THE CHANGING LANDSCAPE OF INTELLECTUAL PROPERTY MANAGEMENT AS A REVENUE-GENERATING ASSET FOR U.S RESEARCH UNIVERSITIES

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INTRODUCTION

There is an ongoing concern that U.S. universities are inefficiently managing the intellectual property ("IP") generated from almost $50 billion in federal funding that they receive for research.[1] The knowledge gained through government-funded university research could potentially give rise to industries and companies that are world leaders in nearly every area, and could serve as a primary contributor to U.S. innovative capacity and economic competitiveness. More and more, both our federal and state governments rely on top-tier research universities to improve our economy by providing the next generation of inventors and entrepreneurs who create groundbreaking inventions, high-growth start-ups, thousands of new jobs, and, ultimately, new revenue streams and wealth. The argument is that these billions of dollars of research should lead to breakthrough inventions and IP that could ultimately be commercialized to drive a cycle of innovation, thereby securing a global leadership position for the U.S. economy. However, the results are anything but consistent from university to university, and there is a great divide between the few universities that actually generate returns on their patents and those that do not. Much of this divide is the result of the Bayh-Dole Act coupled with the absence of a road map guiding or structuring universities' management of their IP assets. In seeking to close that divide, technology transfer from our universities has become a national priority. Technology transfer offers the hope of improving the delivery of university research to the innovation market and is envisioned as a key driver in our nation's quest to maintain a competitive advantage on the world stage.[2]

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1 Ed Paisley & Sean Pool, *Big Ideas for Small Business: Getting Good Technology out of the Lab and into the Marketplace*, CTR. FOR AM. PROGRESS (Jan. 5, 2012), http://www.americanprogress.org/issues/economy/news/2012/01/05/10885/big-ideas-for-small-business-getting-good-technology-out-of-the-lab-and-into-the-marketplace/.

2 Zoltán J. Ács & László Szerb, *The Global Entrepreneurship Index (GEINDEX)*, 5 FOUND. & TRENDS IN ENTREPRENEURSHIP 341, 421-22 (2009).

The White House, the Office of Science and Technology Policy, and the Department of Commerce have spent substantial resources trying to transform university patent commercialization, but whether or not those efforts will generate a substantial impact is still unclear.[3] The president of the United States recently delivered a technology transfer memorandum to encourage the federal government to improve technology transfer commercialization performance.[4] Additionally, the National Advisory Council on Innovation and Entrepreneurship recommended further actions needed from universities.[5] While these two steps move toward improving technology transfer, a road map that drives sustainable, successful outcomes and maximizes commercialization results is needed.

Part I of this Article reviews the genesis of the disparity between universities' patent commercialization outcomes and provides an analysis of the trends and value of university patents. Part II then examines some new models for commercialization to improve efficiency of technology transfer, and is followed by a brief conclusion.

I. THE BAYH-DOLE ACT AND UNIVERSITY PATENTING

While many forces have influenced the development of university research and the technology transfer process of bringing that research to market, several key factors have played central roles. The Bayh-Dole Act is oftentimes credited with the modern state of university technology transfer. However, equally important are the emergence of university interest in patenting the research of its faculty, the resultant recognition of waste in their research efforts, and the development of Technology Transfer Offices ("TTOs") in response to that waste. The TTO approach has several shortcomings that result in both excessive costs and missed opportunities for universities, businesses, and the economy. The purpose of this Article is to examine ways to improve the efficiency and efficacy of TTOs. But first, it is important to understand the context in which TTOs have emerged.

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3 U.S. DEP'T OF COMMERCE, THE COMPETITIVENESS AND INNOVATIVE CAPACITY OF THE UNITED STATES 3-3 to -4 (2012), *available at* http://www.commerce.gov/sites/default/files/documents/2012/january/competes_010511_0.pdf.

4 U.S. DEP'T OF COMMERCE, ACCELERATING TECHNOLOGY TRANSFER AND COMMERCIALIZATION OF FEDERAL RESEARCH IN SUPPORT OF HIGH-GROWTH BUSINESS 1 (2012), *available at* http://www.nist.gov/tpo/publications/upload/DOC-Tech-Transfer-Plan.pdf.

5 Letter from Mary Sue Coleman, Co-Chair, Nat'l Advisory Council on Innovation & Entrepreneurship, et al. to Gary Locke, Sec'y, Dep't of Commerce (Apr. 15, 2011), *available at* http://www.scribd.com/doc/53643557/University-Presidents-AAU-APLU-And-AASCU-Pledge-Expanded-Efforts-to-Foster-Economic-Growth.

A. *What is the Bayh-Dole Act?*

Sponsored by Senators Birch Bayh of Indiana and Bob Dole of Kansas, the Bayh-Dole Act was passed in 1980 and instituted to clarify IP rights so that universities generating inventions and patents from federally funded research could control their IP and take greater control over its outcome. Prior to the Bayh–Dole Act, inventors were obligated to assign to the federal government ownership of inventions made using federal funding.[6] Bayh-Dole permits a university, small business, or non-profit institution to elect to pursue ownership of an invention in preference to assigning ownership to the government.[7] Since its enactment, university technology transfer has created billions of dollars of direct benefits to the U.S. economy. More than 5,000 new companies have formed around university research, the majority of which locate in close proximity to the university from which the research is derived. In fiscal year 2008, and as a testament to the success of the Bayh-Dole Act, 684 new products were developed and 1.6 new companies a day were started from university research. Metrics like these cause supporters to believe that this legislation is critical to the successful transfer of technology from university to industry, and that it serves as a catalyst for economic growth.[8] The Bayh-Dole Act has been heralded by many as one of the key pieces of legislation over the past century, and its enactment has undoubtedly stimulated economic growth and new product development in the United States.[9] However, critics argue that the Act has brought about unintended and serious consequences for the United States as a global leader in innovation and has changed the nature of the public research university.[10] These arguments are mostly based on barriers that have arisen from a lack of access to inventions originating from federally funded research; monopolies that have been created from pharmaceutical and biotech companies; and the conflicts of interest that have resulted from the wave of new faculty inventors that have sprung up since the Bayh-Dole Act was approved. It is not within the scope of this Article to weigh in on the discussion of these arguments, but it is important to understand the unintended

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6 Ashley J. Stevens, *The Enactment of Bayh-Dole*, 29 J. TECH. TRANSFER 93, 94 (2004).

7 Steven E. Feldman & Sherry L. Rollo, *Emerging Energy and Intellectual Property: The Often Unappreciated Risks and Hurdles of Government Regulations and Standard Setting Organizations*, HUSCH BLACKWELL (2012), http://www.huschblackwell.com/files/Publication/08dec303-70bc-435e-a4f2-0a86ce7540f5/Presentation/PublicationAttachment/2f36d540-f6bd-4e5b-861e-0b208a9cf31a/Article_NationalLawReview_Rollo_Feldman_0512.pdf.

8 Opinion, *Innovation's Golden Goose*, ECONOMIST (Dec. 12, 2002), http://www.economist.com/node/1476653.

9 WENDY H. SCHACHT, CONG. RESEARCH SERV., RL32076, THE BAYH-DOLE ACT: SELECTED ISSUES IN PATENT POLICY AND THE COMMERCIALIZATION OF TECHNOLOGY 8 (2012).

10 Clifton Leaf, *The Law of Unintended Consequences*, FORTUNE (Sept. 19, 2005), http://money.cnn.com/magazines/fortune/fortune_archive/2005/09/19/8272884/.

consequences that frequently arise from such major legislation and to explore ways to maximize the law's original objectives.

B. *National Trends in Patenting*

Most experts and policy advisers would agree that the Bayh-Dole Act has met its primary objectives of using the patent system to encourage more inventions and patent filings arising from federally funded research while promoting the utilization of and collaboration inherent to public-private partnerships. In one study of the Bayh-Dole Act, the General Accounting Office found that the legislation had a significant impact on university research and innovation efforts.[11] The legislation led to an exponential increase in the number of patents filed by universities, from a low of less than two thousand to more than fifteen thousand applications filed in 2008.[12] Professors Loet Leydesdorff and Martin Meyer provide strong evidence that there have been three distinct periods of university patenting activity since the Bayh-Dole Act of 1980. The first period represented an exponential increase in university patenting until 1995. There was a second period that saw a decline in patenting activity. A third period, beginning in 2008, has seen a linear increase in university patenting.[13] Leydesdorff and Meyer argue that the third period has been driven by non-U.S. universities increasing their patent filings to secure a competitive position in growing U.S. high tech markets. No matter the reasons or fluctuations in patent filings, one fact remains: U.S. universities have led a dramatic shift in patenting over the past thirty years and contributed substantially to the growing pool of U.S. IP assets.

C. *Wasted Assets*

This growing base of IP assets and increasing activity in patent filings may seem like a boon to the innovation economy in the United States, but it does come with a price to American research universities. Most of the time that price is in the form of a false hope—a hope that if a university spends enough money on patents, licensing activity, and technology transfer it can generate huge sums of revenue that will justify the initial investment. However, the statistics paint a much different picture. Of the U.S. research uni-

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[11] U.S. GEN. ACCOUNTING OFFICE, GAO/RCED-87-44, PATENT POLICY: RECENT CHANGES IN FEDERAL LAW CONSIDERED BENEFICIAL 21 (1987).

[12] David Schwartz, *AUTM Licensing Surveys Reveal Steady Growth in U.S., Canadian Commercialization*, TECH TRANSFER ENEWS BLOG (Feb. 24, 2010), http://techtransfercentral.com/2010/02/24/autm-licensing-surveys-reveal-steady-growth-in-us-canadian-commercialization/.

[13] Loet Leydesdorff & Martin Meyer, *A Reply to Eskowitz' Comments to Leydesdorff and Martin (2010): Technology Transfer and the End of the Bayh-Dole Effect*, 97 SCIENTOMETRICS 927, 928 (2013).

versities that engage in technology transfer and report their metrics, fewer than 10 percent generated over $10 million per year and fewer than 65 percent even manage a break-even recovery on their tech transfer budget. Only six universities or systems—the University of Minnesota, Wake Forest University, the University of California system, Columbia University, New York University, and Northwestern University—generated more than $70 million in licensing revenue, and most of these were from a single blockbuster pharmaceutical.[14] If you look at the Association of University Technology Managers ("AUTM") reporting metrics, universities generate about 184,000 invention disclosures.[15] Roughly 8 percent of those disclosures are then licensed.[16] Ultimately, only about 0.8 percent lead to a new start-up company, with the final result that only 0.6 percent of all the active licenses generate returns in excess of $1 million.[17] That is an incredibly low return on investment from the almost $55 billion spent on federal research and development. Even more alarming is the fact that with all of these inventions being captured and patents being filed, more than 70 percent will sit on "university shelves" and never be licensed—which is still better than the more than 90 percent of U.S. patents that never make any money and will remain idle in the U.S. Patent and Trademark Office.[18] The academic literature has also criticized measuring technology transfer success merely by counting the number of patents acquired by universities. Specifically, metrics based on patents filed and patents issued can be misleading because universities frequently collaborate on joint inventions.[19]

Related to the increasing glut of patents is the concern that as quantity increases, quality decreases. In two separate studies investigators found that "the relative importance and generality of university patents ha[d] fallen at the same time as the sheer number of university patents ha[d] increased."[20] The authors of these studies also found that this trend is largely the result of a very rapid increase in the number of patents filed and that steady growth

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14 Darrell M. West, *Improving University Technology Transfer and Commercialization*, CTR. FOR TECH. INNOVATION AT BROOKINGS 1, 8 (Dec. 2012), http://www.brookings.edu/~/media/Research/Files/Papers/2012/12/05%20tech%20transfer%20west/DarrellUniversity%20Tech%20Transfer.pdf.

15 ASS'N OF UNIV. TECH. MANAGERS, AUTM U.S. LICENSING SURVEY: FY 2004, at 15-16 (Ashley J. Stevens et al. eds., 2005).

16 *Id.* at 27-29.

17 *Id.*

18 Stephen Key, *97 Percent of All Patents Never Make Any Money*, ALLBUSINESS, http://www.allbusiness.com/legal/intellectual-property-law-patent/15258080-1.html (last visited Dec. 22, 2013) (arguing that most people do not take the end goal of manufacturing into consideration when filing for patents).

19 Sarina Saragossi & Bruno van Pottelsberghe de la Potterie, *What Patent Data Reveal About Universities: The Case of Belgium*, 28 J. TECH. TRANSFER 47, 49 (2003) (finding that "[t]he use of patents as an indicator of university technology transfer performance may be highly misleading").

20 Rebecca Henderson, Adam B. Jaffe & Manuel Trajtenberg, *Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting, 1965-1988*, 80 REV. ECON. & STAT. 119, 126 (1998).

in university patenting has been accompanied by a steady fall in the average quality of university patents.[21] It would be inaccurate to conclude that these accumulating IP assets and patents have no value, so the methods and models of how they are transferred to the public sector for commercial value and the indirect benefits of commercialization are worth investigating.

D. *Tech Transfer Business Models*

The traditional method of technology transfer from a university is a linear model whereby an idea or invention is formally disclosed to a TTO. The TTO then might conduct a prior art search to assess the existing patent literature and see if the invention has already been patented, or if the invention meets the criteria set forth for a patentable discovery. If the invention appears novel, the TTO then makes the financial decision whether to file an application and undertake the expensive process of pursuing patent filings and the issuance of claims. In 2010 alone, universities spent over $320 million in legal costs on technology licensing, with very little to show for it in the end.[22] It is worth noting that the ability to redirect some of these funds toward more efficient transfer models would positively affect both the quality of the patents that were filed by universities and the substantial inventory that exists. Returning to the typical transfer process, if a patent is issued the TTO then begins actively marketing the patent in an attempt to match the IP with an appropriate corporate partner. The first step in the marketing process is an extensive contact period to gain interest from industry, after which the negotiation of a confidentiality agreement begins so that proprietary information can be shared. If both parties remain interested after the university shares the patent, a term sheet and license eventually are negotiated.

This process can be lengthy and adversarial. It is not out of the question for the process to take as long as two years, although generally it goes much faster. The types of deals in this linear process tend to be heavily focused on up-front fees and cash payments. In almost 72 percent of the cases in one study, TTOs structured licenses for cash and fees.[23] In contrast, licenses with an equity stake or sponsored research obligations were much less popular, occurring 17 percent and 11 percent of the time, respectively.[24]

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21 Diana Hicks, Tony Breitzman, Dominic Olivastro & Kimberly Hamilton, *The Changing Composition of Innovative Activity in the US—A Portrait Based on Patent Analysis*, 30 RES. POL'Y 681, 689 (2001).

22 Paisley & Pool, *supra* note 1.

23 Gideon D. Markman et al., *Innovation Speed: Transferring University Technology to Market*, 34 RES. POL'Y 1058, 1069 (2005).

24 *Id.*

These findings are consistent across a broad range of universities and tend to paint a very one-dimensional picture of technology transfer.[25]

Despite the popularity of cash arrangements, research has shown that equity licenses provide better long-term financial returns to universities.[26] These equity licenses, usually implemented through start-up companies, not only provide a more diversified and higher-value revenue stream but also have the added benefit of fostering local economic development, entrepreneurial development, and job creation. All of these benefits tend to stay within very close proximity of the university from which the invention originated. These start-up companies, launched by university faculty and TTOs, provide an alternative mechanism for industry engagement and should be given serious consideration as part of any tech transfer model. One study indicated that approximately 29 percent of patents with university faculty inventors were assigned to firms rather than to the university.[27] This high rate of faculty-industry cooperation means that a high percentage of university researchers are actually going around the process and not through the TTO, a clear indication that any new business model should consider integrating faculty-driven licensing rather than fighting it.[28]

All of this information together points to the realization that the process of technology transfer actually is much more complex than a simple, linear process model can support. To be effective, nonlinear approaches need to be developed that allow the exchange of intellectual assets to be transferred through outside parties and diversified channels, all with the goal of expediting and simplifying the process. A Carnegie Mellon survey looking at the role of industry in knowledge transfer found that the most commonly reported mechanisms for diffusion of university research to industry were publications, conferences, and informal exchanges.[29] Industry capture of patented university inventions ranked low in most industries ex-

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25 Jerry G. Thursby, Richard Jensen & Marie C. Thursby, *Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities*, 26 J. TECH. TRANSFER 59, 70 (2001) (finding in a "survey of TTOs at 62 major research universities" that "[l]icenses executed almost always include royalties and up-front fees, often include sponsored research, but less frequently include equity shares in the licensee").

26 Michael J. Bray & James N. Lee, *University Revenues from Technology Transfer: Licensing Fees vs. Equity Positions*, 15 J. BUS. VENTURING 385, 391 (2000).

27 Donald S. Siegel, David A. Waldman, Leanne E. Atwater & Albert N. Link, *Toward a Model of the Effective Transfer of Scientific Knowledge from Academicians to Practitioners: Qualitative Evidence from the Commercialization of University Technologies*, 21 J. ENGINEERING & TECH. MGMT. 115, 126 (2004).

28 *Id.* at 136-37.

29 Robert A. Lowe, *The Role and Experience of Inventors and Start-Ups in Commercializing University Research: Case Studies at the University of California* 16 (Ctr. for Studies in Higher Ed., Research & Occasional Paper Series CSHE.6.02, 2002), *available at* http://cshe.berkeley.edu/publications/docs/ROP.Lowe.6.02.pdf (discussing an instance of university research diffusion to industry where several UCSB professors gave papers at a conference, resulting in several firms playing a crucial role in their research development).

cept for pharmaceuticals,[30] indicating a need for a business model that more effectively encompasses all the phases of invention from research to development, IP disclosure, and ideation services for industry. These critical phases of invention and technology transfer should not be overlooked in seeking to capture both value and deal flow, and the importance of their inclusion further supports the argument that a linear model is both unrealistic and much too narrowly focused.

One other important metric in evaluating the efficacy of technology transfer is the time between discovery, patent protection, negotiation, and ultimate commercialization. A nonlinear model would accelerate the pace of the transfer process, providing both direct and indirect benefits to the university and licensee by increasing collaboration and inventor engagement, reducing time to revenue, and securing longer-term business development.[31] With the average time from license to first sale at about five years, there are a number of activities TTOs can and should undertake to reduce the overall time frame. In establishing nonlinear technology transfer models, TTOs should focus on including external engagement, prototyping, industry participation, grant funding for inventions, software development, and accelerating the creation of start-up companies. Time is frequently the enemy not only of the business model of TTOs, but also of the negotiation process. Excessively long transfer processing is one of the major complaints by industry and venture capitalists in dealing with universities, and it should be addressed through new, nonlinear business models, as well as TTO policy and culture.

E. *Assessing and Leveraging the Value of U.S. Intellectual Property*

In summarizing the analysis of technology commercialization to this point, it should be clear that technology transfer at U.S. universities is a value-losing proposition for the majority of cases. In addition to the long time frames of linear business models and the reduced revenue of cash licensing agreements, legal costs are extremely high and can represent as much as 60 percent of a TTO's budget. Under these pressures, few TTOs make money or even break even, and a linear business model is much too constrained to be an effective vehicle for the transfer of a university's intellectual assets. The measurement of revenue as a metric of success is also much too limited as we have a burgeoning mountain of IP that seems to be accumulating with no apparent end users. So why spend so much time and

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30 Wesley M. Cohen, Richard R. Nelson & John P. Walsh, *Links and Impacts: The Influence of Public Research on Industrial R&D*, 48 MGMT. SCI. 1, 16-17 (2002).

31 Markman et al., *supra* note 23, at 258 (proposing a model that "argues that for-profit UTTO structures and licensing in exchange for equity are most positively related to new venture formation").

money on a model that doesn't seem to be working? Because intellectual property used properly has tremendous value.

The current value of IP in the United States is estimated to be approximately $5.6 trillion, which accounts for nearly 35 percent of the U.S. gross domestic product ("GDP").[32] The Department of Commerce and the Patent and Trademark Office study that produced that estimate attributed this valuation to about seventy-five distinct industries that are considered "IP intensive."[33] Of these IP-intensive industries, the study looked at those that are patent intensive and those that focused on other forms of non-patentable IP. Less than 15 percent of the $5.6 trillion could be attributed to patents and patent-intensive industries, leading to the conclusion that the real value of our IP lies in other, less expensive forms of IP.[34] There is a growing school of thought that U.S. universities spend too much time focused on the pursuit of patents that lead to little value, with the effect being that they spend far too little time trying to assist in the development of other, more lucrative forms of IP.[35] As the study concludes, "[p]atenting is one strategy towards achieving successful technology transfer, but it should not be an end unto itself. That is, patents are one of many options to be considered in practice for IP protection."[36] As was cited earlier, most of the transfer of knowledge to the public sector does not occur through the mechanism of patents, so why spend so much time and money on them in the transfer process? Other forms of IP, such as tangible property, trade secrets, know-how, trademarks, and copyrights, are much more valuable and are becoming much more prevalent on our research campuses.[37] Without the ability to set up methodologies to assess and capture these other forms of IP, a university becomes one dimensional in its technology transfer focus and limits the effectiveness of its researchers to better access industry partners and channels.[38] An even greater concern should be the tremendous value and opportunity that is lost with the external partners and alumni that are not being engaged throughout the technology transfer process.

The value of IP also dramatically increases the overall valuation of early-stage companies. Research looking at early-stage funding by angel

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32 U.S. DEP'T OF COMMERCE, INTELLECTUAL PROPERTY AND THE U.S. ECONOMY: INDUSTRIES IN FOCUS vii (2012), *available at* http://www.uspto.gov/news/publications/IP_Report_March_2012.pdf.

33 *Id.* at *vi*.

34 *Id.* at 45.

35 Samantha R. Bradley, Christopher S. Hayter & Albert N. Link, *Models and Methods of University Technology Transfer* 61 (Univ. of N.C. Greensboro Dep't. of Econ. Working Paper Series, No. 13-10, 2013), *available at* http://bae.uncg.edu/assets/research/econwp/2013/13-10.pdf.

36 *Id.* at 40-41.

37 Aldo Geuna & Alessandro Muscio, *The Governance of University Knowledge Transfer: A Critical Review of the Literature*, 47 MINERVA 93, 98-99 (2009).

38 David C. Mowery, Richard R. Nelson, Bhaven N. Sampat & Arvids A. Ziedonis, *The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Effects of the Bayh-Dole Act of 1980*, 30 RES. POL'Y 99, 118 (2001).

investors and venture capitalists found a high preference for companies that held issued or pending patents. Further, the exit value of those companies with patented inventions was even more dramatic. Companies that had patents as part of their merger, acquisition, or IPO realized about a 32 percent increase in their acquisition price. The investigators then assessed the quality of the patents in each of these exits by reviewing the citations and claim strength. This assessment found that even with poorly constructed patents and weak claims, the exit value increased by over 20 percent simply because the company had a patent as part of its asset sale.[39] With both angel investors and venture capital such a perceived barrier is an important competitive differentiator for investment. Integrating this knowledge into a university's economic development strategy by simplifying the licensing process for start-up companies could make IP that is gathering dust or losing its patent life more attractive. Such strategies should not be overlooked as part of a comprehensive licensing model.

One final indicator of the value of U.S. intellectual property, and one that has far reaching implications, is a research study that sought to understand the correlation between a foreign country's investment in U.S. IP and the resulting economic impact, if any. The researchers found that a single standard deviation increase in a country's investment in U.S. patents equated to a 78 percent increase in venture capital into that country.[40] The correlation was related to the value of what the authors termed "innovative output," which was a measure of the value of a patent, indicating a high value for U.S. patents and an even higher value if the patent had been filed in both the United States and European Union. The development of an international entrepreneurial strategy, indicated by a focus on teaching, education, and investment in early-stage companies, technologies, and individuals interested in entrepreneurship, when coupled with an increased investment in U.S. patents, led to an even greater attraction of venture capital into a country. In a related study, Professor Isin Guler found that, combined with innovative output, one standard deviation increase in a country's scientific publications equated to a 113 percent increase in venture capital investments in that country.[41] No other measures, including stock market capitalization, political constraints, or number of students studying in the country, were as important. These figures should lead our universities and TTOs to think beyond our borders and develop strategies that attract international partners to de-risk their investments in patents while at the same time be-

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39 John E. Dubiansky, *An Analysis for the Valuation of Venture-Capital-Funded Startup Firm Patents*, 12 B.U. J. SCI. & TECH. L. 170, 191 (2006).

40 Astrid Romain & Bruno van Pottelsberghe de la Potterie, *The Determinants of Venture Capital: A Panel Data Analysis of 16 OECD Countries* 11-16 (Solvay Bus. Sch. Centre Emile Bernheim, Research Inst. in Mgmt. Sci., Working Paper No. WP-CEB 04/015, 2004).

41 Isin Guler & Mauro F. Guillén, *Institutions and Internationalization of U.S. Venture Capital Firms*, 41 J. INT'L BUS. STUD. 185, 195-96, 197-99 (2010).

ginning to reduce the clutter of lower-quality filings. Such a strategy would be a powerful model for IP management, producing a multiplier effect for beneficial and long-term metrics.

II. THE ROBUST BUSINESS MODEL

This Article has not used the word "ecosystem" to this point because it is an overused word that means many things to many people, in much the same way "innovation" has become overused and misinterpreted. Despite its overuse, the term "ecosystem" as to IP technology transfers is nevertheless useful in describing all of the parties and procedures involved in the process of carrying an invention from initial idea to the marketplace. The ecosystem includes not only individuals and institutions but also the structure of their interaction. Critically, understanding the ecosystem means understanding the parties and their interactions and how each can aid or undermine the process. The complexity of building an innovation ecosystem has been a much-studied field, but there are a few seminal papers that describe the value and strength of identifying the role of stakeholders and the need for their participation.

A. *Identifying Stakeholders*

In describing an improved and nonlinear model of commercialization, it is best to start with the stakeholders in the process: the individuals required for successful engagement, acceleration, growth, and translation of research and IP into positive outcomes and metrics. These individuals should be the backbone of any tech transfer strategy, and their involvement is paramount to a participative and value-driven TTO. These stakeholders comprise students, research faculty, entrepreneurs, financial investors, large and small companies, and government participants. Each of these stakeholders serves a valuable role in furthering the development of a technology; increasing the value of an invention as it progresses; and, most importantly, increasing the effectiveness of decisions so that low-quality, low-value ideas are weeded out quickly and the resultant IP portfolio is lean, focused, and driven toward a licensed endpoint.

In separate studies conducted by the Kauffman Foundation and researchers at Rutgers University, an examination of the principles, best practices, and variables of successful knowledge transfer led to surprisingly similar conclusions.[42] When most people think of successful technology transfer they think of Massachusetts Institute of Technology ("MIT"), Stan-

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[42] Robert E. Litan, Lesa Mitchell & E. J. Reedy, *Commercializing University Innovations: Alternative Approaches*, 8 INNOVATION POL'Y & ECON. 31, 53-54 (2007).

ford University, and a few other select universities. None of these universities' models sprung up overnight, and none of them was reliant on any single factor. These universities did not rely on the "one hit wonder drug," but instead built a steady, progressive TTO alongside and in response to their surrounding ecosystem. For instance, most of the successful universities have a large number of venture capitalists in their regions. They also have large industry partners that surround their campuses, engaged faculty, high-quality researchers with high publication rates, and very large research budgets far in excess of $500 million. The aforementioned studies therefore looked at these factors to determine the key drivers, including some other standard metrics to determine which had the greatest influence on technology commercialization success. What the research found was that most of these factors, although influential, were not the key to a university's success. Rather, it was the quality of the interaction between these factors which had the biggest impact on tech transfer success.[43] The researchers found that the creation of "network-bridging ties" and "trusted bridging" created the most influential determinant of high-quality transfer of knowledge and IP across the stakeholders in a given ecosystem.[44] So it is not the case that universities such as MIT succeed because they have a high concentration of venture capitalists, industry partners, and entrepreneurs. They succeed because of the quantity and quality of the interactions between those groups. The fact that MIT and Stanford have higher concentrations of these stakeholders in their vicinity does increase the quantity of the interactions, but it does not affect the quality.

The idea that small, trusted networks lead to positive outcomes should be a mantra for every TTO in the country and should be factored into any business model. These interactions between research and business are key drivers in commercialization outcomes, and they can be implemented at any university. It simply takes focus, determination, and an aligned university culture. The ability to build trusted bridges and networks between businesses, venture capitalists, entrepreneurs, and researchers should involve an outreach plan consciously focused on getting the groups together as often and creatively as possible. Frequent creative interactions also act as a filter. Individuals and groups will test and weed through different interactions and ad hoc collaborative groups until they find combinations wherein relationships and trust can be built. Everything else grows from there.

It turns out that the practice of getting researchers to mix with business and corporate partners has a long history of beneficial results, a trend that is growing as university researchers look for more alternatives to federal research funding. In general, university faculty that engaged with industry

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43 *Id.*

44 Daniel Z. Levin, Jorge Walter & Melissa M. Appleyard, Trusted Network-Bridging Ties: A Dyadic Approach to the Brokerage-Closure Dilemma 29 (Sept. 2011) (unpublished working paper), *available at* http://www.levin.rutgers.edu/research/trusted-bridging-ties-paper.pdf.

partners to further their research generated overall positive results in their academic careers. In a study of over 2,000 university research faculty, those that took sponsored research funding from industry had higher rates of patenting, publication, and federal funding and started a greater number of companies than those that did not engage with industry.[45] It makes sense that as basic research moves from applied to more market-directed research, valuable input and outcomes would be gleaned from increased industry relations.

B. *Developing the Nonlinear Model*

In using the preceding analysis to formulate a new business model for technology transfer which aligns with the mission of the university to enhance education, it becomes clear that linear models cannot appropriately capture or engage the parties or interests that need to be aligned for success. As such, a nonlinear model needs to be developed in order to secure an energetic interaction between a university and its ecosystem; to give more ownership to colleges and their faculty; to develop entrepreneurial programs that are aligned with a business school; and to facilitate an ongoing collaboration with industry. Programs that rely on and include the larger university ecosystem have a significant impact on technology transfer and should be a priority for strategic development.[46] The business model for this new century is an entrepreneurial university with a mission of economic development, in addition to research and teaching, and an interdisciplinary organizational structure that facilitates knowledge-based innovation.[47] Such a new business model would have the ability to translate research results into valuable patentable subject matter with positive economic outcomes.

1. Measuring for Success—A Performance Model

As the old adage states: “What gets measured gets done.”[48] Measuring a complex relationship such as technology commercialization requires an understanding of what success means to a university and how the business model affects the stakeholders throughout the commercialization process.

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45 *See* Darren E. Zinner et al., *Participation of Academic Scientists in Relationships with Industry*, 28 HEALTH AFF. 1814, 1818-19 (2009) (observing that technology transfer offices are crucial in strengthening weak links between academia and industry in the technology transfer process).

46 Jeanette Colyvas et al., *How Do University Inventions Get into Practice?*, 48 MGMT. SCI. 61, 67 (2002).

47 Henry Etzkowitz, *Research Groups as ‘Quasi-Firms’: The Invention of the Entrepreneurial University*, 32 RES. POL’Y 109, 119 (2003).

48 For what is widely regarded as the source of this truism, see generally MICHAEL LEBOEUF, THE GREATEST MANAGEMENT PRINCIPLE IN THE WORLD (1985).

The complexity and importance of this analysis should not be understated. For instance, and at the outset, measuring the wrong values will lead to difficulty in identifying corrective measures should they need to be taken. Owing to this complexity, performance management in technology transfer has been elusive for many organizations. Multiple performance management models have been created to benchmark TTOs over the years, and while many have merit, none of them provides a comprehensive, balanced framework. Current frameworks measure important individual elements. However, an overall model that measures effectiveness ("what is done"), efficiency ("how it is done"), and overall return on investment ("ROI") is needed.[49] For example, if you were to measure your organization just on full-time equivalent ("FTE") efficiency, which is a popular measure in many TTOs, you may have very strong numbers in the volume of processed licenses and/or patents, but are they the right ones? If you only measure how many big product hits you get, you will have significant scrutiny around which technologies to patent and which licenses to secure, and you may have lots of hits; however, at what cost? And if money is the prime metric that drives decision making, you may drive licensing income, but you stand to lose the impact that results from the possibilities of truly transformative technology commercialization.

2. Performance Management Complexities

Performance management is actually a complex art and science, and there are a few critical layers to getting it right. Industry benchmarking is the first step to understanding relative performance and helps establish a baseline. It is critical in this step to select the right peers and harmonize data to get an "apples-to-apples" comparison. While getting an apples-to-apples comparison can be difficult, one can use leading practices to get as close as possible. In technology transfer, it is imperative to select peers based on relative size of the research expenditure, technology portfolio mix similarities, age, and the number of "hits." For example, one of the benchmarking metrics that is important under the FTE efficiency umbrella is licenses/FTE. However, if you were benchmarking the National Institutes of Health, it would be inappropriate to perform a comparison to California Institute of Technology given the significant differences in the portfolio. Other information such as public/private status and region can further illuminate the benchmark results. The outcome of performance management

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[49] *See* Press Release, RHT Consulting, RHT Consulting and Hult International Business School Students Perform Benchmark Analysis for Technology Transfer and Commercialization (June 17, 2011), *available at* http://www.rhtconsulting.com/rht-consulting-and-hult-international-business-school-students-perform-benchmark-analysis-for-technology-transfer-and-commercialization.html.

metrics is simply an understanding of how one performs relative to one's peers and what metrics can be improved.

Once one understands the potential improvement opportunity, it's important to identify the key initiatives required to drive enhanced performance. Therefore, the second step in improving performance is creating a prioritized road map or plan with an associated benefits model. So, for example, if one of the initiatives in the road map is focused on relationship management, the benefits model will likely reflect improvement in license volume and associated royalty income as a result of an increased number of strategic alliances and/or enhancements in how alliances are managed. It should be noted that improvements in licensing income and volume take time, so it is important to put in place measures that identify and reveal improvements in daily and weekly performance activities. The use of key performance indicators ("KPIs") is a great tool that allows one to understand improvements at the activity level. For example, to measure progress in relationship management on a tactical daily or weekly basis, one should measure "close rate," which is one of the basic relationship management measures. Close rate is a KPI that measures the percentage of time that a prospect engages with a solution provider in order to consummate a deal. This could be a measure of the number of times a prospective licensee engages with the organization to consummate a licensing deal and does not terminate or withdraw from the contract before the deal is executed and the up-front payment is made.

The third step in performance improvement is setting up an overall performance management system. The system should include defined targets, structured processes to measure progress, and a governance model that outlines the frequency of measuring as well as the decision-making processes surrounding performance management. In this step, organizational targets are set. In addition, the technology transfer personnel need to have their individual performance targets and incentives aligned with both overall performance management of organizational technology transfer targets and the KPIs.

In addition, data tracking the reasons licenses are withdrawn and/or terminated should be collected. On a regular basis, the licensing team should come together and discuss their close rates (among other metrics) and share best practices around how they were able to improve these close rates (examples include, but are not limited to: increased follow-ups, new contracts with a bonanza clause, master research agreements, and team licensing). It is important to capture the leading practices that help improve KPIs and institutionalize these into processes. This is sometimes a Herculean change management task, but one well worth tackling. Just based on these three steps, one can see that developing an overarching performance management system can be complex. Nevertheless, doing so is a necessary challenge that a technology transfer leadership team needs to address.

3. Flawed Performance Management Frameworks

Every organization should establish performance management frameworks that align with their technology transfer strategy. These frameworks should include metrics that assess the following goals:

- Increasing innovation by improving the number of inventors disclosing high-quality inventions that become licensed products;
- Increasing the conversion of disclosures to patents, patents to licenses/start-ups, and licenses/start-ups to commercialized products and revenue; and
- Self-funding research by increasing license income relative to research expense, thereby improving ROI.

Without effective metrics that gauge the quantitative results of TTOs, as well as the contributing qualitative factors to improving technology transfer, there is a loss in effective and efficient resource management as well as potential funding, which leads to a vicious cycle of underperformance.

As a result of the need for a more holistic performance management framework, Truman Consulting developed a new model based on a first-principles approach to performance management—measuring effectiveness ("what is done"), efficiency ("how well it's done"), and the "output," as well as the speed of improvement of these metrics. The group assessed the successes and failures of TTOs and the opportunities to improve them. They selected forty-three peer organizations and analyzed a three-year period of research expenditure, license income, and licenses exceeding $1 million in revenue. The metrics were based on cumulative AUTM data from 2007 to 2009 as well as analysis of effectiveness, innovation, financial efficiency, FTE productivity, and overall performance. To gain a comprehensive view of performance, the new framework included metrics in the following categories:

- *Effectiveness—The "What"*: Focusing on the right things
  - Do disclosures become patents?
  - Do patents become licenses, start-ups, or options?
  - Do licenses, start-ups, and options become commercialized?
- *Innovation—"Net Newness"*: How much of what's being done is new?
  - Are patents issued based on *new* patent applications?
  - How many new patent applications are processed per FTE?
  - How many new patent applications are supported per $1 million in research expenditure?

- *People Efficiency—The "How"*: How much does each FTE support/produce?
  - How many disclosures, licenses, options, and start-ups are processed per FTE?
  - How much in licensing income and research expenditure do FTEs support?
- *Financial Efficiency—The "How"*: How much does the organization get out of each research dollar, including research expenditure from government sources, research expenditure from industrial sources, and total research expenditure?
  - How many disclosures are produced per dollar of research expenditure?
  - How many patents are issued per dollar of research expenditure?
  - How many licenses, options, and/or start-ups are consummated per dollar of research expenditure?
- *Performance*
  - How much licensing income is produced as a percentage of research expenditure?
  - How many licenses, options, and start-ups are created as a percentage of research expenditure?

The data was then normalized on a 1-10 scale to make each metric comparable to one another. Based on these metrics, the study developed a list of some of the top performing universities, which are outlined in Table 1.

INSTITUTION	Overall Effectiveness	Overall Efficiency	Overall Score
California Inst. of Technology	6.84	9.44	8.23
New York Univ.	5.24	5.05	5.14
Univ. of Georgia	4.49	5.42	4.98
Stanford Univ.	4.47	4.97	4.74
Northwestern Univ.	4.31	5.31	4.84
Univ. of Florida	4.02	5.19	4.64
Georgia Inst. of Technology	4.11	5.80	5.01
Columbia Univ.	4.63	3.72	4.14
Univ. of Utah	3.44	4.73	4.13
Mass. Inst. of Technology (MIT)	4.41	3.86	4.12

Table 1: Top Performing Universities and their Performance Scores

No one metric or even a few should be considered as a stand-alone measure of success. Relying on a single metric when measuring patents and patent filings leads to being buried in burdensome costs and low-quality, unmarketable IP. Measuring strictly financial indicators, such as revenue, detracts from the mission of the university and diminishes the ability to create a valuable experience for students looking to explore and engage in entrepreneurial activities. At a time when students have the greatest ability to take risk, there should be no more motivating factor than the existence of programs allowing students to explore that risk while assisting in entrepreneurial activities and the technology transfer process. In recent comments, Scott Case, the CEO of Startup America, emphasized the role of entrepreneurial development on our college campuses and argued that it was imperative to get students off our campuses and engaged in extracurricular development as part of a start-up culture. Whether it be coding or app development, technology assessment, business competitions, internships, maker fairs, or designing, we have to get our students out of the classroom. If we focus too much on start-up creation we get too many low-quality, underfunded companies with little chance of growth. The nonlinear model is one of aligning partners and balancing metrics that considers the needs of the stakeholders. There are very few metrics-based systems that appropriately measure all the needs for successful tech transfer, especially ones that appropriately deemphasize revenue generation in favor of a more balanced system that can measure more broad-based outcomes and overall impact.

4. PricewaterhouseCoopers's "Four Pillars" Approach

One comprehensive model, developed by PricewaterhouseCoopers ("PwC"), seeks to measure the appropriate drivers of innovation at universities in a balanced and simple format. In its analysis, PwC found that practices varied considerably across institutions in their approach to patenting, networking, marketing, funding structures, and licensing. These varied practices resulted in measurable differences in workflow processes and outcomes. No one university stood out from the rest in terms of innovation capacity, indicating that all institutions could benefit from applying what PwC has termed the "Innovation Scorecard."[50] They also discovered that there was not a single institution with a robust measurement system that could provide a balanced approach for assessing and managing innovation and technology transfer.

PwC's Innovation Scorecard seeks to measure "four pillars" that effectively drive best practices for innovation and lay a foundation for long-term growth. The pillars are: input, activities, output, and impact. "Input" relates

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[50] PRICEWATERHOUSECOOPERS, IF INNOVATION ISN'T MEASURED, CAN IT BE MANAGED? HOW UNIVERSITIES MANAGE INNOVATION THROUGH DISCIPLINED AND NOVEL MEASURES 3 (2011).

to a university's research funding, its research-related facilities, and the quality of the workforce associated with these activities. "Activities" is intended to measure how creative and robust the technology transfer activities are in engaging the surrounding ecosystem and building trusted networks of partners. "Output" measures the more traditional metrics, including patents filed, inventions disclosed, licenses completed, start-ups formed, and others. "Impact" is the most interesting and complex of the pillars in that it attempts to measure the impact of the TTO, the university's programs, and how their technologies ultimately affect consumers, patients, and the marketplace. The beauty of this system is that it surveys the stakeholders on a scale of 1-10 for each of the four pillars and creates one simple numerical measure that can be compared against peer institutions. The measurement of these metrics does take time, but it provides one of the more comprehensive systems to track technology transfer success.

5. The Ohio State Case Study

In a case study designed to combine the best practices that have been outlined throughout this Article, the Ohio State University ("OSU") embarked on a mission to completely transform and overhaul its technology commercialization operations based on the involvement of an engaged ecosystem and a performance-driven operation. The transformation started with a focus on determining the stakeholder needs in the region and building an entrepreneurial, proactive culture. This involved a commitment to outreach, a celebration of successes, and the development of customized initiatives established within key research colleges. Undertaking such a cultural shift should not be forced and should take into consideration the existing cultural norms, offering an explanation for the shift while seeking the acceptance of existing faculty. It is critical to have strong support from the university's senior leadership throughout the process. Without this support most shifts in culture are doomed to fail. It is also important to understand the subcultures that exist within different divisions of the university and to ensure that alignment is broadly recognized and that the shift's objectives are embraced.

Cultural shifts start by defining the behavior that you are seeking and rewarding conduct when it is observed. This creates reinforcement and allows the new cultural norms to accelerate. The second component of the OSU transformation involved creating student initiatives for every new program within the TTO. This was important in reinforcing the educational mission of the university and enhancing the student experience by providing real-world transactional opportunities in both entrepreneurship and commercialization. The third component involved developing performance-based programs and metrics that drove high-value deals and larger partnerships with small and large corporations. By combining these elements with a high-performing team the TTO was, within two years of implementation, able to secure the following results:

- Invention disclosures increased by 55%
- Mark-to-market deal valuation more than quadrupled
- The PwC Innovation Score rose from an initial value of 2.0 to 5.2
- New inventors exceeded 400
- Patent filings increased by 61%
- Issued patents increased by 65%
- Deals increased by almost 75%
- Start-up companies doubled along with early-stage funding
- Cash inflows increased by more than 300%
- More than 1,400 students engaged

CONCLUSION

The complexities of technology transfer at our research universities coupled with the daunting task of assessing and protecting early-stage inventions has led to business models that have produced less-than-positive results and caused the whole function of commercialization to be reassessed. The sheer volume of patents being generated by universities and the lack of a clear financial return on patent and infrastructure investment has led to a narrowing of the technology transfer function at a time when the opportunity to capitalize on new business models is greater than ever. The data show that our research universities are economic engines for growth, innovation, and new business development. Patents have made an increasing contribution to our GDP and drive broad international partnerships, but the United States seems to be scaling back in technology transfer, not ramping up. All of this points to a tipping point whereby those that recognize and invest heavily will realize even greater returns and build more creative and lasting university programs. It also leads to a very real opportunity for an aggregation of the technology transfer function at a majority of our research universities and for increased synergy, collaboration, and very real cost savings. New models for the creation of public-private partnerships, start-up development, student engagement, ecosystem inclusion, and an entrepreneurial explosion provide the means for a tectonic shift in technology transfer and IP management. The fact that so many of the business models that still exist in technology transfer are linear and focused solely on the licensing transaction indicates a desperate need for change. The commitment to make such a change to a university's technology transfer model and IP management should not be taken lightly. It involves a substantial commitment to long-term success and an investment in risk. It takes the collective engagement of the faculty, the community, and the experts that assist in critical technology asset and start-up development. Developing such a complex technology transfer model has an incredible and rewarding return on investment and produces long-term value in relationships, revenue, impact, and economic development.