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Examining the Licensing Efficiency of Academic Technology Transfer: Are there better indicators?

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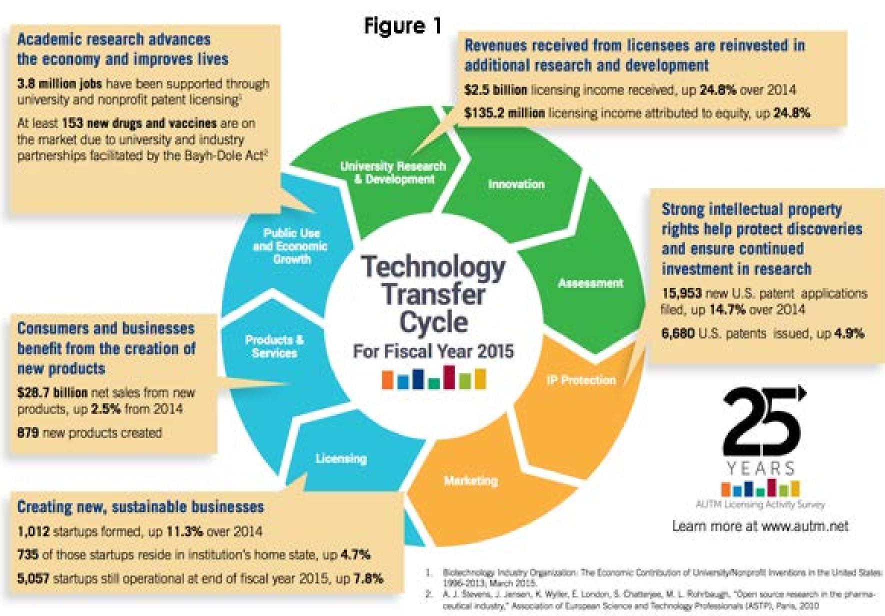
Universities in the U.S. have engaged in academic technology transfer since before the Bayh-Dole Act and make significant contribution to the economic and social health of the U.S. The 2015 AUTM Licensing Activities Survey and the Biotechnology Industry Association provide impressive figures regarding licensing activity and the economic impact of academic technology transfer. AUTM's Better World project has a repository of almost 500 stories from across the world demonstrating the value of academic research. Also, the Association of American Universities has a repository of numerous studies attesting to the impact of universities on economies and the innovation ecosystem. Figure 1 provides a perspective on the overall impact of technology transfer based on 2015 fiscal year data.

Each year the AUTM Licensing Activities Survey (ALAS) reports metrics for research expenditures, invention disclosures, licenses, patent activity, number of technology transfer professionals, and startups created. These figures show a steady increase in the overall activity – all numbers trend up driven by increased research funding. In 2015, over 25,000 invention disclosures were received, almost 16,000 new patent applications filed, and close to 8,000 licenses and options executed.



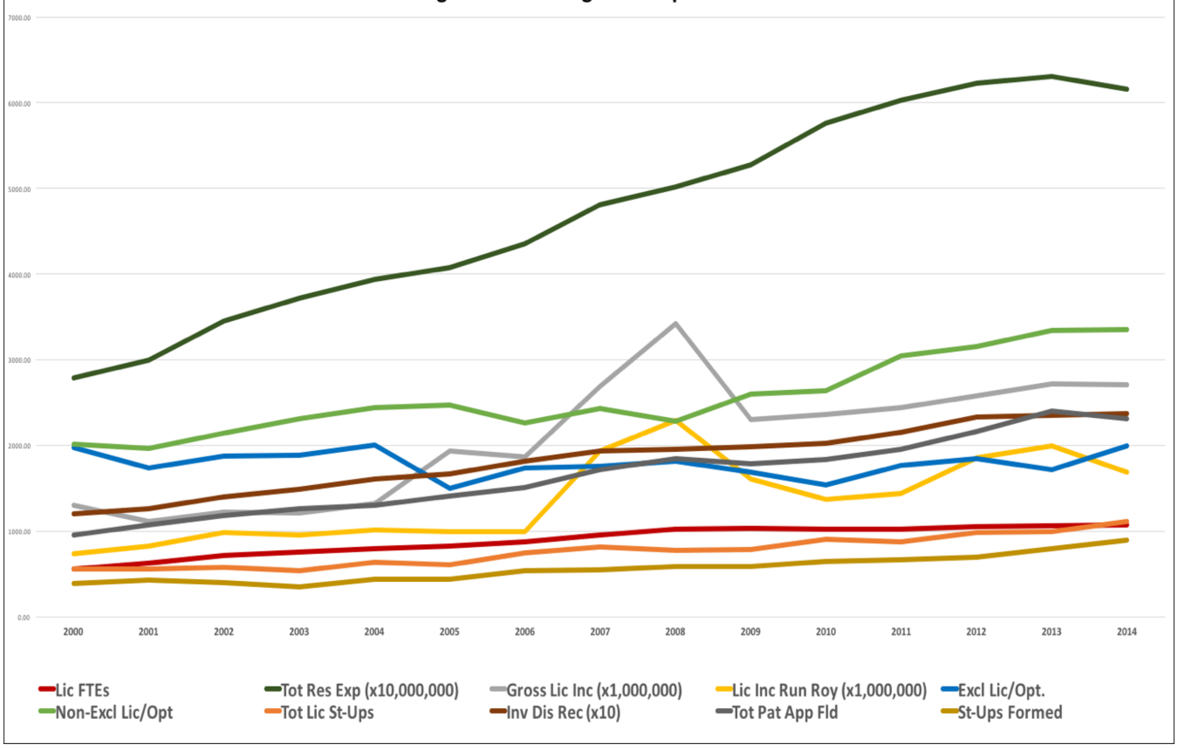
Typically, a technology transfer enterprise's (TTE) success is based on performance indices such as invention disclosures received, licenses signed, patent applications filed, patents issued, and licensing income. With increases in these numbers each year, this paper seeks to examine the licensing efficiency of academic technology transfer and determine if there are better indicators of success and licensing efficiency.

Licensing is a complicated multi-year process that begins with assessing the innovation and prophesizing its potential use and applications. While there is no doubt that academic technology transfer has a positive impact on the national economy and the innovation ecosystem, the question is, what is the efficiency of transferring innovations from universities to industry? Is licensing efficiency a measure of success? And, can we improve the manner in which we transfer innovations?

Method

Data used for this analysis spans 14 years, from 2000 to 2014. Figure 2 shows licensing full-time equivalent staff (FTEs), total research expenditures, licenses and options executed, licenses to startups, startups formed, invention disclosure received, and patent applications filed. Income is not included in this analysis as licensing income is neither a direct measure of licensing activity, nor TTE success because the TTE does not control the technology after executing a license. The responsibility for commercialization falls on the licensee and is influenced by many factors. In other words, TTE success is determined by how many innovations transfer from academia to industry. The real measure of TTE output is the number of agreements executed – getting deals done.

Figure 2: Licensing Data as per ALAS



Some interesting trends emerge from the ALAS:

1. A significant increase in the formation of and licenses to startup companies (almost doubling in 15 years).
2. The total number of licenses and options (exclusive and non-exclusive), which has increased by about 150%.
3. Invention disclosures and patent applications filed have more than doubled.
4. Gross licensing income shows a two-fold increase.
5. Steady growth in research expenditures.
6. The number of FTE increased steadily – until 2009 when FTEs failed to keep up with the growth rate of research expenditures (which may be attributable to the increase in research funding as part of the American Recovery and Reinvestment Act (ARRA) of 2009).

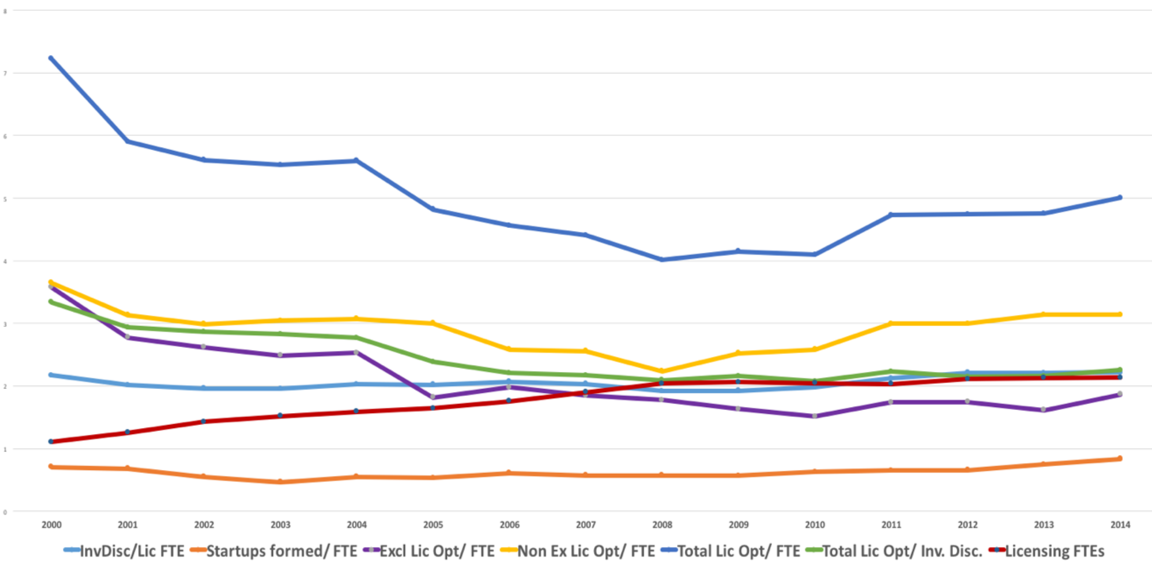
While these numbers reflect well on the profession, they only tell part of the story. Analyzing the data from a different perspective provides additional insights into the performance of the profession. In the past, universities have benchmarked metrics by "per million dollars of research," which makes sense from one perspective as more research leads to more invention disclosures and licensing activity; however, there are wide variations in research funding based on whether universities have medical schools and/or colleges of engineering, it is not an “apples to apples” normalization. Further, it does not necessarily reflect the size or the licensing efficacy of the TTE -- TTE size is not necessarily proportional to university research expenditures.

One way to gauge the efficacy of a TTE is to normalize licensing activities to FTE to get a different perspective and new insights. Based on the ALAS definition, a licensing FTE is “…involved with the licensing and patenting processes as either full or fractional FTE allocations… examples include licensee solicitation, technology valuation, marketing of technology, license agreement drafting and negotiation, and start-up activity efforts”. The following analysis assumes that a licensing FTE is solely focused on the process of licensing and no other activities (such materials transfer agreements, industry sponsored research, etc.). The following criteria were used:

1. Invention disclosures per FTE
2. Total licenses and options per FTE
3. Exclusive licenses and options per FTE
4. Non-exclusive licenses and options per FTE
5. Startups per licensing FTE, and
6. Total licenses and options per invention disclosure.

General Observations: *Measuring the output efficiency*
The above metrics reflect the effectiveness of a TTE to reach out to faculty, the efficiency with which innovations are licensed, and the efficiency of startup formation and licensing which creates a baseline for determining licensing efficiency. Licenses per patent application filed was also considered, but it would not capture licenses to innovations that do not require patents.

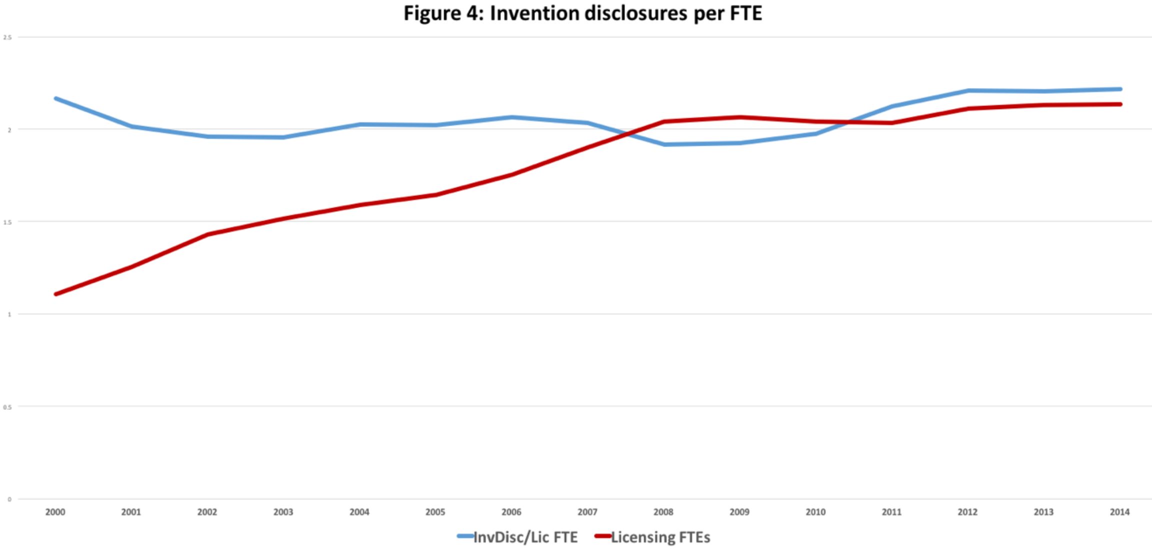
Figure 3: Select licensing metrics per FTE



The data in Figure 3 shows some disturbing trends; overall it looks as though we are not doing any better in the rate of executing license agreements in 2014 than we did in 2000. The total number of licenses per invention disclosure decreased significantly over the last 15 years, as did the number of exclusive licenses and options per FTE. There was a slight increase in the number of licenses per FTE in 2014. There is an increase in non-exclusive licenses and the number of startups per licensing FTE (both formation and licenses). These new metrics provide an opportunity for robust discussion.

Invention disclosures: *Consistent over the years*
Invention disclosures per FTE (Figure 4) should reflect the results of TTE outreach to faculty i.e. the effectiveness of an office to convey to their faculty the value of the activities being undertaken by the office. The average number of disclosures per FTE has remained relatively flat, ranging from 190 to 220, with an average of 205. This means that either the outreach to faculty is no more effective today than it was in 2000; that the relative TTE budgets have remained flat and we are just keeping up with the numbers of invention disclosures received; that TTE efforts are as effective now as they were in 2000; or, that this is the

Figure 4: Invention disclosures per FTE



saturation point. It also raises the question of whether we should try to decrease this number (by either hiring significantly more staff or decreasing the disclosure rate). This assumes that if the number of invention disclosures per FTE goes down over time, it could result in increased licensing efficiency and overall efficacy of the TTE due to better quality of invention disclosures.

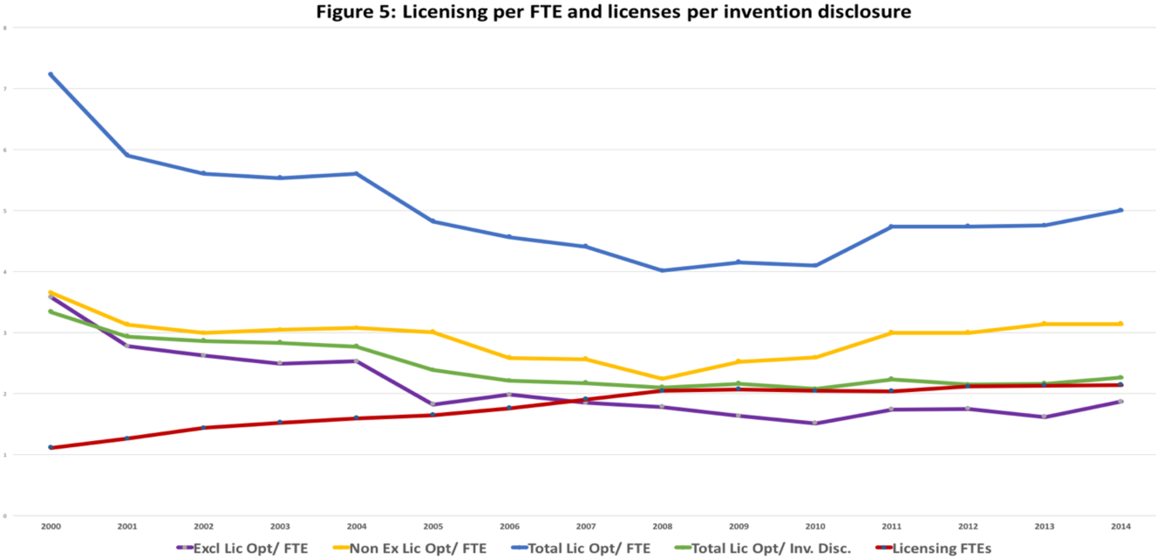
Invention disclosures per FTE provides a macro picture of a TTEs outreach efforts and has at times been uses as a surrogate measure for FTE caseload. To have a complete understanding of the workload and outreach efforts additional information such as the number of disclosures licensed, closed, or being actively marketed is needed. Categorizing innovations based on classification such as actively marketing, licensed, requiring further research, released, not pursued, and possibly other classifications would help.

This type of classification requires some level of management, but without that additional information, it's hard to assess the nature of the invention disclosures and a licensing FTE's workload. Each category also indicates what is needed to license the invention and the different levels of effort being expended. It would provide the detailed information needed for a better understanding of the pipeline of invention disclosures. Creating such a classification system may seem tedious, but it is quite straightforward.

Licensing: *Worrisome trends*

The decrease in the rate of licenses per FTE (Figure 5) is the most disturbing trend shown by this data. Total licenses and options executed per FTE trend down from 2000 to 2008 (by about 50%), increase slightly from 2008 to 2009, and then increase significantly from 2010 to 2014. The upward trend in licenses per FTE from 2011 to 2014 is due primarily to a higher rate of non-exclusive licensing. There is however a steady increase in the rate of non-exclusive licenses and options starting in 2008. The other notable trend is a nearly 30% decline in the numbers of licenses per invention disclosure, which dropped from 2000 to 2008, and seems to be holding steady since then.

Figure 5: Licenisng per FTE and licenses per invention disclosure



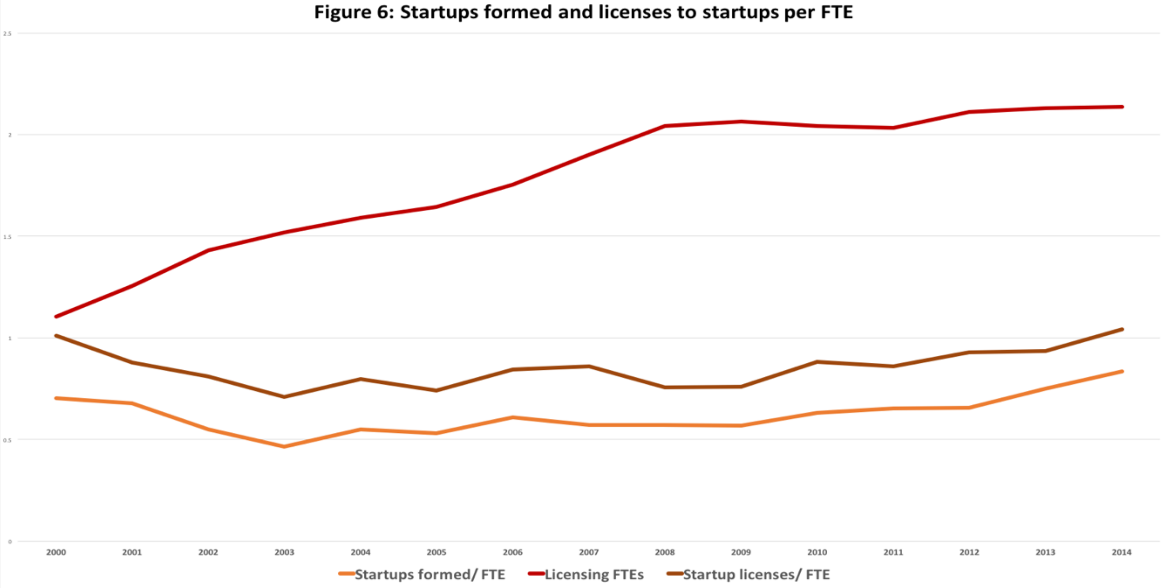
The increases in licensing from 2011 to 2014 may be due to the end of the recession (which started in 2007) and corporate investment in new technologies. There is also a likely increase in innovation disclosures such as biological materials, research tools, software, etc. that lend themselves to non-exclusive licensing; a lower reliance on exclusive licenses; and changes in patent law. Without additional information, the cause of lower rates of licenses per FTE and per invention disclosure remains unclear.

Determining the efficacy of a TTE requires different types of data, such as the Licensing Readiness Level™[1] of the innovations being disclosed. Other types of data include tracking lead generation and marketing efforts, feedback and responses from potential licensees, and tracking time taken by negotiations. These, when combined with the data collected to determine the caseload per FTE, would start to give a better picture of the licensing efficiency of a TTE.

[1]Licensing readiness is a way to assess and quantify an innovation based on intellectual property, stage of development, product application, benefits, market need, market size, market saturation, competition, industry environment, and other encumbrances.

Startups: *Steady increases*
There is an increase in startup formation and startup licensing since 2003. Several factors play a role in this increase. There has been a steady increase in faculty and student entrepreneurs as an outcome of the recession (there is documented increase in startups during recessions) with programs that provide education and support, greater funding opportunities, and increases in student entrepreneurs. Also, universities have had high- profile startup success stories that increase the visibility of startups and highlight the impact of startups on the local innovation ecosystem.

Figure 6: Startups formed and licenses to startups per FTE



The focus on startups was not limited to universities; state governments also recognized the potential impact of startups on the local innovation ecosystem. Many states and universities augmented their programs or created new programs to support startups. These include USTAR (Previously the Utah Centers of Excellence program), Tech Launch Arizona's SBIR/STTR assistance program, Cornell University's Runway program, Advanced Industries Accelerator Colorado, and Startup NASA to name a few. Some of these programs were established over 15 years ago. The increase in startup activity can also be attributed to the start of the recession, a trend documented in previous recessions, which has served to increase the emphasis on startups and their potential impact on local and regional economies.

Discussion: *Decreasing efficiency*
The efficiency of transferring innovations to industry relies on two factors, the desorptive capacity of academic institutions (the ability to "release" innovations for commercial application) and the absorptive capacity of industry (capacity to incorporate innovations into product development). Within each of these factors, there are many elements that influence the interactions and efficacy of innovation transfer. An essential element of the desorptive capacity of academic institutions is the TTE, which is the formal channel through which licenses, collaborations, joint research, etc. are created. Are there improvements that can be made in licensing efficiency? Or, more broadly how can we increase the desorptive capacity of a university?

The purpose of this analysis was to examine the data and determine if there are new insights or lessons to be learned regarding the efficacy of licensing innovations from academia to industry. The metrics described in this paper were selected as they represent the outputs of a TTE, i.e. major components of a university's desorptive capacity.

Invention disclosures per FTE have remained relatively flat since 2000. This means that the staffing level of TTEs is at least keeping pace with incoming invention disclosures. The general thinking in the profession is that 25 - 30 new invention disclosures per year should be the caseload for an FTE to be effective at assessing using objective measures (for example the Licensing Readiness Level™ developed by Apio, the Technology Readiness Level scale developed by NASA, or others), marketing, and licensing innovations.

A more accurate measure of caseload (and the nature of invention disclosures) would first require classifying the incoming disclosures in two major categories, those that do not require detailed assessment or intellectual property protection (such as biological materials, research reagents, copyrightable subject matter etc.) and those that require detailed assessment. Further classification in the second step could use designations such as not commercially viable, seeking IP protection, marketing, licensed, and additional research (versus development, because almost all university inventions need development) needed. This would create a system that would provide a more accurate picture of the caseload, nature of incoming disclosures, and where to focus outreach efforts. This information can also be used by TTs to allocate and request resources (such as staffing). This process separates disclosures into three groups: those put "on-hold" for further results; disclosures that are not commercially viable; and, disclosures that are commercial viable, are licensable, and/or are actively marketed.

The trend of declining numbers of licenses per FTE and licenses per invention disclosure is concerning. The decrease from 2000 and 2014 indicates either a decline licensing efficacy, changes in industry, less licensable invention disclosures, or all of the above. This becomes even more of a concern when considering the introduction of the easy access license and quick license concepts. The reasons for this decline are not readily discernable from the data. There may be several reasons for this trend which include:

- Complexity: Licenses are increasingly complex to negotiate. This may be because both universities and industry are much more aware of what it takes to develop university technologies and may lead to longer negotiation times.
- Volume: Given the mission(s) of universities, TTEs must assess all disclosed innovations, a time-consuming process.
- Time: Innovations take three to seven years to license from the date of disclosure and, there can be significant variations by industry.
- Startups: There continues to be a focus on startups, a trend that started 2008. This focus takes time and effort away from licensing and could contribute to an overall decrease in licenses per FTE, especially if the FTEs are responsible for both licensing and startup licensing.
- Development Stage: There may be increasing numbers of innovations being disclosed at early stages of development and therefore less licensable.
- Publishing: Disclosing innovations earlier due to pressures of publication. While there has always been a pressure to publish, this has been exacerbated with the advent of online publications.
- Licenseability/commercial viability: There may be an increasing proportion of invention disclosures that are either commercially not viable or licensable.
- Reporting: Invention disclosures that are not commercially viable (the invention disclosures that are closed or put on hold) are not reported, so it is quite possible that the licensing rates of commercially viable innovations is increasing rather than declining.
- Expanding roles: FTEs may be dividing their time with other activities such as industry sponsored research, materials transfer agreements, economic development, and business development if the TTE does not have dedicated staff for each function. Categorizing TTEs based on these criteria may also shed additional light on these numbers.
- Administration: The number of individuals involved in either participating, reviewing, and/or approving agreements at universities may have grown and may include inventors, associate vice presidents, legal and others.
- Expertise: TTEs may not have the right expertise to effectively “package” and “market” the type of deal that is needed for the innovation to be commercialized.
- New models: Several Universities have introduced “easy access licensing” and “quick licenses” based on models developed at Glasgow University and University of North Carolina respectively which require little or no negotiation. It may be that both universities and industry are more conservative in adopting these approaches.
- Industry: There may be a shift from licensing to sponsored research, collaborations, and joint development.
- Risk: Industry is becoming even more risk-averse.

A more detailed assessment needs to occur to understand the factors that influence licensing efficiency. Currently, we lack the necessary the data for a complete analysis. Lastly, this maybe the efficiency of the current system.

Startups per FTE are already trending up. This is in part due to dedicated teams devoted to startups and programs at universities that support faculty and student entrepreneurship. There is likely to be an increase in the rate of university startups based on increases in gap funding programs and, more recently, university specific venture funds.

Recommendations

AUTM has collected data through the ALAS for the last two decades. Over time the nature of data being collected has changed to reflect some of the changes in technology transfer. It is time to once again reassess where we are and the type of data we need to accurately reflect TTEs. It’s onerous to collect data on all TTE functions, especially as TTEs have a variety of responsibilities. However, the licensing data currently being collected can be augmented by the additional metrics mentioned in this paper, which would not be hard to do. Having a classification such as actively marketing, licensed, requiring further development, released, not pursued, and others are most likely already being used. Updating the status may be onerous, however carefully creating processes and procedures in a TTE can make that part of routine workflow. Brining a consistency through defining these terms and collecting the information would provide greater clarity about the pipeline of invention disclosures and the numbers of commercially viable innovations that get licensed.

Therefore, the focus should be to identify the right type of data to be collected with minimal additional burden on TTEs. Universities would benefit from the additional data and information as it provides a more accurate representation of academic technology licensing. AUTM, universities, and database providers can come together and take the following actions to standardize data collection and implement these changes:

- Definitions. AUTM can create standard definitions for classifying invention disclosures and disclosures status and an ALAS portal into which universities can automatically input data.
- Automation. Database providers can create the appropriate fields so that data collection is integrated into the workflow of the TTE and reports to and provide the data to AUTM through the ALAS portal.
- Universities should create internal processes and procedures to easily collect the data.

The first and foremost objective in licensing innovations is to get the innovation "out the door". Because of that licensing staff should not fight for the perfect financial/non-financial terms. The licensing process is a way to establish a relationship with the licensee, and because of the nature of the relationship, it's critical to get off to a good start. The objective should be to license the technology as quickly as possible. The three most critical things needed to increase the rate of licensing per FTE are:

- FTEs dedicated to licensing. This team needs to be supported by expertise in marketing, finance, and legal. The other activities of a TTE relating to industry sponsored research, business development, startups etc. should have separate teams.
- Staff dedicated to market research, lead generation, and marketing invention disclosures.
- Establish goals for TTEs based on numbers of deals executed, which means streamlining internal processes and procedures.
- Allocating more resources to hire FTEs so that the annual case load for FTEs is manageable. More FTEs also means that FTEs will have more time to spend with innovators, resulting in a more informed faculty and student population and increasing the quality of disclosures.

Finally, there are other actions that can be taken to improve licensing efficacy such as allocating resources to assess innovations, improve market research, faculty education, and enhance FTE expertise through hiring and continuing education.

If licensing efficiency is the measure of success, we need more information regarding the nature of invention disclosures with which TTEs have to work. In addition, will adding more FTEs make the process more efficient, or should we strive to decrease the numbers of disclosures (assuming that lower number of disclosures will result in higher quality (i.e. licensable) disclosures? What kind of targeted outreach is necessary to achieve this? With this in mind, and after analyzing and reflecting on the data we end with more questions: Why are these metrics trending the way they do? What do we need change? Are there things we can we do to be more efficient, if so what? Are more technology gap funds needed? Should universities be more selective in choosing the invention disclosures to take forward? What resources will be needed to implement this approach?

We need more data, not less, especially if universities want to accurately reflect the true nature of academic technology transfer. If we enhance data gathering it will create a better picture of the nature of invention disclosures in the pipeline for licensing efforts. It will also provide a way to track progress and quantify the process. These methods and metrics don't serve to compare one institution against another as there is no simple way to determine the nature of invention disclosures and resources allocated (to marketing for example). Rather, these provide a way for TTEs to create management tools for self-monitoring and assessment.

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