

Key Insights into Technology Transfer Offices

Translation of academic innovation has matured since the passage of the Bayh-Dole Act, 28 years ago. Universities and research institutes have contributed towards this to the tune of 380,000 disclosures, 206,000 new patent applications and 84,000 issued US patents.¹ The market has responded in turn, generating 11,000 startups and 10,000 products that have yielded more than \$1 billion in equity for the institutions.² Deerfield Management has joined in this effort by entering into significant collaborations with leading academic institutions. In conjunction with these investments, the Deerfield Institute, the research division of Deerfield Management, surveyed 35 university technology transfer offices to endeavor to understand current trends impacting their organizations. The survey revealed insights that can shed light on the operations of these groups, provide guidance to those seeking to collaborate with academia and serve as a guide for continuous improvement in the practice of academic commercialization.

KEY INSIGHTS FROM A 35 TECHNOLOGY TRANSFER OFFICE SURVEY

- Technology transfer offices (TTOs) operate within a unique 2-customer model that values faculty inventor and technology buyer relationships, but can create tension at certain points.
- Technology evaluation by TTOs is a key challenge that can be addressed with independent, knowledgeable advisory boards.
- TTOs make commercialization through startup licensing and incubation a priority.
- Future commercialization success will depend upon a focus on technology and developing trusted relationships with the TTO customer base.
- Evolving academic/industry collaborations have risen to extract the value of underutilized intellectual property from research institutions.

The Deerfield Institute Survey

The Deerfield Institute, part of Deerfield Management Company, engaged with 35 TTOs at universities and academic medical centers through a survey that covered areas including Structure, Metrics, Evaluation, Clients, Barriers, Resources, and Startups. Among the responding institutions, 30 of 35 had both a university and medical school with four respondents not having a medical school and one respondent having a medical school TTO. The respondents themselves, one from each TTO, were executive leaders, overwhelmingly either Executive Directors or Vice Presidents/Chancellors.

Buyers and Sellers of Academic Intellectual Property

Jay Walker, co-founder of Priceline.com, diagnosed both the opportunity and challenge for intellectual property (IP) commercialization back in 2014.

“Of today’s (in 2014) 2.1 million active patents, 95 percent fail to be licensed or commercialized. These unlicensed patents include over 50,000 high-quality patented inventions developed by universities. More than \$5 trillion has been spent in the U.S. alone on research and development over the past 20 years, much of which went to create the very patents that remain unlicensed.”³

Buyers (licensees) of intellectual property are often represented by established companies, venture capitalists or other investors looking to create

and fund startup companies, and individual entrepreneurs seeking technology to create companies for funding. To that end, industry buyers, particularly large pharmaceutical companies and academia, collaborate on research and development.

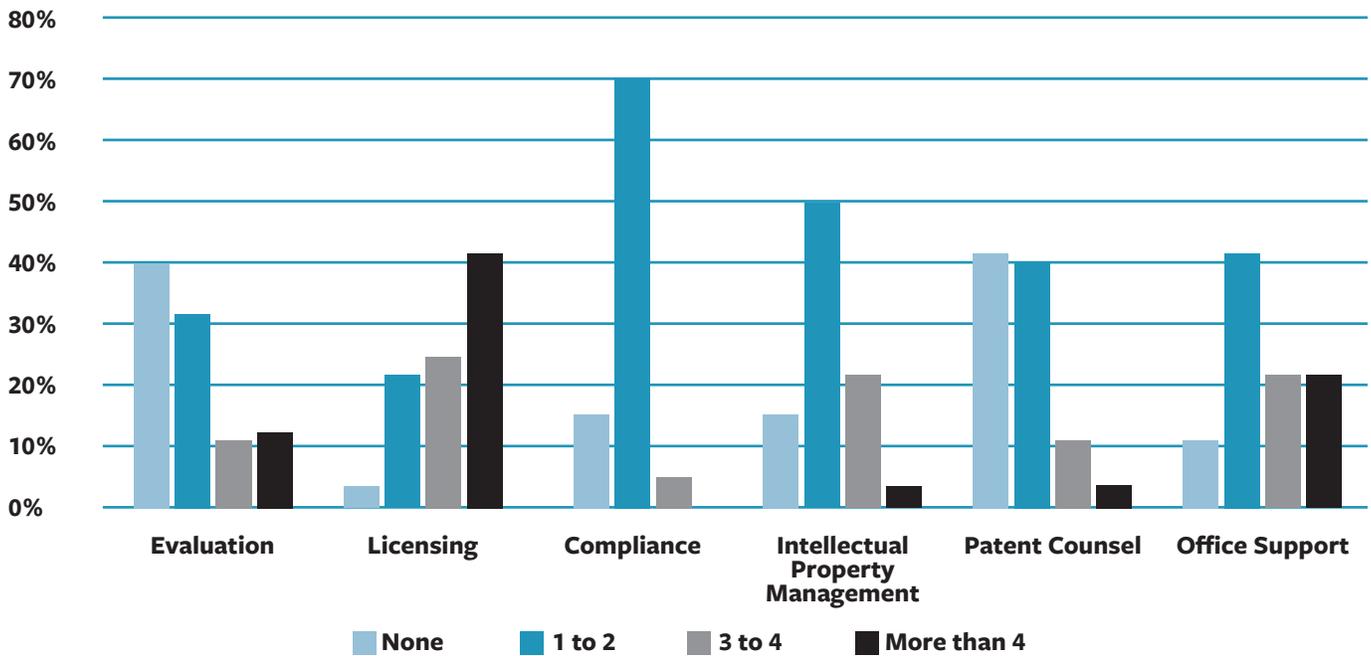
The Pfizer-driven Centers for Therapeutic Innovation (CTI) has the pharmaceutical company partnering in key geographies such as Boston, California and New York with institutions such as University of California San Diego, Sanford-Burnham, Mt. Sinai, Weill Cornell and Memorial Sloan-Kettering.⁴ GlaxoSmithKline utilizes its Discovery Partnerships with Academia (DPAC) and Discovery Fast Track programs to collaborate with researchers and scientists.⁵ Underlying these two examples of such higher profile programs, universities continue to enter into project-specific sponsored research agreements that have taken on a greater importance with the reduction of traditional government grant funding programs.

Creators and sellers of intellectual property in academia are represented by university inventors (often faculty members) and university administrators (usually TTOs) that file and bear the initial costs of intellectual property and have the authority within the

university to grant licenses to them. Faculty inventors usually operate individually within the university, although they may be loosely organized if there are multiple inventors on a patented technology. TTOs, on the other hand, usually have formal structures given their multiple duties of patenting, licensing and enforcing agreements. An examination of these office models is useful in understanding technology transfer operations and interpreting the survey findings.

Academic TTOs are somewhat unique amongst sellers of intellectual property in that they do not (and cannot) direct production of their assets and must operate within a 2- customer model. Invention disclosures and patents from faculty are not the result of top down direction to create new therapeutic drugs or software/ information technology but rather from discoveries that emerge organically from independent faculty research. More likely than not, a university’s IP portfolio will consist of assets in broad areas rather than self-selected fields.⁶ Since most TTOs are dependent on university funding and not self-sustaining from royalty revenue, TTOs aspire to have good relations with two customers: one, the faculty inventors whose assets they evaluate, protect and

TABLE 1. SPECIALTY REPRESENTATION IN TTOs*



*Based on the 35 surveyed TTOs.

license and two, the companies, investors and entrepreneurs to whom they sell.

An examination of TTO structures is helpful to understand their operations and needs. Broadly speaking, TTOs are structured in one of two ways: a vertical model in which the staff does a bit of everything within the IP commercialization pathway or a horizontal model wherein the staff are specialized within specific roles.⁷ Often described as the “cradle to grave” approach, the vertical model

can promote continuity and broad experience among staff, and is often of necessity in small to mid-sized staffed offices. The horizontal model allows for focus and specialization on a select aspect of technology commercialization.

The Deerfield Institute survey findings indicated respondents primarily utilized a horizontal office model with separate functions including compliance, evaluation, IP management and licensing amongst others (Table 1). The bulk of roles within a TTO, however,

were in licensing with 43% percent of respondents having 5 or more people in that role. Additionally, TTOs reported themselves as being structured primarily around science topics such as Medical Device, Life Science and Health IT.

Motivations and Mission for Academic IP Sellers

The uniqueness of the academic technology commercialization function was further revealed by the survey results.

When asked to rank performance metrics in order of importance, respondents ranked faculty satisfaction of utmost importance (37%) followed by the number of license agreements (34%) (Table 2).

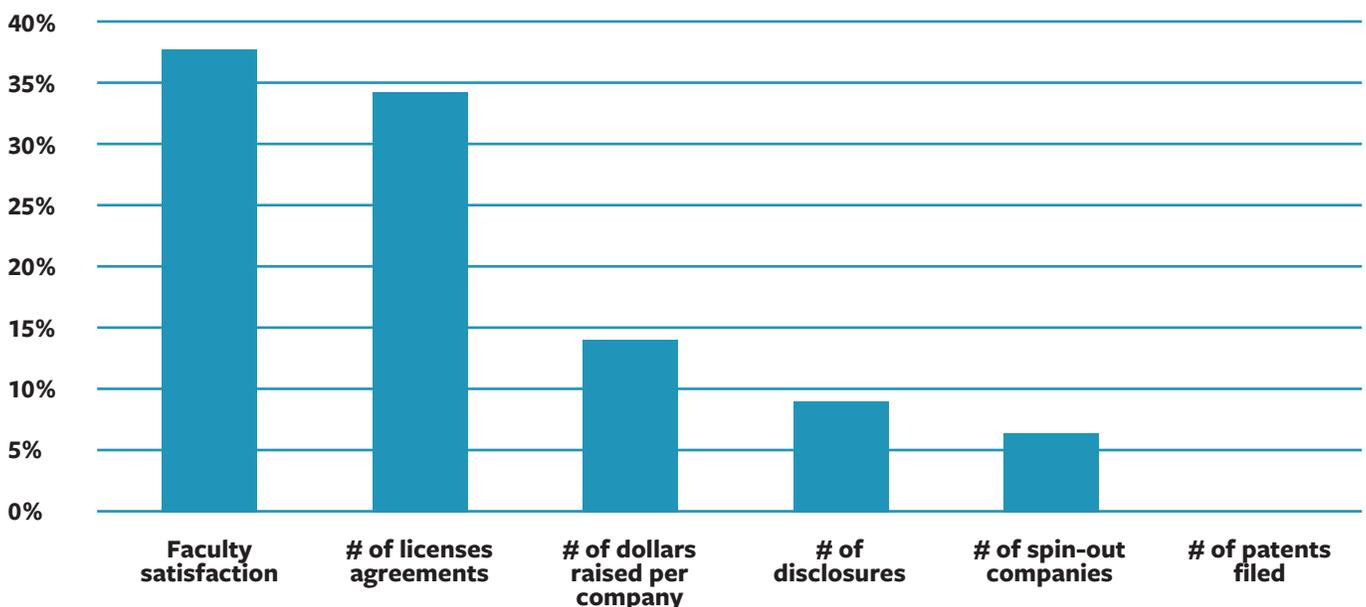
Within the university, respondents overwhelmingly identify faculty (77%) as their primary client. These findings provide support to the idea of TTOs operating within a 2-customer model that provides service to both faculty inventors and the various buyers of university technology.

This model is unique within the IP licensing industry. A 2005 survey of Licensing Executive Society (LES) members and IP asset owners (including both buyers and sellers), reported the top three motivations for developing IP assets as “Realizing higher margins on proprietary products,

Generating licensing revenue, and Use as a basis for strategic partnering and JVs”⁸. Additionally, these survey findings differ from the mission statements of many TTOs that broadly refer to a mission of translating research discoveries into products rather than faculty satisfaction or high deal volume.

The survey findings make sense within the context of the university environment. Faculty inventors know the most about their invention and are crucial in working with patent attorneys on application drafting and with interested technology buyers on providing technical diligence

TABLE 2. TTO METRICS TO EVALUATE PERFORMANCE*



*Based on the 35 surveyed TTOs.

information. Faculty opinion and comment can often influence university administrators for TTO funding and personnel decisions. Interestingly, IP buyers (particularly venture capital firms) often seek out relationships first with faculty members to source new technology inventions before engaging with the TTO.

However, engagement and cooperation with a TTO can benefit faculty members as well. The TTO is typically charged with making upfront decisions on paying for patent prosecution for the faculty inventor. For licensed technologies, the TTO administers the agreement in place of the patent inventors. And, unlike most corporate employees who invent intellectual property, university faculty inventors often receive a percentage of any revenue generated from licensing.

The focus on faculty satisfaction also stems from an acknowledgment that without a steady stream of new inventions, TTOs would lose their *raison d'être*. As technology sellers and producers respectively, TTOs and faculty inventors are inextricably combined in technology commercialization. This symbiosis is highlighted by the fact that a majority of technology transfer projects come from “repeat investigators” rather than from new ones (Table 3).

The second ranked motivation of generating high numbers of license agreements was further supported by the number of discrete answers to “What are the primary metrics you use in evaluating a project’s performance over time?” More than half of the verbatim answers related to the metric of the asset’s licensed status. This focus on deals is a reflection of the university’s role as a research and discovery engine rather than a product development and selling center. The university needs outside partners to license, develop and sell their technologies in order to fulfill stated missions of translating research into products. This further strengthens the technology buyer’s position as a key customer for TTOs.

TABLE 3.*

	INVESTIGATORS WHO ARE NEW TO THE TTO	REPEAT INVESTIGATORS
Less than 25%	20%	0%
25 to 49%	69%	9 %
50 to 74%	12%	54%
75 to 100%	0%	37%

*Based on the 35 surveyed TTOs.

Technology Evaluation Within TTOs

As noted previously, university inventions mirror the panoply of research being conducted within the institution.

As the steward of university funds for patent protection, the TTO must assess these invention disclosures to select those that can be protected with patent, copyright or trademark applications. The Deerfield Institute survey highlighted the two primary characteristics that TTOs utilize in technology assessment – marketability and patentability (97% and 94% respectively, in Table 4). Elements identified in the survey verbatims were essentially offshoots or paraphrasing of these two key areas including “clear path to market,” “commercial potential,” “licensability,” “protectability” and “EIR interest.”

Staffing dedicated to the evaluation function in TTOs was surprisingly

low. Approximately one third of respondents indicated 1 to 3 individuals are involved in the evaluation stage for new projects (Table 5). These roles were often covered by members of the licensing team and junior members of the office, and were described in optional comments as “licensing and patent team,” “...technology development managers,” “...licensing associates and interns,” “plus interns, occasionally.” Viewed from the lens of the TTOs motivations and mission, this becomes a setting that has the potential for conflicting interests. For TTOs whose primary metric is Faculty Satisfaction (Table 2) and primary client is Faculty, (Figure 6), they are put in the awkward position of telling faculty inventors that their disclosures may not be patented and licensed.

Fortunately for both faculty inventors and TTOs, evaluation decisions are not made unilaterally or entirely subjectively. As illustrated by Table 7, there are multiple tools employed by TTOs for evaluation. External data such as

venture relationships and outside patent lawyers (83% and 80%, respectively) lead the way. External databases (54%) were comprised of tools such as Google Patents, United States Patent & Trademark Office (USPTO), World Intellectual Property Organization (WIPO), and commercially available third party databases that provide information on technology patentability and related markets.

The use of venture relationships as an evaluation tool harkens back to a previous model of technology commercialization that had many TTOs filing “coversheet provisional patent applications” on inventions and seeking to market them during the one year period prior to provisional conversion to solicit some sort of outside interest. While this approach has faded somewhat after the passing of the America Invents Act which limited the usefulness of coversheet provisionals, the practice of marketing technology to potential technology buyers continues to be an important tool for TTOs.

However, the conflicting interests of TTOs once again appear. To heavily rely on venture (buyer) relationships during the evaluation (pre-patent stage) has limits. For unpatented technology, the information provided to the venture

TABLE 4. ELEMENTS CONSIDERED WHEN EVALUATING NEW PROJECT*

Marketability	97%
Patentability	94%
Availability of funding	60%
Other	66%

*Based on the 35 surveyed TTOs.

TABLE 5. # OF INDIVIDUALS INVOLVED IN EVALUATION STAGE*	
1 to 3	37%
4 to 6	29 %
7 to 9	12%
10 or more	23%
Mean #	6.7

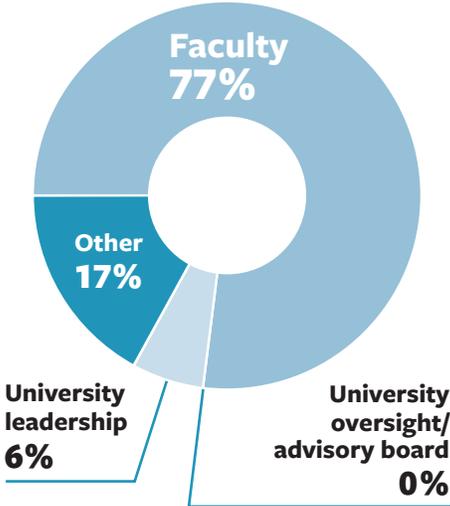
TABLE 7. TOOLS USED WHEN EVALUATING NEW PROJECT*	
Venture relationships	83%
Outside patent lawyers	80%
Market sizing databases	66%
Deal term databases	60%
Publicly available databases	54%
Academic advisors	51%
Outside consulting groups	29%
Other	26%

*Based on the 35 surveyed TTOs.

relation is necessarily vague to limit disclosure as to render any venture relationship observation to be speculative at best. Conversely, if sufficient pre-patent information on the technology is provided, future patentability is put at risk. Further complicating the situation is the limited bandwidth of technology buyers to evaluate broadly differing, high volume disclosures and the fact that buyer relationships (particularly among venture capitalists) are with inventors first and TTOs afterwards.

Despite the potential contradicting aims involved, the desire by TTOs to evaluate technology on patentability and marketability with established tools (rather than solely on the basis of subjectivity) is to be applauded. These efforts can lead to the protection and commercialization of useful products and are appreciated by the university employers of TTOs. Indeed, an independent survey reported that 47% of university administrators would grade their TTOs a “B” and above, while 40%

FIGURE 6. “CLIENT” WITHIN INSTITUTION*



of administrators would like their institution to spend more dollars on fostering technology transfer and only 3% of the group would want to spend less.⁹ Clearly, TTOs are pursuing rigorous methods on evaluation, with many groups doing even more to increase their effectiveness.

Decreasing Barriers to Commercialization

The Deerfield Institute survey asked respondents to describe the project elements most difficult to evaluate. A majority of the written verbatims identified marketability as the most challenging, spanning from defining markets that may not exist for early stage projects to determining market penetration and potential for established markets. Other elements such as not knowing how a technology will evolve, competition, patent freedom to operate, and finding fundable business teams were identified.

The TTO leaders also demonstrated a desire to expand past the venture relationship tool for evaluation and utilize outside experts and advisors who know a particular market space, technology area, or domain. Iterations of this response appeared in a third of the responses (12 of 35) in the survey verbatims. When given a listing of additional areas of investment or focus for a university TTO, over a third of the respondents found “Having an external advisory board to evaluate commercial viability” to be extremely valuable (Table 8). With an expert network aligned with the university, TTOs expand the ability of the TTO licensing staff to deliver objective analysis and make evaluation, patenting and commercialization decisions

prior to engaging with potential buyers and give objectivity to TTOs when delivering bad news to the faculty inventor that his or her invention is either not patentable or not attractive to the market of technology buyers.

Within the university, academic medical center or research institution, technology sellers listed a lack of entrepreneurship among faculty as an internal barrier to completing more technology transfer projects (Table 9). Without being overly critical to faculty (who are TTOs’ primary client), this finding underlines the difficulties of translating research into products. Being more “entrepreneurial” can be attributed to faculty not wanting to or not knowing enough to

TABLE 8. AREAS FOR ADDITIONAL INVESTMENT AND FOCUS*

Developments in Electronic Document Management Systems (EDMS)	Standardizing invention disclosure formats	Educating faculty on start ups	Educating faculty on patents/licensing	Continuing education of tech transfer/licensing personnel on best practices
3%	6%	9%	11%	17%
Standardizing licensing	Having an external advisory board to evaluate invention disclosure	Having an external advisory board to evaluate patentability	Forum to discuss best practices with peers	Having an external advisory board to evaluate commercial viability
6%	9%	9%	11%	34%

*Based on the 35 surveyed TTOs.

do more to push their invention forward, particularly in pursuing startup companies. This is often exemplified by the mentality of “the patent is the product” wherein a patent is the only thing that is needed by a licensee for successful commercialization.

Other barriers in the survey included funding challenges, lack of access to entrepreneurs and VCs, and lack of internal staff to manage large technology portfolios.

For TTOs, educating faculty inventors to think beyond their research and into the product applications of it can aid their efforts in both evaluating technologies that are not patentable or marketable and also in supporting the TTO to be more effective in patenting, marketing and licensing.

TABLE 9. BARRIERS TO COMPLETING MORE PROJECTS*

Lack of entrepreneurship among faculty	49%
Academic resistance to commercialization efforts	26%
Lack of internal IP/legal support	11%
Physical space	6%
Lack of continuing education on developments in IP law	6%
Other	2%

*Based on the 35 surveyed TTOs.

Focus On Startups for University TTOs

A journal publication by Swamidass criticized university approaches to technology commercialization for not focusing enough on startups as an outlet for licensing.

Claiming that university startups provide higher returns to a university than licensing to established companies, and that TTOs are unprepared for university startups, and universities are too risk averse and cash flow driven to pursue startups, the article urged programs that ripen technologies to increase their commercial value.¹⁰ While examples of licensing to established companies such as with the Cohen-Boyer¹¹ and Axel patent portfolios¹² provide a counterpoint to such an approach, TTOs have indeed increased their activities to facilitate and incubate startups. Over three-fourths (77%) of survey respondents had Incubation Resources on campus, including educational, mentoring and incubation facilities (Figure 10). These resources are usually managed by TTOs and readily accessible to faculty inventors, which can also increase their level of entrepreneurship.

Direct investments by institutions into their startups are still in the minority (Figure 11). Rather, institutions have stepped up their internal project funding for translation (Table 12), recognizing that the lack of funding was identified as an obstacle to funding translation of science (Table 13). Research funding may be more prevalent than direct startup investments because they dovetail with existing university programs to support researchers, provide resources to the TTO's preferred faculty client base, and do not cross paths with investment initiatives controlled by other institutional stakeholders such as endowment, investment or treasury offices.

FIGURE 10. INCUBATION RESOURCES ON CAMPUS*

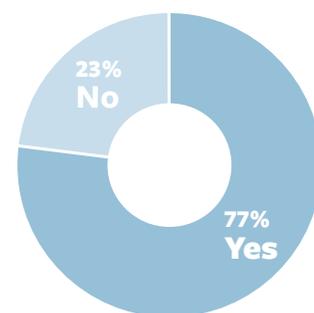


FIGURE 11. INVEST IN COMMERCIAL PROGRAM SPINOUTS*

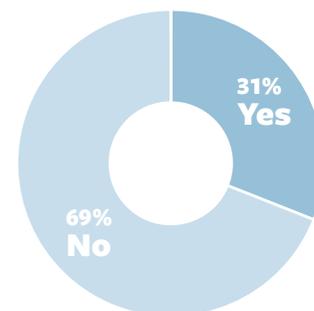


TABLE 12. FINANCIAL RESOURCES DEDICATED TO TRANSLATING SCIENCE INTO INNOVATION TYPES*

	NEW THERAPEUTICS	NEW MEDICAL DEVICES AND/OR DIAGNOSTICS	NEW HEALTHCARE INFORMATION TECHNOLOGY
No	77%	74%	63%
Yes	23%	26%	37%

TABLE 13. OBSTACLES TO FUNDING TRANSLATION OF SCIENCE INTO INNOVATION TYPES*

	NEW THERAPEUTICS	NEW MEDICAL DEVICES AND/OR DIAGNOSTICS	NEW HEALTHCARE INFORMATION TECHNOLOGY
Yes	66%	57%	46%
No	34%	43%	54%

*Based on the 35 surveyed TTOs.

Measures of Success

The survey queried these TTO leaders for who they considered as well-regarded commercialization offices as well as their ideas for Measurements of Success. The “big three” of Stanford, MIT, and Columbia lead the group respectively (Table 14). The individual responses also revealed a nuanced approach towards these executives’ view of their industry.

Two themes of TTO success emerged – financial success as measured by deals, royalties and income; and reputational success as evidenced by the greater university community’s awareness of a TTO’s programs, practices, and ability to be a thought leader in the industry.

Evolving Partnerships Between Industry and Academia

Deerfield Management partnerships with academia represent a unique iteration of industry/academic collaborations from the past.

In this vein, the partnerships begin to address emerging themes in academic technology commercialization – particularly institutional moves towards project funding and increased startups. The Deerfield partnerships focus on funding, drug development, operational and managerial support to further research programs. Should results emerge that are commercially attractive, the primary vehicle for subsequent development is through startup licensing, in which Deerfield can directly invest.

The Deerfield Institute survey highlights how TTOs are seeking new ways to evaluate the wide range of inventions that they see to patent and position them for licensing. When asked for areas an Investment Partner Could Provide Value-Add (beyond financial support) the response showed that TTOs desire independent, expert advice (13 of 33 responses). A distant second to this was in TTOs obtaining access to executives to lead and staff startups. The desire for management highlights an interesting challenge in the use of startups as a path for commercialization. While there are willing sellers of technology and willing funders of startups, obtaining talent to run startups is a continuing challenge. Given the high risk associated with early stage ventures, and, particularly for life science companies, that executive talent resides in limited clusters throughout the country, it is hard for technology buyers and sellers to obtain startup management. Initiatives such as the Academic Venture Exchange, have emerged to help address the need and seek to have TTOs pool and share their entrepreneurial networks.¹³

Stanford	25
MIT	21
Columbia	19

*Based on the 35 surveyed TTOs.

Elevating TTOs To Their Full Potential

The Deerfield Institute survey of TTOs provides insight into the thinking of academic technology commercialization leaders and can be used to shed light on the operations of these groups; provide guidance to those seeking to collaborate with academia and serve as a guide for continuous improvement in the practice of academic commercialization.

For those interacting with universities, academic medical centers, and research institutions, the realization that these groups are a web of individuals (from TTOs, to faculty, and administrators, among others), relationships and motivations rather than a single entity can give perspective in how to engage effectively with them. For TTOs and faculty inventors there is a willingness to engage in new collaborative partnerships,

and especially a marked desire for objective, product focused advice to guide them in translating research discoveries into patents and products.

By putting faculty inventors and technology buyers first among their customers, TTOs are in a unique position to drive technology commercialization. Rather than taking a purely transactional approach (file patents, license them, enforce agreements), TTOs should become trusted advisors to the faculty inventors and technology buyers that they serve. By educating themselves of market trends and unmet needs, TTOs can impart commercialization advice to faculty that looks beyond patents and begins to contemplate how basic research can be focused to maximize the chances of successful commercialization. With this understanding of a university's technology portfolio, and the means to license it for commercialization, TTOs can also position themselves for technology buyers as the gate keepers of innovation.

Key to this evolution of TTOs should be a careful nurturing, maintenance and deep knowledge of their technology portfolios. From executive directors to the newest licensing associate, technology should be the focus. This evolution can start with developing trusted relationships with faculty inventors around their new ideas. It can develop with the evaluation of new inventions by larger groups augmented with outside expertise. It can grow with effective communication of these assets to potential technology buyers. And it can continue with effective monitoring of licensed products.

In these ways, the full value of the public and private investment into academic research and development can be extracted. For the players involved (faculty inventors, TTOs, buyers), their interactions will become more meaningful and the fruits of their labor even more important and fulfilling.

¹AUTM FY2015 Highlights of AUTM's U.S. Licensing Survey; pp.2. ²AUTM FY2015 Highlights US; pp.2. ³Walker, J.; The Real Patent Crisis is Stifling Innovation; Forbes (June 18, 2014). ⁴"Centers for Therapeutic Innovation," https://www.pfizercti.com/about_cti/co-located_sites. ⁵"Academic Collaborations," <https://www.gsk.com/en-gb/partnerships/academic-collaborations/#tab-6687>. ⁶University of California Office of the President Technology Commercialization Report; pp.3. ⁷Axonova, L., U.S. Academic Technology Transfer Models; Les Nouvelles, (June 2012); pp.128. ⁸US/ Canadian Licensing in 2005 – Survey Results; Les Nouvelles; (December 2006); pp. 238. ⁹International Survey of Research University Leadership: View of Technology Transfer and Sponsored Research Offices; Primary Research Group;(2017); pp 15,16. ¹⁰Swamidass, P.; "University startups as a commercialization alternative: lessons from three contrasting case studies"; Journal of Technology Transfer; 2013; pp. 791-792. ¹¹Feldman et al; "Lessons from the Commercialization of the Cohen-Boyer Patents: The Stanford University Licensing Program"; Handbook of Best Practices; 2007; pp. 1801-1802. ¹²Colaïanni and Cook-Deegan; "Columbia University's Axel Patents: Technology Transfer and Implication for the Bayh-Dole Act"; The Milbank Quarterly; 2009; pp. 683,690. ¹³Innovation Accelerator; <http://www.innovationaccelerator.org/academic-venture-exchange-avx-a-new-initiative-of-the-innovation-accelerator-foundation/>

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