

# TECH TRANSFER BENCHMARKING

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With the aid of data from licensing surveys taken by the Association of University Technology Managers (AUTM), we can offer the following (perhaps idiosyncratic, but hopefully fair) observations on the “game” of university technology transfer.

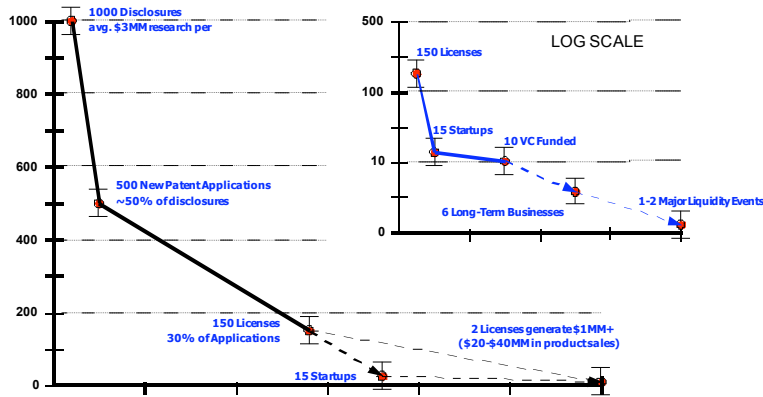
The central operational value chain in technology transfer is the transformation of research into invention disclosures, invention disclosures into patents, patents into licenses, and licenses into dollars, i.e.:

**Research → Disclosures → Patents → Licenses → Dollars**

It typically takes between \$1.5m and \$3m of basic research to generate one invention disclosure (closer to \$3m historically at the University of Chicago).

There is tremendous fallout along the value chain. Perhaps half of the disclosures will be transformed into patents, 15% of the original disclosures (once patented) will be licensed for development and commercialization. Only a fraction of these licenses will make any money, especially beyond their initial upfront payment. And a very small fraction of these licenses (1 or 2% of the licenses, 0.1 or 0.2% of the disclosures) will meet with commercial success sufficient to generate six to seven figure royalties to the university. Almost every university licensing program has one or two licenses constituting most of its income. Generally more than 99% of the value typically turns out eventually to come from less than 1% of the technology.

## Typical Value Chain Normalized for 1000 Disclosures



Sources: AUTM Surveys  
UCTech History

Perhaps 10% of university licenses go to start-ups, of which perhaps two thirds will get funded, and 10-20% of these will generate major value in the form of liquidity events (IPO's or acquisitions). This can generate income from sales of stock independent of royalty income. Any way it's looked at, university tech transfer is truly "panning for gold", even among its best practitioners.

Because of the early stage nature of university technology, there is typically a lag of between five and 15 years between the time a disclosure is received and the time such a technology (if ever) meets success in the marketplace sufficient that it brings in significant royalties. Thus:

- a 15-20 year time period to break even is typical and to be expected;
- in the paradigm of the graph above, the time it will take an institution to accumulate 1000 disclosures will be highly dependent on its research base;
- tech transfer financial performance tends to "pop" to a different level, like popcorn, when eventually a big winner arrives
- big winners are driven disproportionately by royalties from pharmaceuticals (e.g. Taxol at Florida State, Remicade at NYU) or broadly adopted biotech tools (e.g. recombinant DNA at Stanford, cotransformation at Columbia).

Although there is noise in the data (to some extent due to the "popcorn effect"), tech transfer office performance broadly correlates with:

- the quantity of research activity (more bets increase likelihood of success)
- the quality of research activity (seminal work has more potential for impact)
- tech transfer office age (a proxy for cumulative experience, time to accumulate big winners, and a "networking effect" related presumably to a lowering of transaction costs because of trust built up with business partners)
- research flavor (basic vs. applied, presence of engineering school or medicinal chemistry capability)

- geography (metrics are better in dense technology clusters)
- investment in tech transfer offices

Tech transfer is generally accepted to have five missions arrayed along the spectrum of public to private interest: 1) public benefit, 2) economic development, 3) faculty service and reward for inventive activity, 4) industry interaction, and 5) revenue generation. In practice, the drop-out rates and time lags discussed above means that almost all the revenue, all the public benefit, and all the economic development stem from a small number of deals, generally many years after they were done. Meanwhile, much of the daily bread and butter of a technology transfer office relates to handling incoming disclosures, patent prosecution and maintenance, and licensee relationship management, all involving intensive interaction with a broad swathe of faculty. Technology transfer offices generally thus live and die by the word about them on the lab corridor. The long term health of the pipeline of technologies depends primarily on the relationship with faculty and the faculty's belief that the TTO is competent and acting in their best interests (i.e., on mission #3).

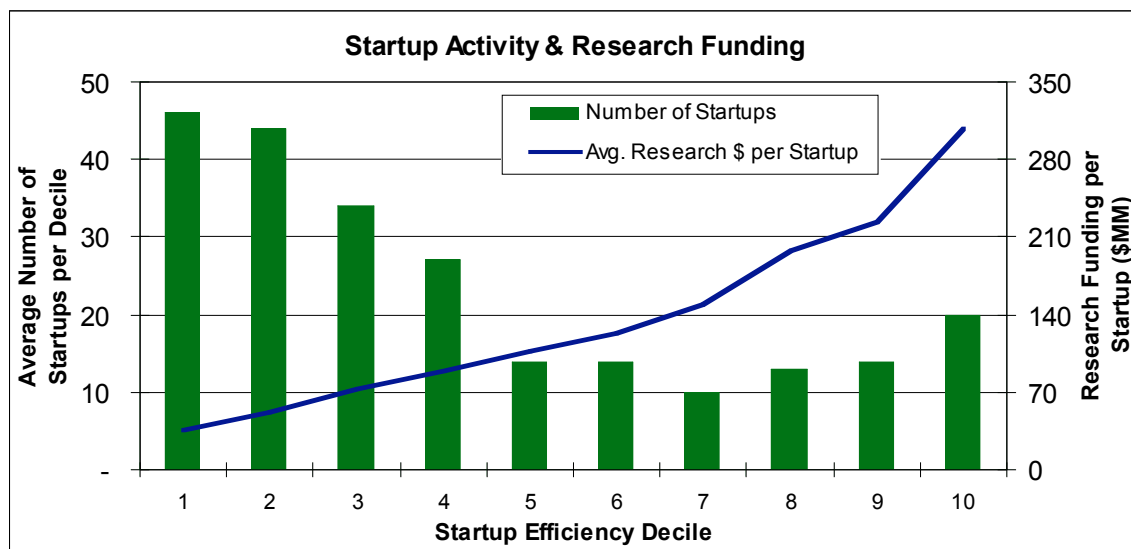
Faculty inventors typically fall in to one of five categories: 1) will never invent (due to nature of work or philosophical disposition, 2) potential inventor, 3) occasional inventor, 4) repeat inventor, 5) serial inventor. It is rare that a single technology or patent supports a new product or market. Value tends to stem from large portfolios accumulated over many years millions of dollars of research. Likewise inventing is an activity with dramatic yields to experience. So the most money is or is likely to be made from serial inventors. The task of a technology transfer office, as a "creative agent" for faculty, is to identify potential inventors, encourage them to become occasional inventors, and if appropriate for the individuals and their field of study, lay out the resources to help them become repeat and serial inventors. There is thus a parallel "demographic" value chain:

### **Potentials → Occasionals → Repeats → Serials.**

Part of the challenge of managing a tech transfer activity is the tension between the reality that economic success is largely driven through a small proportion of the inventing individuals, and the egalitarian nature of a university, particularly The University of Chicago, where everyone is entitled to good service, every serial inventor starts somewhere, and word about the tech transfer office "in the lab corridor" has significant influence. An emphasis on start-ups, for instance, pushes the pendulum in the favor of "the few elite", a political dynamic that needs to be managed if broad trust in the function is to be maintained.

We've estimated start-ups form around approximately 1.5% of the intellectual property coming out of universities. Yet their dynamics have a disproportionate ability to involve and attract academic "rock-stars", engage large numbers of the university community including faculty, graduate students, alumni, trustees and visiting committee members, bring venture capitalists to a region, create jobs, attract investment, engage local politicians, enrich research interactions, bring big riches if successful, and generally influence the gestalt. Everyone can feel like a "winner" from big success stories

We analyzed conversion rates of basic research dollars into start-ups using AUTM data from 2002 to 2006. Although subject to some qualifications, we found a 10-fold difference in conversion rates between the most effective and least effective “practitioners of the art”, i.e. a range between \$30m to \$300m of basic research required to create each start-up. We divided the universities in the sample into deciles. The green bars show the four-year average of number of start-ups per year in each decile, and the blue line indicates the research funding required to generate each start-up. By this analysis the University of Chicago is in the 5<sup>th</sup> decile. This is a potential benchmark of our start-up productivity.



## DECILES

First	Second	Third	Fourth	Fifth
North Carolina State Univ.	<b>Stanford Univ.</b>	Univ. of Virginia Patent Fdn.	Baylor College of Medicine	New York Univ.
Univ. of British Columbia	Purdue Research Fdn.	McGill Univ.	Oregon Health & Science Univ.	Univ. of South Florida
California Inst. of Technology	Univ. of North Carolina, Chapel Hill	Ohio State Univ.	Univ. of Pennsylvania	Mount Sinai School of Medicine of NYU
Univ. of Oklahoma-All Campuses	Columbia Univ.	Virginia Tech Intellectual Properties, Inc.	Univ. of Michigan	Univ. of Texas at Austin
Univ. de Montreal	<b>Boston Univ./Boston Medical Ctr.</b>	<b>Beth Israel Deaconess Medical Ctr.</b>	Carnegie Mellon Univ.	Rutgers, The State Univ. of NJ
Univ. of Alberta	Georgia Inst. of Technology	<b>Massachusetts Inst. of Technology (MIT)</b>	Univ. of Kansas	Univ. of Texas Medical Branch
M.D. Anderson Cancer Ctr.	Indiana Univ. (ARTI)	Univ. of Minnesota	Northwestern Univ.	Univ. of Chicago/UCTech
Sixth	Seventh	Eighth	Ninth	Tenth
Univ. of Southern California	Univ. of Georgia	<b>Massachusetts General Hospital</b>	Case Western Reserve Univ.	Univ. of Texas Southwestern Med. Ctr.
Dartmouth College	Univ. of Maryland, College Park	Fred Hutchinson Cancer Res. Ctr.	Texas A&M Univ. System	Univ. of Rochester
Univ. of Florida	Sloan Kettering Inst. for Cancer Res.	Univ. of Nebraska	Univ. of Illinois, Chicago, Urbana	Penn State Univ.
Univ. of Toronto	Univ. of New Mexico/Sci. & Tech. Corp.	Duke Univ.	Cornell Research Fdn., Inc.	<b>Harvard Univ.</b>
Univ. of Utah	Florida State University	Washington Univ. St. Louis	Vanderbilt Univ.	Johns Hopkins Univ.
Emory Univ.	Mayo Fdn. for Medical Education and Re	Univ. of Pittsburgh	Univ. of Colorado	Univ. of Massachusetts
<b>Dana-Farber Cancer Institute</b>	Univ. of Tennessee Research Corp.	W.A.R.F./Univ. of Wisconsin Madison	Univ. of Washington/Wash. Res.	SUNY Research Fdn.
				The UAB Research Fdn.
				<b>Univ. of California System</b>

## START-UP EFFICIENCY BENCHMARKING

What drives differences in start-up efficiency? Start-ups require work, of two kinds and highly coupled. The first is “knowledge work”: recognizing opportunity and creating and refining a credible story that will attract the necessary resources. The second is actually recruiting the

necessary resources: intellectual property, money, management, equipment, space. A fundable start-up might require between 1000 and 2000 hours to create. Start-up efficiency is driven by the transaction costs involved in such activities. These often have a strong geographical dependence. As regional “eco-system” builds up, transaction costs fall. Eco-system can be deconstructed as another value chain:

At source:

- a reliable flow of innovations stemming from a strong research base (>\$500m)
- tech transfer supportive of start-ups; strong, secure, and well-regarded in its institution and region, not protective of access to faculty

For incubation:

- mechanisms for networking that allow the top academic inventing talent and the top entrepreneurial management to “find each other”
- ready availability of early stage venture management talent and appropriate space in which early stage venture can locate themselves
- proof-of-concept funding, whether as university or quasi-university dedicated bridge funds, angel funds, or seed stage venture funds

For growth:

- later stage venture funding
- available and appropriate facilities to expand into
- a ready pool of qualified labor to recruit and specialist suppliers of services

As with other economic cluster phenomena, entrepreneurial eco-system operates according to the dynamics of critical mass. At about the level of 60 to 80 companies in a particular technology area (e.g. biotech, or IT, or instrumentation, or medical devices) in a particular region, technology cluster dynamics start to become self-reinforcing, and energy no longer has to “put into the system” to make it work. At this level a handful of the start-ups will statistically see significant success, involving a liquidation event that generates substantial wealth, and managers starting to spin out to “do it again” both as angels and entrepreneurs. Concentric circles of management “generations” grow. Shared background and known measures of track record “pedigree” lower transaction costs since shared experience generates trust. The perceived risk of investing in an early stage venture falls as it becomes easier to find high quality management, other funds to syndicate with, appropriate facilities etc. The perceived risk of being involved in a venture as entrepreneurial management falls as the ease of recycling to neighboring ventures increases. Cumulative regional experience leads to increasingly sophisticated diligence capabilities for local investors.

Entrepreneurial eco-system also operates according to the dynamics of critical density. Although regions tend to have reputations as technology clusters (San Francisco Bay Area, Cambridge MA, San Diego, Research Triangle), activity is actually clustered even locally in very particular zip codes (02139 in Cambridge, Longwood Medical Campus in Boston, Sand Hill Road in Palo Alto, Torrey Pines Road in San Diego). It is difficult to name a well-known technology cluster in a major metropolitan area. New York, Los Angeles, and Chicago for instance have major challenges of dispersed research, distance, traffic, and parking.

Clusters tend to contain a high degree of collaboration (as opposed to competition), among the various interested organizations in town. The competition for donors, local government funding, networking forums, entrepreneurial talent, companies to populate incubators etc. is not regarded as a zero sum game.

Much of the leverage and conversion efficiency of the high-functioning clusters come from the fact that the tech transfer office is no longer doing most of the heavy lifting in terms of sourcing deals, trying to fund early proof-of-concept and building the business cases. The tech transfer offices ultimately are not the progenitors of most of the deals being struck, merely a waypoint and facilitator. The lab corridors are metaphorically “crawling” with entrepreneurs and venture capitalists already doing this work. Alternatively, for other institutions with a high efficiency of start-up creation, their region is committed enough to throw several million dollars a year at trying to create the elements of eco-system.