/uscode35/usc_sup_01_35_10_II_20_18.html.

24 www.federallabs.org.

25 www.lesi.org.

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