APIO
DISCOVERY TO COMMERCIALIZATION
INNOVATION TRANSFER EXPERTS

The Evolution of Technology Transfer

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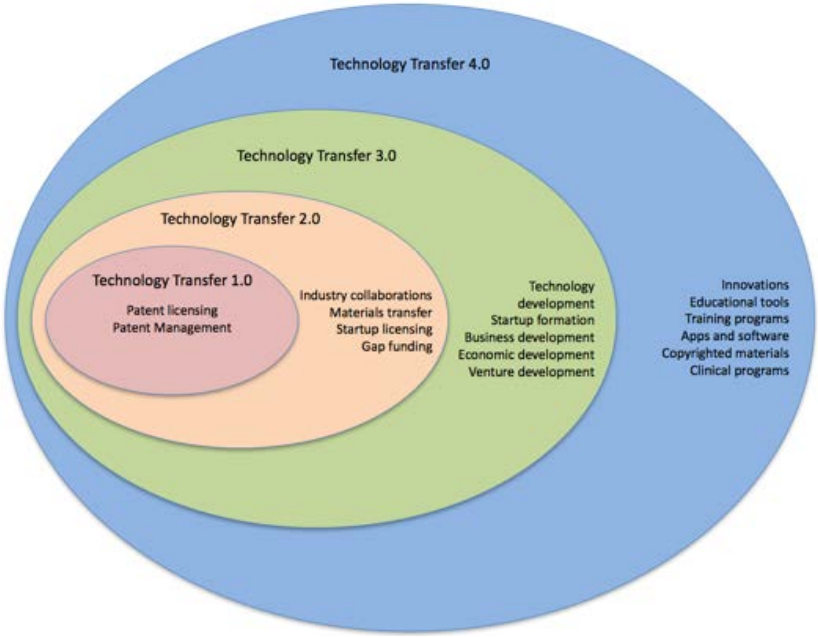
As I see it, technology transfer has gone through four broad phases, which I refer to as Technology Transfer 1.0 to 4.0. The first reference to TT1.0 I heard was in 2009 by Aneesh Chopra, who was the Chief Technology Officer in the Obama administration. In a meeting, Aneesh asked the question "what do we need to do to move to TT2.0?" The question was in response to criticism that academic technology transfer was under-performing. In thinking about it, it was quite evident then, and even more so now, that technology transfer had already evolved far beyond TT2.0.

Technology transfer has grown to encompass multiple activities since the passage of the Bayh-Dole Act in 1980. Moreover, as we get closer to the 40th anniversary of the Act, it is important to understand how our profession is evolving and to understand what the future might hold. Not all universities engage in the same scope of technology transfer activities, but as a collective, universities do more than just patents and licenses. Technology transfer has grown to include technology development, robust startup programs and startup funding, industry collaborations, and business development. There have been significant changes in patent laws and standards for licensing university technologies. Also, the scope of innovations that are commercialized has broadened from patentable inventions to innovations and innovative programs that can be commercialized.

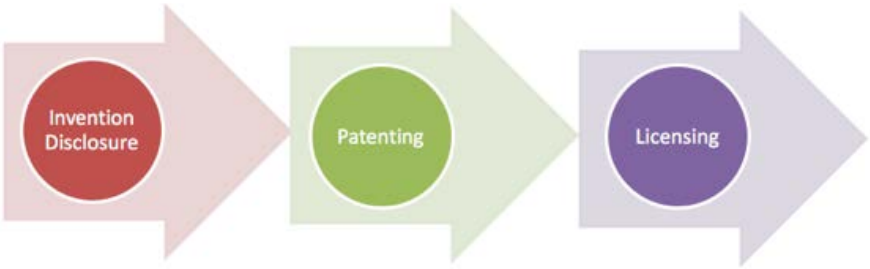
The four phases are not discrete periods of time, they are the stages of evolution of the profession, and as Everett Rodgers classical model of Diffusion of Evolution suggests, there were universities that led the way with successful innovative programs and those that have yet to adopt them. All of this begs the questions “where have we been?” and “where are we going?”

Technology Transfer 1.0

The Bayh-Dole Act was in response to the economic threat to the U.S. (primarily from Japan) and the fact that there were thousands of patents owned by the U.S. Federal Government that were not being commercialized. The intent of the act was to boost the economy through commercialization of patents resulting from research. The Act gave universities ownership of patents resulting from federally funded research in return for a commitment by universities to try to commercialize the patents.

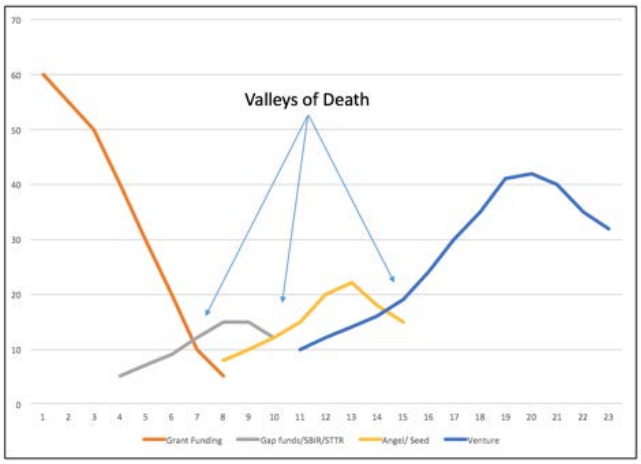


At the University of Utah - where I started my career in the late 80s, the focus was patenting and licensing driven primarily by the obligations under the Bayh-Dole Act, as it was at most universities at that time. Some universities were better than others and were engaged in licensing to startups, but that was not the primary focus for most. The main effort at universities was to reach out to faculty to participate in technology transfer and solicit invention disclosures. After receiving the invention disclosure, the major undertaking was to determine the patentability and to find licensees for those that seemed to have potential commercial applications. There was not much effort on market research and marketing. Marketing by most universities was limited to providing a brief non-confidential summary to companies and for the most successful ones using networks of contacts in the business and venture communities.



Technology Transfer 2.0

In the era of Technology Transfer 2.0, several drivers surfaced to influence the profession and to prompt changes. Among these drivers were an increasingly entrepreneurial faculty, the need to foster relationships with industry, advancing technologies for a greater commercial value, protecting non-patentable materials, and developing targeted communications to stakeholders.



This period saw increases in the number of licenses to faculty-owned startups and greater emphasis on industry-sponsored research. Some universities excelled due to the robust innovation ecosystems that had evolved around them providing access to both capital and management for university startups, most notably Stanford and MIT. Most universities, however, struggled with the prevailing mindset being to license the technology to the faculty inventor and wish them the best of luck. In a majority of cases, there was either no, or a nascent, innovation ecosystem to provide appropriate resources.

Driven by the desire to capture value in licensing and address and increased risk aversion in industry, universities started gap funding programs to address the first "valley of death," the gap between funding basic research and development. In 1999, there were about 15 gap funding programs, which, according to Mind the Gap have expanded to over 80 such funds that have invested $300m and had a return of approximately $4b. One of the first of such programs developed at the University of Utah, the Technology Innovation Grants, had complete support from the administration and resulted in significant enhancement of

an already entrepreneurial culture.

Due to the rising importance of intellectual property to universities, the non-profit status of universities, and obligations under the Bayh-Dole Act, technology transfer offices were increasingly involved in negotiating industry sponsored research agreements. The negotiations principally addressed intellectual property related issues such as ownership and licensing.

Material transfer agreements (MTAs) were a new mechanism that also saw a beginning – something that had one of the biggest impacts on technology transfer operations as they ballooned in number and complexity. The rapid increase of the use of MTAs was in response to universities and companies recognizing that unpatented biological materials have value. This rapid growth and the desire to ensure that biological materials were still available for research led to two milestones in the field of technology transfer. The Universal Biological Materials Transfer
Agreement or UBMTA in 1995 which was an NIH and university-led effort to standardize the transfer of materials by protecting the rights of researchers, while providing the recipient the ability to pursue unfettered research. The second milestone was the NIH's policy decision in 1996 that allowed universities to commercialize unpatented biological materials. While the NIH decision and the UBMTA made an impact, the rapid growth of material transfer agreements became (and still is) a significant burden on technology transfer operations.

Technology Transfer 3.0

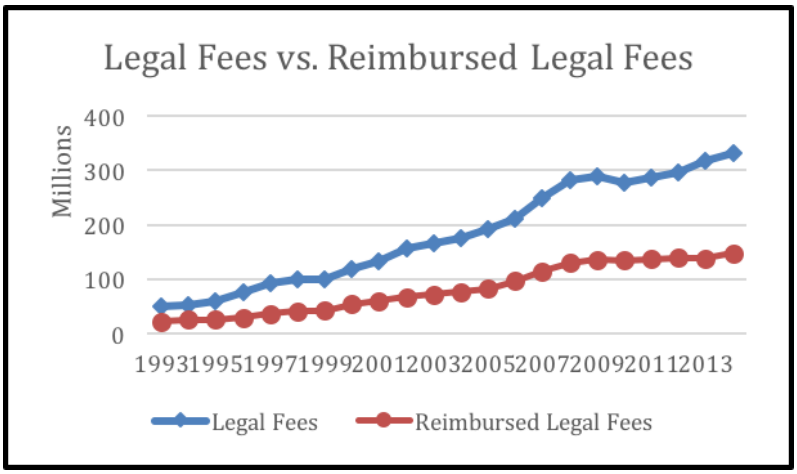
TT3.0 saw technology transfer better resourced and elevated to a more prominent position in the university infrastructure as a result of integrating industry-sponsored research and collaborations, economic development, and startup development (including seed funding) under one umbrella. Universities realized that they needed to do a lot more in these areas, especially in regions that did not have a robust innovation ecosystem. These changes were prompted in part by a need to engage industry proactively, pressure from state and regional governments for more high-paying technology based jobs, the lack of early stage seed funding for university startups, and increasingly visible successes of technology transfer outcomes at some universities.

Startup programs became more robust, such as PCI Ventures at the University of Pennsylvania, the Springboard program at Oregon Health & Science University, and Health Science Entrepreneurs at Northeastern University to name a few. These programs provide an internal infrastructure through which the university mentors and educate entrepreneurs, assists with establishing the appropriate legal entity, helps look for management, and helps access venture capital and SBIR/STTR grants. Universities also started to create seed funds to address the "second valley of death" because of a decrease in availability of seed-stage venture funding in many areas. These seed venture funds are usually in partnership with the university foundation and venture capital companies.

With the increase in the scope of technology transfer activities and the number of stakeholders, marketing began to be an important and integral part of the technology transfer office. This increased scope resulted in coordinated strategies targeting internal and external stakeholders. For internal stakeholders, such as faculty and students the messaging focused on how they could work and partner with the technology transfer office, while for administration messaging stressed the impact of technology transfer. Education and outreach became more sophisticated by better understanding the differing needs of departments and

having the ability to balance research agreements, industry collaborations and licensing. Marketing to external stakeholders became more refined as well, by targeting and messaging companies, government, and community. Are we good at it? Some institutions are better than others, but overall as a profession, consistent messaging about "impact, not income" seems to have made an impression. Marketing efforts also focused on market research to better understand the commercial applications of inventions, where third-party vendors have made a niche for themselves.

Another trend worth mentioning is the addition of legal staff to the technology transfer office to manage an increasing and complicated portfolio of intellectual property and also to prepare and file patent applications internally. The biggest driver for this was (and is) to control the ever increasing cost of obtaining protection. Based on the AUTM Licensing Activity Survey, the gap between legal fees expended and legal fees reimbursed continues to grow steadily wider. This increasing gap is a direct result of increases in invention disclosures which in turn leads to filing more patent applications, the complexity of patent applications, and rising attorney fees.



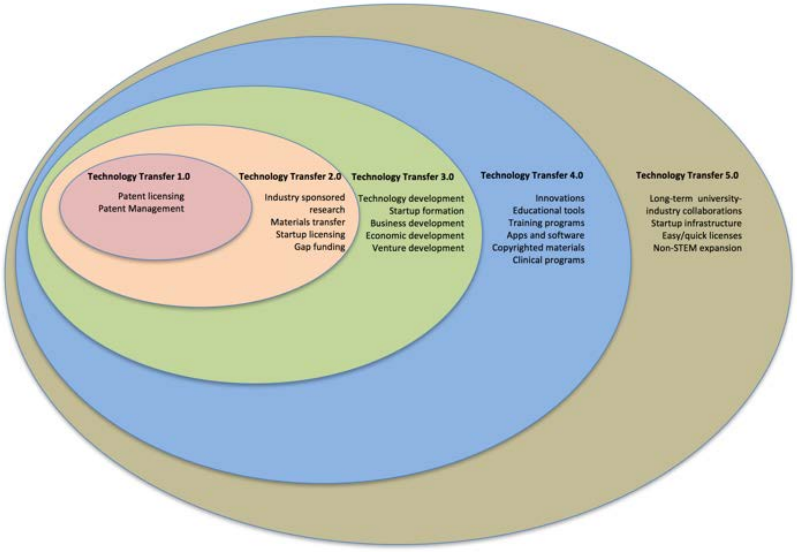
Technology Transfer 4.0

TT4.0 has seen a tremendous focus on clinical translational research. Initially, created through the NIH's Clinical and Translational Science Awards (CTSA) program, the purpose was to advance promising research into interventions. More specifically the question was how to improve clinical research management, develop core competencies in clinical and translational science, and accelerate the dissemination of research findings into clinical practice. As a result, there are over 50 university programs in 30 states, such as the Office of Therapeutic Alliances at NYU Langone Medical Center and the Translational Science Research Development Program at the University of Minnesota. The CTSAs led universities to be more active in advancing biomedical research into products.

The scope of technology transfer increased even more by encompassing innovations (versus inventions) and including liberal arts, social sciences, and training and clinical programs. Traditional research-intensive universities, as well as smaller less research intensive institutions, are starting to commercialize training and clinical programs, mobile apps, non-software copyright materials, and educational tools. While the innovations from these disciplines are usually not patentable, they represent novel approaches and advancements that can be commercialized. Several universities have, and are developing programs, to capitalize on these types of innovations. When innovations (versus inventions) are the subject of technology transfer, the nature of the process changes. Rather than focus on intellectual property protection and licensing, there needs to be a broader perspective of how to disseminate the innovation. Having a broader focus means thinking beyond a traditional licensing approach. It means exploring other

mechanisms that let the institution distribute the innovation directly to the end-users using transaction-based technology portals, app stores, and publication downloads.

Some universities such as Michigan State University and Colorado College already have a strong legacy of working in non-STEM fields to encourage entrepreneurship. Every year there more universities that are starting to explore and work with innovations resulting from areas that have not traditionally worked with technology transfer.



Technology Transfer 5.0

So, what does this mean for the future? What will TT5.0 look like? Technology transfer in the U.S. is continuing to evolve. New models are being explored, especially in the form of partnerships between universities and companies (and sometimes venture funds). University administrations have begun to understand that technology transfer is not about the income and that there are many other tangible and intangible benefits of having a technology transfer office.

In my opinion, the next ten years are going be highlighted by some major trends. The first is increasing collaboration between universities and companies such as the Celgene-John Hopkins, U. Penn, Columbia U and Mt. Sinai alliance on cancer and inflammatory disease and GSK-Avalon Ventures Discovery Partnerships with Academia. I was part of a team that put into place two such collaborations at OHSU, one with Intel on the Behavioral and Interventional Commons about nine years ago and the OHSU-FEI collaboration to create the Living Lab for Cell Biology in 2011. The University-Industry Demonstration Partnership provided a list of 10 collaborations demonstrating long-term benefits of university-industry partnerships. There are many factors that drive these collaborations including the desire of universities to engage in more translational research, a better alignment of objectives with industry partners, a decline in research & development funding in the pharmaceutical industry, increasing cutting-edge facilities at universities, and a more open innovation approach, especially in the pharmaceutical and biotechnology sectors, and access to a potentially highly qualified works force for the industry partners. Other notable trends include innovative ways in which industry is approaching partnering with universities such as GE's partnership on incubators, and the increase in corporate venture capital funds.

Another emerging trend is universities establishing infrastructure and facilities (in addition to the gap funds) to develop innovations and create mechanisms to work with entrepreneurs and local companies on their specific problems such as the Runway Program at Cornell University and the startup program at the University of Utah. With an increasing focus on entrepreneurship, prompted by the need to enhance the local innovation ecosystem and have an economic impact, universities are creating programs and infrastructure to fill the gaps that startup companies and small and medium enterprises need ranging from

facilities to space and funding.

The concept of express licensing started with the University of North Carolina with the intent of licensing patented technology in return for a commitment to commercializing with pre-determined financial terms. Several universities including the NIH have adopted versions of this concept for startup companies. Universities have started to take this approach not only for startup companies but also for the large (and increasing) number of issued patents in their portfolios. Most of these types of licenses incorporate financial terms that are deferred for a period. While overall adoption of this approach has been slow, I believe that with the increasingly large portfolios of patents that universities are accumulating and the pressure to make technologies available for commercialization, there will be an increase in the use of the express licensing approach.

Universities are increasingly using the technology portals to promote their technologies. In addition, some universities have started to automate their transactions, especially with MTAs, which can take up a lot of time and effort. Most notably, this effort began with trying to automate the UBMTA and resulted in efforts by Addgene, Oregon Health and Science University, City of Hope, and more recently Vanderbilt University. I believe the use of automated transaction systems will see an increasing use in the next five to ten years and include express licensing, quick licensing, and certain types of sponsored research agreements. The increase in electronic transactions will primarily be driven by the need to reduce time-consuming negotiations for agreements which can be automated and the need to improve access to university technologies.

The technology transfer professional is already transitioning into their roles and responsibilities with the diversity of activities for which they are responsible. Moreover, technology transfer officers will need to manage increasingly complex projects that have multiple aspects such as collaborations, joint development, partnering and the resulting licensing and commercialization. Alternatively, at a minimum, the technology transfer professional will need to be part of the executive teams of such projects.

The transformation of technology transfer in the U.S. has been in response to the many factors as outlined above but has always upheld the primary intent of the Bayh-Dole Act, to transfer technology to benefit the public. I believe that technology transfer will begin to undergo yet another transformation exhibiting greater flexibility and broader scope. Technology transfer offices are going to need to revise the way they track their metrics in order to track their activities and show the impact of those activities. The future of technology transfer in the US continues to look great. As a profession, we need to continue to focus on increasing access to universities by the commercial sector.