Tracking Innovation: An Examination of University Research and Its Relationship to Early Stage Venture Capital

by

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Abstract

In seeking to understand the relationship between university technology transfer and early stage venture capital, one must review the historical impact of the Bayh-Dole Act, the amendment of the "Prudent Man" rule by the Department of Labor, the historical association between academia and venture capital, as well as the rise and influence of formal and informal social networks. Within this thesis, one can observe the issues that arise in designing successful university commercialization processes and licensing relationships. Specifically, this paper will outline the common formal and informal elements found within the process of commercializing university-born technology and research at the Massachusetts Institute of Technology ("MIT"). Utilizing a sample set of licensing arrangements from MIT's Technology Licensing Office, a compilation of interviews with 10 early stage venture capitalists and a series of personal insights from academics and entrepreneurs, this thesis will seek to understand if a formal "entry point" exists for early stage venture capitalists seeking to harness the best university research for commercial applications.

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I. INTRODUCTION

The commercialization of university-born technologies and research has increased dramatically in the last 20 years. This stems from the alignment of a number of forces, both internal and external to academia. These forces are comprised of U.S. legislative changes, formalized university technology transfer processes, the social influence of premier scientists and researchers as well as a significant growth in early stage venture capital funds. This thesis is focused on how early stage ventures evolve from universities. Specifically, I ask the question of whether a formal channel exists, or should exist, as a primary entry point for early stage venture capitalists in pursuing the “best-of-breed” technologies in commercially-applicable university research. In particular, I focus on the research and entrepreneurial environment at the Massachusetts Institute of Technology (“MIT”). Base upon this line of questioning, it is my goal to uncover a number of specific recommendations for early stage venture capitalists seeking to manage the dearth of research and innovation within this particular university. Additionally, I will make recommendations of further research and study regarding MIT and its relationship to “seed” and early stage ventures.

In 1980, with the passage of the Bayh-Dole Act, it was deemed socially acceptable for, and legally obligated, universities to be interested in commercial gain. This Act gave universities the right to own, license and administer the result of federally funded research. The key underlying principal to Bayh-Dole was that any inventions that were federally funded should be licensed commercially to the private sector for public gain\(^1\). Although not all academic research has federal backing (a recent survey of 190 universities and academic institutions shows that of the $29.5 Billion in total research expenditures in year 2000, $18.1 Billion or 61%, came

\(^1\) The Economist, “Innovation’s Golden Goose.” December 12, 2002
from federal sources\(^2\) this Act did serve as a catalyst in the creation of a variety of administrative entities focused on commercialization.

Another significant force that has spurred more established university technology transfer processes, and one that lives outside the boundaries of academia, is the role of external financial partners such as early stage venture capitalists. Prior to the passing of the Bayh-Dole Act, the Department of Labor clarified the “Prudent Man” rule which amended restrictions on pension fund investments in regard to “high risk” assets. This key amendment to the Employee Retirement Income Security Act (“ERISA”) helped to foster a dramatic rise in institutional Limited Partnerships (“LP’s”) in venture capital funds. With this rise in interest, came a gradual increase in the amount of early-stage venture capital funds. This trend has ultimately fostered a direct link between university technology transfers and successful entrepreneurial startup companies. In 1980, at the time of the passing of the Bayh-Dole act, 87 venture capital firms existed with an aggregate amount of capital raised that year of 2.08 Billion dollars. In contrast, by the year 2000, there were 693 venture capital firms in existence with total amount of aggregate capital raised that year representing over 205.5 billion dollars\(^3\).

Since these two significant passages, a number of technology licensing offices (“TLO”) have been created within university walls. In fact, according to a 2000 survey by the Association of University Technology Managers, there are more than 200 universities engaged in technology transfer, “eight times more than in 1980.” By establishing a formal technology transfer process, the university system has been able to directly affect the private sector through an ever-increasing amount of patent licenses granted to startup and entrepreneurial endeavors.

\(^3\) VentureOne’s “VentureSource” database findings
Technology transfer in 1999, "specifically the licensing of innovations by U.S. universities, teaching hospitals, research institutes, and patent management firms" added about $40 billion to the U.S. economy and supported approximately 260,000 jobs.

The establishment of a campus-specific TLO does not necessarily lead the charge towards a fruitful windfall of licensing royalties for a particular university. In fact, a variety of reasons exist for the inconsistency in commercialization and technology transfer within academia. Both Casper and Murray propose that university resource constraints play a key role in the failure to commercialize. Additionally, as pointed out by MIT Professor Edward Roberts, "although direct technology transfer provides a competitive advantage to the entrepreneurial carrier of that technology, embodiment of the technology in product form is necessary for significant and leveraged company growth to occur." Hence, many technologies that emerge from research laboratories are just that – research. This combination of a lack of resources, as well as the nascent stage of some university inventions, proffers up the possibility that not all the best licenses or disclosures are actually available through a TLO. We will examine Bernstein and Hsu's take on this later on in this research. As well, we will examine just how relevant MIT's TLO is in regard to early stage venture formations.

I have divided the paper into five sections and a conclusion. Following this brief introduction, a historical overview of the three areas of analysis is presented: the Bayh-Dole Act, venture capital and the university, and the rise of the Technology Licensing Office. The third section reviews a collection of literature and theoretical considerations. A fourth section outlines

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1 The Association of University Technology Managers, AUTM.net Web site
and applies the methodology and principal research that much of this research paper is based upon. A recommendation section follows while the paper ends with a detailed summary and conclusion. As a general note, this paper focuses a great deal on the inner workings, relationships, dynamics and characteristics of the Massachusetts Institute of Technology ("MIT"). Although other universities are represented or discussed, the primary data and series of interviews are focused on MIT-related discussions and facts.
II. HISTORICAL OVERVIEW

A Change in Legislation: The Bayh-Dole Act

One of the most controversial, yet inspired, pieces of legislation to emerge from Congress in the last 25 years was the creation of the Bayh-Dole Act. This key passage unlocked the door to ownership of university-driven innovations and research. Prior to this Act, intellectual property that had been generated in federally funded laboratories was the actual property of the United States government7. As an early stage venture capitalist, it is imperative to understand the impact this legislation has had on technology commercialization along with some of its finer points.

Bayh-Dole brought about two changes to a fairly chaotic and frustrating world of university technology transfer. By its very design, the Act allowed a government agency that funded specific research at a university to transfer the ownership of the innovation or discovery to the university itself. Second, the act allowed researchers who worked on the project to potentially stake a claim on the intellectual property and any potential future royalties8 (this is subject to university policy). The latter helping intellectual property to vault forth from an academic environment into a private, commercialized setting. Hence, the spillovers of academic-lead research into the private sector increased dramatically. Bayh-Dole served as a watershed event in entrepreneurship as it facilitated the creation of a true source of innovation and deal flow, not just for researchers but for non-academics and financiers alike.

Prior to the Bayh-Dole Act, any research that was government-funded was owned specifically by the government. Any possible commercialization of this research would have to

evolve from a government body. If a researcher did actually want to commercialize a particular
discovery or innovation, it would require a series of complex and frustrating negotiations in
order to obtain any sort of viable licensing arrangement. In addition, to gain an exclusive license
for an innovation was almost unheard of in this governmental context\(^9\).

During World War II the Office of Scientific Research and Development (OSRD) was
placed in charge of setting strategy and policy in terms of funding, administering and
coordinating the actual usage of research\(^10\). It was in this office that the director, Vannevar Bush,
a former MIT professor and administrator, started to look at how government-sponsored research
patents would be organized. It was his belief that as the United States evolved from a wartime
economy towards a peaceful industrial nation that issues of ownership and conflicts of interest
surrounding federally-funded intellectual properties would materialize. Bush helped to formulate
the notion that patenting would allow for a system to grant licenses but, according to Etzkowitz,
the belief at the time was that “no company should have the exclusive right to exploit patents that
had been publicly funded by the taxpayer.” Bush also held a belief that the government should
play a “hands off” role in relation to university research and discovery by simply funding and
supporting the research but not interfering with it. The logic was that ultimately the successful
dissemination of the research would ultimately translate into practical uses\(^11\).

The regulation and administration of academic-driven patents and licensing segued from
the ORSD and ultimately fell upon the shoulders of the Department of Commerce’s National

\(^9\) Stanley, p. 6.
\(^10\) Etzkowitz, p. 116.
\(^11\) Howard W. Bremer, “The First Two Decades of the Bayh-Dole Act as Public Policy”, Speech to the National
Association of State Universities and Land Grant Colleges. (November 11, 2001)
Technical and Information Service (NTIS)\textsuperscript{12}. In keeping with Bush’s notion of a “hands-free” government, this system kept university and government at quite a distance. According to Etzkowitz, it worked “reasonably well” as private companies that discovered relevant research could reach out to the government regarding licenses in “fields such as mechanical devices, electronics and chemical processes, where development costs and product development times, and consequently risks, were low” However, due to the fact that all licenses were non-exclusive and “freely available to all” this posed a problem with traditional industry. Its interest level and appetite for government backed research was moderate at best as it would never be realized in an “exclusive” form. This would ultimately change, through some aggressive work by the Johnson administration in the early 1970’s but not before the licensing process continued on with its legacy of non-exclusivity and “government-sponsored, government owned” ideology.

Over time, a variety of governmental funds to underwrite academic research accrued\textsuperscript{13}. The logic behind this surplus was that just as government funded innovation helped advance weaponry at a time of war, so to would this innovation lead to “civilian uses in the post-war car…”\textsuperscript{14} In 1950, The National Science Foundation (NSF) received an annual budget of $15 Million from Congress to allow for research at universities. In a post-war environment, and with more formal streams of funding, a challenge existed to create a mechanism in which to harness this university research. Hence, the government created 26 different agencies in which to handle the varying types of discoveries – all results from this research was still owned and maintained by the government\textsuperscript{15} In much the same way that Bush’s work in regulating government-enabled research and patenting attempted to keep a distance and maintain an equal footing for all

\textsuperscript{12} Etzkowitz, p. 117
\textsuperscript{13} Stanley, p. 5
\textsuperscript{14} Etzkowitz, p. 116
\textsuperscript{15} Bremer Speech
licensees, this lead ultimately to more complications in license negotiations as well as a strict policy of non-exclusivity for licensees. It was industry, however, that ultimately laid the groundwork for changes to this ideology.

In 1968, in a study conducted by the Johnson administration, it was uncovered that the government had actually never owned a pharmaceutical patent that was commercially developed. As the creation of a new drug takes a great deal of time and resources to bring to market a profitable pharmaceutical, no company was interested in licensing a government owned patent that they could not possess on an exclusive basis and for a reasonable amount of time. Having monopoly marketing rights over a 20 year period was the key to success for large drug companies and they simply would not waste resources on anything that did not adhere to this characteristic. With that in mind, this lead to the creation of the Institutional Patent Management Agreements (IPAs). According to Stanley “originally from the department of Health, Education and Welfare and later from the NSF.” IPAs broke new ground for the university technology transfer process. These agreements allowed universities to negotiate with the government for the title rights to any university-born works. Although less than perfect in design – these negotiations could take up to three years – as Bremer stated, this finally acted as a catalyst to which academic institutions could participate in the business of technology transfer.

As the United States grew concerned about its leadership in industry throughout the 1970’s, the notion of IPA’s and the lengthy process by which they took in terms of negotiations needed to be re-considered. It was this reconsideration that lead to the formation of the Bayh-Dole Act in 1980, known formerly as “Patent and Trademark Act of 1980” (P.L. 96-517)\textsuperscript{16}, that paved the way for a uniform process of patent administration. This Act aligned the many federal

\textsuperscript{16} Stanley, p. 6
agencies that funded research in such a way that helped eliminate many issues around exclusivity and technology transfer by universities and non-profit groups. According to Etzkowitz, the Bayh-Dole Act contained six important provisions:

1. Universities could elect to retain title to the results of federally funded research.

2. Universities were required to share proceeds with inventors. This was a most important aspect of the act. The concept of patenting was foreign to most academics. Their academic reputations, under conditions when current, would not be enhanced by adding patents and licenses to their curriculum vitae. In contrast to corporate R&D scientists who typically are required to sign away their patent rights as a condition of employment, academic scientists and engineers were given a tangible incentive to expand their purview to include the commercialization of research. US academics joined German workers as beneficiaries by law in the fruits of their creativity.

3. Restrictions on licensing terms were removed. Licenses to small businesses could be for the lifetime of the patent. Licenses to large businesses were still limited to ten years.

4. US manufacture was required for products to be sold in the USA. This requirement was to ensure that a reasonable share of the benefits flowed into the US economy. Waivers can be obtained if the licensor can show the agency that funded the research that the licensee cannot economically develop the product if this requirement is enforced.

5. Small business preference. This was one of the most debated aspects of the act. There remained considerable concern in the Senate about handing monopoly power that had been created with government funding to large corporations. It was felt that small companies would be less able to exploit that monopoly power at the expense of the public than would large companies, so a preference for small companies was incorporated into the act. The meaning of the requirements has never been seriously tested. If an institution received equal offers to license a technology from a large and small company, then it would clearly have to accept the small company offer. However, this is never the case. Licensing proposals always differ, so the overall economic attractiveness of the competing offers must be compared and weighed.

6. The government retained a non-exclusive license to use the technology and march-in rights. The government’s license is for its own use only. This therefore primarily impacts technologies for which the government is the primary consumer and has not been a major factor. The march-in rights give the government the right to take back title if it believes that an important technology is not being properly exploited. This rarely happens and has not been an important factor in technology commercialization.17

17 Etzkowitz, p. 120
By 1980, just prior to Bayh-Dole, it is obvious that university-driven innovations accounted for only a very small portion of commercial industry. In fact, of the 28,000 patents that the government actually owned, less than 5% had actually been licensed to industry\textsuperscript{18}.

Post Bayh-Dole, and leading up to the current time frame, university patents have exploded. This had been shown by Henderson, et al\textsuperscript{19}, as well as a recent Association of University Technology Managers’ survey where it is noted that university patents have increased from fewer than 250 per year (prior to Bayh-Dole) to a current rate of about 2,000. In addition this legislation has acted as a catalyst to the creation of over 3,376 spin-off businesses\textsuperscript{20}. According the Economist, this has lead to 260,000 jobs and an annual contribution of $40 billion to the national economy. Additionally, Bayh-Dole’s bias and skew towards smaller business, or startup business, licensing policies helped to unlock a new set of deal flow for early stage venture capitalists.

\textit{Venture Capital and the University}

Another significant force that spurred a more established university technology transfer process, and one that lives outside the boundaries of academia, is the role of external financial partners such as seed stage venture capitalists. According to Lerner, just prior to the passing of the Bayh-Dole Act, the Department of Labor introduced the “Prudent Man” rule which loosened restrictions on pension fund investments in regard to “high risk” assets. This key amendment to the Employee Retirement Income Security Act (“ERISA”) helped to foster a dramatic rise in institutional Limited Partnerships (“LP’s”) in venture capital funds. With this rise in interest,

\textsuperscript{18} The Economist, December 12\textsuperscript{th}, 2002
\textsuperscript{20} AUTM Licensing Survey, p. 9.
came a gradual increase in the amount of early-stage venture capital funds. This trend has ultimately fostered a direct link between university technology transfers and successful entrepreneurial startup companies. In 1980, at the time of the passing of the Bayh-Dole act, 87 venture capital firms existed with an aggregate amount of capital raised that year of 2.08 Billion dollars. In contrast, by the year 2000, there were 693 venture capital firms in existence with total amount of aggregate capital raised that year representing over 205.5 billion dollars\(^{21}\).

Venture capital, distilled to its simplest form, is the process of investing in, and shepherding riskier private investments than traditional banking and investment professionals may otherwise become involved with. Accordingly, Gompers & Lerner have noted that this may very well be the only source of capital for younger upstart organizations. “Entrepreneurial firms that are characterized by significant intangible assets, expect years of negative earnings, and have uncertain prospects are unlikely to receive bank loans or other debt financing. For many of these young companies, the tremendous uncertainty and asymmetric information may make venture capital the only potential source of financing.”

Venture capitalists (“VC”), however, are more than just “gun-slinging” investors that “shoot” at a series of deals to see what materializes. In fact, as described by Erik Straser of Mohr Davidow Ventures, the art of venture capital is more about acting as a “craftsman” than a “financier.” In Straser’s view, this notion of an apprenticeship followed by years of practicing the craft are what drives a successful VC\(^{22}\). To that end, Gompers and Lerner take a more pragmatic approach by comparing and contrasting the role of a VC versus the traditional commercial lender or investment banker: “While banks monitor the financial health of firms they lend to, venture

\(^{21}\) Venture Economics, 2001
\(^{22}\) Personal Interview between Erik Straser and thesis author, Palo Alto, CA, (March 2003)
capitalists monitor strategy and investment decisions as well as taking an active role in advising the firm." In fact, it is this value-added advisement and consulting that should help the firm achieve success in the long run. From an early stage, just setting the right benchmarks and metrics for tracking company progress is a collaborative process between VC and entrepreneur.\footnote{Personal Interview between Paul Ciriello, TD Capital, and thesis author, Boston, MA (March 2003)} As shown by Brav and Gompers in 1997, venture backing add substantial value both pre and post Initial Public Offering and that "venture-backed companies substantially outperform non-venture backed firms."

The true dawning of the age of venture capital occurred in the late 1970’s and early 1980’s with significant policy and tax changes in the United States. As noted by Gompers and Lerner and others, it was these series of events that helped drive a previously limited investment niche to a much bigger and broader industry. It can be noted from the dates of these events that they propitiously aligned with the passing of the Bayh-Dole Act in 1980:

- 1978: Revenue Act lowers capital gains tax rate from 49.5% to 28%
- 1978: Pension rules changed allow fund managers to invest in venture capital pools and other higher risk activities. Known as "Prudent Man" rule.
- 1980: Small Business Investment Act streamlines venture capital reporting requirements.
- 1980: "Safe Harbor" regulation shields venture capital firms from assuming full risk as fiduciaries of pension fund assets. (explain more)

As the 1980’s and 1990’s progressed, and venture capitalists saw successful returns from such entities as Apple Computer, Cisco Systems, Genentech and Netscape, a dramatic rise in investment in venture capital occurred. As evidenced in the following chart, the increase in the number of venture capital firms from 1980 (87) to 2000 (693) represents a growth of roughly eight times. Additionally, the average fund size increased from 36.5 Million in 1980 to 211.4 million in 2000. Although, in recent times, venture capital has been in the midst of a correctional state due to a preponderance of failed ventures and a break-down in the technology initial public offering market, 108 VC firms in 2002 still raised $6.9 Billion in new funds. This represents an increase of well over 4 times that of the committed investment dollars to venture capital in 1980\textsuperscript{26}.

\textbf{The VC Landscape By 2000\textsuperscript{27}}

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1990</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td># of VC Firms in Existence</td>
<td>87</td>
<td>375</td>
<td>693</td>
</tr>
<tr>
<td># of Professionals</td>
<td>1035</td>
<td>3794</td>
<td>8368</td>
</tr>
<tr>
<td># of First Time VC Funds Raised</td>
<td>24</td>
<td>14</td>
<td>164</td>
</tr>
<tr>
<td># of VC Funds Raised This Year</td>
<td>57</td>
<td>82</td>
<td>497</td>
</tr>
<tr>
<td>VC Capital Raised This Year ($B)</td>
<td>2.08</td>
<td>3.20</td>
<td>105.5</td>
</tr>
<tr>
<td>Avg VC Fund Size Raised This Year ($M)</td>
<td>36.5</td>
<td>39.0</td>
<td>211.4</td>
</tr>
</tbody>
</table>

Investors are much more skeptical since the crash of the NASDAQ stock exchange in March of 2000 but are still actively engaged in funding early stage activity. According to the

\textsuperscript{26} Thomson Venture Economics and the National Venture Capital Association, joint report, February, 2003
National Venture Capital Association, $21.2 was committed to venture investing in 2002. This represents an almost 8-fold increase from the amount invested in 1990 ($2.8 Billion). There is, however, a significant amount of un-invested capital “sitting on the sidelines” and not being put to work. This “overhang” of capital has caused some dramatic tension between the general partners of early stage venture capital funds and their limited partners. By the end of 2001, the estimated amount of uncommitted venture capital was pegged at $106 Billion\(^{28}\). However, as previously mentioned, new funds are raising capital despite the rampant changes that are occurring within the venture capital industry.

**Technology Transfer and the University**

An introductory paragraph to a recent article by Kenneth Ducker in the *Food and Drug Law Journal* highlights the early stages of university technology transfer:

> **One hundred years ago, there was no such thing as university technology transfer. Ideas moved beyond the academic realm through the training of students who left the university and the publication of papers in academic journals. The world of academia seemed to be hermetically isolated from the hustle and bustle of the business world...**

Indeed, the notion of transferring technologies into the burgeoning set of industries shaping the US economy at the time, seemed, at best, as an afterthought. However, as Dueker points out, the “robber barons” and various other captains of industry began to develop philanthropic habits and a keen interest in funding academic research and infrastructure. As donations from the private sector continued to play a more direct role in growing university endowments, it was also the creation of the Morrill Act in 1862 that helped foster a direct relationship between academia and industry. This act, also known as “The Land Grant College Act,” paved the way for states to

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donate land and territories to provide "Colleges for the benefit of Agriculture and Mechanical Arts."\textsuperscript{29} MIT is one such institution that is a benefactor of this Act and became a Land Grant Institution in 1863. And, in fact, as we will see later in this thesis, MIT’s intentional ties to industry and commercialization would prove to be an anomaly for the times.

The first university patent procedures and policies were set by Columbia University and Lehigh University, respectively, in 1924\textsuperscript{30}. However, it was the Wisconsin Alumni Research Foundation ("WARF") that became the "progenitor of university technology transfer."\textsuperscript{31} WARF was formed around the idea of commercializing a cure for rickets. Professor Harry G. Steenbock made the discovery that, through ultraviolet radiation, Vitamin D could be produced in milk.\textsuperscript{32} Through genuine biomedical need, and despite having significant governmental legislation to clear the path, WARF was quite successful in biomedical innovation. In fact, WARF has gone on to create 8 well-noted and clearly documented commercial biomedical inventions since the famed 1925 breakthrough by Steenbock:

\textsuperscript{29} Dueker, P. 456.
\textsuperscript{32} Dueker P. 456.
1925  Steenbock Vitamin-D Milk Irradiation  
1932  Hart Copper-Iron Complex  
1947  Link Blood Anticoagulants (Dicumarol & Warfarin)  
1953  Wurster Pharmaceutical Coating Process  
1962  Knight Fungicide  
1971  DeLuca Vitamin-D Discoveries  
1977  Mistretta Digital Subtraction Angiography  
1982  Moran MRI Imaging techniques  
1991  Swerdloff/Mackie/Holmes Tomotherapy  
  * Source: Dueker, p. 456

In general, and long since the initial success of WARF, universities have established a formal technology transfer organization. Although many credit Vannevar Bush of MIT for actually formalizing the concept of university technology transfer in a report entitled “Science—the Endless Frontier” that he wrote for the President in 1945, it should be seen that the true formalization of technology transfer (as it pertains to startups and university-born ventures) has arrived in the form of a specific academic administrative body. For the purposes of this paper, we will refer to such a group as the Technology Licensing Office (“TLO”). Other nomenclature exists to describe this type of organizational body, such as Office of Technology Transfer (“OTT”) or Office of Technology Licensing, (OTL) however, for the purposes of this paper we will work with the former, the “TLO”.

In most cases, the TLO at a university was created in the wake of Bayh-Dole. Prior to this, formalized commercial technology diffusion processes, at best, were somewhat anomalous in academia. However, in some instances, where the legacy and history of a university is one in which a portion of its startup or growth costs were funded by an early American entrepreneur, such as at MIT or at Harvard, an element of university-industry relations did exist and helped
drive a connection of some type. Perhaps not downright symbiotic, and in a way more in-direct than direct, these relations did end up laying the foundation for what is now a formalized and growing element of research-oriented institutions. In order to examine the performance and impact of the university TLO, it is important to track the evolution and growth of this type of organization. Well over 200 universities now have a formalized technology transfer program\textsuperscript{33} to coordinate the multiple licensing arrangements that occur within a given school. But, as previously noted, this formalized process was not always in place, and, in most cases, only existed when a direct industry tie permeated the environment at the school’s infancy and more formative stages.

\textit{What the TLO Does}

At each university, the TLO actually differs both in makeup and process. However, with most TLO’s formed post Bayh-Dole and, in clear anticipation of solidifying a revenue and exposure mechanism, universities seem to be moving towards a “best practices” methodology. This is seen in such instances as simply the forming of the AUTM or the actual creation of training institutes and seminars. To understand the true nature of what each TLO does would be difficult to track in just one research paper (a recent AUTM survey claims that there are more than 200 universities “actively engaged” in technology transfer). In order to put a meta-context around the TLO’s role in this overall process, we will borrow Michael Allan’s definition of university technology transfer, where this is “mainly a system of disclosure, patenting, licensing and enforcement of patents and license.” In addition, based upon Allan’s findings in a recent article entitled “A Review of Best Practices in University Technology Transfer Offices”, it appears that the only reliance on external forces in this process is in regard to patent law

\textsuperscript{33} Association of University Technology Manager’s Web Site, \textit{Surveys-Bayh-Dole Act} (posted online November, 13, 2000)
expertise. Hence, at a very baseline, a TLO is "in the business" of establishing a system as defined by Allan, as well as enforcing and maintaining this system. Each university most likely differs in their approach to running a formal TLO, but each comes from a similar set of end-goals and overall philosophies. In working with, and understanding what compels TLO officers, an early stage investor should start by understanding their prime motivations. At MIT, the mission of the TLO is stated:

"The M.I.T. Technology Licensing Office is to benefit the public by moving results of M.I.T. research into societal use via technology licensing, through a process which is consistent with academic principles, demonstrates a concern for the welfare of students and faculty, and conforms to the highest ethical standards.

This process will benefit the public by creating new products and promoting economic development.

It will help M.I.T.:

- show tangible benefits of taxpayers' support for fundamental research
- attract faculty and students; generate industrial support of research
- generate discretionary income
- generate new job opportunities for graduates

We will continue to be a world class model of excellence in university technology licensing."34

With this formal understanding of the TLO's mission in place, the next area which must be considered in a historical context is the actual reward or compensation system.

**How Are Royalties Administered?**

Typically, each university that patents and licenses research and new technologies must set forth a policy structure that adheres to proper compensatory structures. In designing such a policy, these universities typically face six issues:

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34 MIT Technology Licensing Office Web site
✓ What criteria will be used in the decision to patent,
✓ How licensing royalty will be divided within the university,
✓ Whether the university will accept equity in lieu of royalty fees,
✓ Whether the university will offer exclusive or non-exclusive licenses,
✓ To which kinds of firms the university will license, and
✓ How the university will structure its licensing office

In working through each one of these issues, and designing a policy by which each licensing agent adheres, a TLO should then be able to determine a structure by which royalties from licenses are distributed. The most common of formulas is a one where an equal sharing takes place among the university (33%), the employee inventor (33%) and 33% for the department. Another common structure is also a 50% split between university and inventor. Conflicts do indeed arise in addressing these administrative decisions. For instance, and as demonstrated by Hsu and Bernstein in a latter part of this thesis, the decision of what to patent can bring about a variety of debates (including whether the TLO should be making this decision). Additionally, if a university decides to take equity in lieu of fees, how much of an interest should the TLO seek in return for the licensing fee? Pursuing a significant stake may bring about a number of responsibilities that are not palatable to university administration (including the opportunity costs associated with startup governance and investment management). Finally, should a particular TLO have success in managing an equity portfolio it may bring about compensatory issues that are not directly in line with traditional university pay structures.

35 Stanley, p. 17
37 Castillo, Federico, Douglas Parker and David Zilberman, "Offices of technology transfer and privatization of university discoveries." Department of Agricultural and Resource Economics, University of California, Berkeley. (2000)
Since Bayh-Dole and the “Prudent Man” rule, a number of technology licensing offices ("TLO") have been created within university walls. In fact, according to a 2000 survey by the Association of University Technology Managers, there are more than 200 universities engaged in technology transfer, “eight times more than in 1980.” By establishing a formal technology transfer process, the University system has been able to directly affect the private sector through an ever-increasing amount of licenses granted to startup and entrepreneurial endeavors. Technology transfer in 1999, “specifically the licensing of innovations by U.S. universities, teaching hospitals, research institutes, and patent management firms” added about $40 billion to the U.S. economy and supported approximately 260,000 jobs (AUTM Survey, 2000).
III. THEORETICAL CONSIDERATIONS

The Bayh-Dole Act

The key underlying principal to the Bayh-Dole Act was that any inventions that were federally funded should be licensed commercially to the private sector for public gain. Although not all academic research has federal backing, this act did serve as a catalyst in the creation of a variety of administrative entities focused on commercialization (Siegel, Waldman, Link, 1999).

In examining the increasing trend in university technology transfers, specifically in terms of “commercial outputs”, Thursby & Thursby explore whether this rise is due to actual “productivity observable inputs” or a change in the “propensity of faculty and administrators to engage in commercializing university research.” In other words, is there a marked difference in the amount of university invention disclosures and patent applications due to an increasing entrepreneurial and commercial vision by academic administrators? The authors analyze technology transfer in a three stage approach. These stages are modeled directly after the typical process that a Technology Licensing Office goes through in attempting to commercialize university research. The first stage is the actual invention or research disclosure. The second stage is the TLO’s filing of an application for a patent. Finally, the third stage is the combined patent application and invention disclosure that the TLO uses to produce license or option agreements. Thursby & Thursby use growth in Total Factor Productivity (TFP) and efficiency as a way in which to measure both invention disclosure and also university licensing.

The study found modest growth in invention disclosures, a much more robust growth in the second stage, patent application filings, and finally, negative growth in TFP for actual executed licenses. The conclusions that are reached by Thursby & Thursby regarding this data
suggest that faculty are not skewing research towards more industry-specific areas in a sole effort to commercialize this research. This has been a significant debate since the passing of the Bayh-Dole act and this research helps to resolve some of that debate. The findings of the second and third stage, however, are of greater importance to this research paper.

The second stage of the analysis shows that university administrators are digging deeper into completed research in order to file more patent applications. However, this aggressive move towards commercialism may not be paying off. In the third stage of the Thursby analysis, there is a negative TFP trend in actual license execution. From this data it can be inferred that as universities continue to increase their patent applications (as seen in stage two of the Thursby model); the quality of these applications does not necessarily increase.

In combining the Thursby model along with the notion that investors are many times lured by brand and “halo” of an institution, significant due diligence in regard to possible licensing arrangements should occur. Many times the actual technology or research may not be optimal to commercialization although it may appear to be attractive based upon the brand equity of the university from whence it came (Shane, forthcoming).

*Venture Capital and University Innovation*

Although much has been written about venture capital, the areas of theoretical consideration that are most appropriate for this paper are specifically in regard to a working definition of venture capital along with the initial effects of the first venture capital fund – American Research and Development.
Etzkowitz points out that due to "legal barriers designed to protect the assets of small investors precluded large financial institutions from investing any of their funds in a new firm based upon a novel concept." Hence, there was an opportunity in which to develop a financial group to leverage unique and novel innovations. In its original form, the venture capital concept included: "a mechanism for amassing capital from a variety of sources through the sale of equity (stock) in the firm; a technical advisory board to provide leads and assess proposals; and a staff with the expertise to offer business advice and take the necessary organizational steps to assist in the formation of a firm."

The existence of the venture capital industry finds its roots and infancy directly tied to academia. In 1946, MIT President Karl Compton and Harvard Business School Professor Georges F. Doriot, along with a series of local business leaders, formed American Research and Development (ARD). In keeping with Compton's belief that a university should help seed commercial innovation, he recruited a series of investors to initially capitalize ARD with a $3 million fund. A purchase by the Morgan Guaranty Trust department "helped legitimate American Research and Development to other financial houses and investors in New York". In addition to MIT's involvement in this fund, other firms such as Lehman Brothers and Harriman, Ripley were among ARD's first investors. With this well-credentialed backing and direct connection to MIT and Harvard, a clear mission of leveraging each other's strengths for commercial and financial gain was on display.

ARD, like any venture capital fund today, had a direct set of goals and a series of guidelines for making investments. These included:

- Research and development carried on to date indicate that the enterprise will be commercially practical
• Satisfactory profit potentialities exist
• The competitive position is initially protected through patents of specialized knowledge and techniques.\textsuperscript{38}

Upon completion of an investment in an entrepreneurial endeavor, based upon these principals, American Research and Development expected to reap both rewards from the endeavor as well as eventually work towards self-funding future operations:

\textbf{When we do invest in a growth company, after careful investigation, we usually have representation on the company’s board and arrange for one of our men to spend time counseling the firm’s management. And after a company is on its financial feet, we begin to think of recovering at least part of our investment so these funds can be re-invested in a new growth situation.}\textsuperscript{39}

Although prior to the definitions and characteristics set forth later on by Gompers and Lerner, from its earliest days American Research and Development set the prominent definitions of some of today’s most successful funds.

In an interview with William Congelton, a retired staff member of ARD, Congelton stated that ARD “very aggressively worked with MIT.” To underscore the symbiotic nature of this relationship, a staff member at ARD typically visit an MIT professor (who also happened to be ARD scientific advisors) and, at the time of this visit a conversation would evolve that typically relayed inside knowledge of ongoing research or bright spots in MIT-sponsored innovations. “These gentleman would alert us, tip us off, help us. ‘There is a young graduate student down the hall that is working on something. We think it is interesting; you have to decide if it has commercial possibilities.’”\textsuperscript{40}

\textsuperscript{38} Etzkowitz, p. 93
\textsuperscript{40} Etzkowitz, p. 94
As this relationship gelled, ARD ended up investing in a variety of MIT-related startups. Included in this group of startups was Digital Equipment Corporation (DEC). In fact, almost 50% of the profits from ARD’s initial investments came from the investment in DEC. A $70,000 investment in 1957 grew to a value of $355 Million (Gompers & Lerner).

The influence of ARD is unmatched, but it did not initially yield a rush to the formation of multiple venture funds. It was not until 1958 with the forming of the first venture capital limited partnership by Draper, Gaither and Anderson that another significant event in the world of venture capital took place. The actual flow of venture capital through the first three decades of its formalized existence never really reached more than a few hundred million dollars\(^\text{41}\). However, this ultimately changed with legislation changes in the late 1970’s and early 1980’s.

**Examining the “TLO”**

It has been stated that one of the most significant combinations of events to lead to a major increase in technology transfer from the academic world was both the passing of the Bayh-Dole act in 1980 and the fall of the Berlin Wall in 1989 (Nelson, 1998). The former legitimized commercial university endeavors while the latter signaled to the world that federally-funded defense spending and research would decline. Hence, an overarching expectation that federally funded university research would also decline.

Nelson has authored a number of essays in regard to the importance of intellectual property to American universities. Like many, Nelson has cited the passage and effects of the Bayh-Dole Act as a catalyst to underscoring this importance. In addition, a geo-political causal statement is made in that the fall of the Berlin Wall lead “to an expected decrease in military

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funding of research, and the emphasis on balancing the federal budget – both producing a fear of decline in federal funding of university research.” (Nelson, 1998).

Like Hsu and Bernstein, Nelson presents the notion of exclusivity as an important factor in commercial license execution. “Exclusive licenses are an inducement and reward for a company willing to step forward and take such a risk – knowing that if it succeeds in the development, the exclusive license will protect it from more risk-averse competitors.” Although it has been argued that the prestige of a university and the size of its overall endowment can provide credibility and a “halo” effect in the marketing and subsequent licensing of an invention disclosure (Di Gregorio, Shane, Sine, 2002), Nelson cites the fact that most university licensing offices barely break even. The notion of a university filled with “blockbuster” inventions such as the Cohen-Boyer gene splicing patent from Stanford University or the fax patent owned by Iowa State, is an overall fallacious assumption. In reviewing these two non-mutually exclusive positions, that university prestige can provide unique credibility while a university TLO may not be delivering recurrent “blockbuster” technology transfers, it is imperative that seed stage investors do not get caught up in institutional brand in lieu of commercial applicability.

Hsu and Bernstein argue that TLO’s need to improve their technology screening abilities and processes in order to favor “good” technologies as well as improve commercial licensing flow (Hsu, Bernstein, 1997). For the purposes of this research effort, the combination of TLO screening recommendations made by Hsu and Bernstein, as well as the identified characteristics of successful commercial technology transfers, will prove to be quite valuable.

In determining a licensing officer’s overall commitment to proposed inventions and new technologies, there are key factors that must be observed. Two that are highlighted within this
work are the “size of the technology” and the “stage of development.” In the first instance, “size” is defined as the “magnitude of advantage over current and other new methods. Size of potential market; cost of time to develop; patentability; and ‘appropriability’ (the ability of a private firm to protect itself profits from an innovation)”. The authors characterize the relevant sizes as:

- **Large:** Major innovations, for obvious (“blockbusters”) or less foreseeable (“disruptive” technologies) markets.
- **Medium:** Innovations significant enough to support a start-up company or a new line of products for an existing company.
- **Small:** Innovations probably too small to support a start-up, but adequate for a product in an existing firm.
- **Embryonic/Uncertain:** Innovations with potential commercial feasibility, but with concepts as yet unproven.
- **Unworthy:** Innovations with little or no commercial potential.

Beyond the “size” of technology, the next key factor is the actual “stage” of development of the technology. Specifically, how far down is it on the commercialization path? This reflects heavily on Roberts’ commentary on the value of “productized” research, as previously mentioned.

In reviewing just these two elements of the proposed Bernstein & Hsu framework, it can be seen that there are common elements that can be used to identify “good” disclosures. Additionally, the research demonstrates the common characteristics of successful commercial licenses.

The authors find that “Individuals who took the initiative to organize a business around a technology were overwhelmingly the single most important factor for technologies successfully licensed to start-up firms.” This is closely followed by the actual “value of technologies”
(defined by “size” and “stage”). The third important point that the authors show through their research is that “Equity and Financing Issues” were an imperative determinant of a successfully executed commercial license. The amount of equity or compensation required by a university could have an adverse effect on the outcome of a successful technology transfer. Other important factors that Bernstein and Hsu uncover include: a) license exclusivity, b) the established geographical “startup” network and c) the defensibility or “patent protection” for the licensed invention. In considering potential recommendations for both TLO’s and venture capital investors, this work offers substantial pathways in which to build upon their suggested framework.

**Social Networks and Idea Carriers**

Finally, as entrepreneurship now coexists with, and in some cases, neatly aligns with, university research, an interesting set of social assets arise. At universities such as the Massachusetts Institute of Technology (“MIT”), a network of “idea carriers” – administrators, professors and influencers moving from academia to the private sector – drive a wide variety of key formal and informal social networks by which research and information are conveyed\(^{42}\). In conditions of uncertainty, such as in the very formative stages of technology transfer, a potential series of dependencies exists on four areas of social capital: information transfer via social networks, third-party referrals, reputation and direct ties\(^{43}\). The influence of these four areas is an important consideration in the technology transfer process. Key actors that possess a high degree of social capital can significantly affect the actual transition of university research to commercialized product. In fact, according to Allan, “research has found that entrepreneurs with

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high social capital are more likely to receive funding from venture capitalists. They also have more access to information than entrepreneurs with lower social capital.\textsuperscript{44}

It is the combination of these informal social networks and Idea Carriers, along with the historical changes in pension funding and government legislation that shine through in the licensing and interview data that is presented in the next section of this paper.

\textsuperscript{44} Allen, Kathleen. "Moving Toward a New Kind of University for Entrepreneurs." University of Southern California, forthcoming paper (2002).
IV. METHODOLOGY

In order to understand if a formal channel exists, or should exist, to foster the university-early stage VC relationship, especially at MIT, I will use the following types of data:

I. Personal interviews with 10 early stage venture capitalists. These interviews took place throughout the first and second quarters of 2003 in Boston Massachusetts and Palo Alto, California. At the inception of this research, an ideal subject profile was created that contained the following criteria:

- Significant work on early stage financing and deal structures
- Significant work or relationships within a university such as MIT
- At least 2 years of experience as a professional venture capitalist
- A member of a venture capital firm that sought out early stage investments
- A member of a venture capital firm that has had experience with university-born startups

The preponderance of these interviewees hailed from early stage venture capital firms within the Boston, Massachusetts and Cambridge, Massachusetts area. In each case, these particular firms had a direct tie to MIT – either with a faculty advisor on staff, a member of the school’s alumni network or, in one instance, a significant school donor and well-known entrepreneur.

II. Personal interviews with 5 MIT-related individuals. This sample set consists of 2 professors, 2 administrators and one “social influencer” who were referred to me – either by the first group of VC’s or through independent research.

III. An analysis of a set of IT-related and non-life science licenses that the TLO office at MIT executed exclusively between 1997 and 2003.
The purpose in gathering this data is not only to express certain trends or characteristics within the university startup phase, but also to expand upon central themes and ideas that have materialized within each of the personal interviews or in reviewing the set of TLO licensing data. This is by no means a perfect sample, but truly meant to help "narrate" the story behind much of the known and unknown elements regarding the early stage VC and university "dynamic." Further research and data gathering is suggested in a latter section of this thesis.

Finally, as suggested within the summary of qualitative findings section, much of the information available in researching this subject is based upon informalities. Many TLO’s are reticent to espouse the terms of their deal structures, and MIT is no different. Additionally, most venture capitalists do not publish their term sheets or discuss the specific inner workings of their firm. For this reason in particular, I have tried to strike a balance between officially recorded information (in the form of the TLO licenses) and first-hand personal interviews.

Although I was able to coordinate meetings with a strong percentage of financiers that focus on MIT, I was not able to meet with a number of prominent firms due to scheduling and time constraints. It should be noted that most subjects that I spoke with are actively engaged in working with MIT as either a source for new deals or as a way to connect to technical and scientific expertise. However, it should also be said that the level of commitment to this interest varies from firm-to-firm.

For the first sample of interviewees, the following questions were asked to uncover any common characteristics amongst the collective sample or to highlight any anomalies that may exist on an individual or firm level.
Interview Questions – Survey #1 -- Early Stage Venture Capitalist

1. Where are your points of reference or entry on a university campus like MIT?

2. Do you see universities as a strong source of deals or more relevant to the technical due diligence process?

3. How much impact do you think the Technology Licensing Office has on early stage venture capital?

4. Are there any issues or conflicts in regard to university-VC relations?

5. Do you see a real need for, and growth opportunity within, early stage on-campus venture capital funding? Is there a funding gap for pre-revenue, research-oriented startups?

6. Can technology transfer exist without “people transfer”?

7. Can you point to any particular deals where you have seen a successful early stage approach to a university-born technology?

8. How do you think “outsiders” connect to MIT and find out about ongoing research?

9. How do you see yourself or outsiders connecting with a university like MIT

10. Would you like to see a central source or “one-stop” location as a guide/shepherd to early stage funding partners?

11. Any suggestions for people to talk to?
For the second sample of interviewees, the following questions were asked to uncover any common characteristics amongst the collective sample or to highlight any anomalies that may exist on an individual or university level.

**Interview Questions – Survey # 2 – Researcher and Entrepreneur**

1. How many groups were involved in your research?

2. If you are not from the actual research team, how did you hear about/connect with the initial people and intellectual property from MIT?

3. Where are your points of reference on a university campus like MIT?

4. How much impact did the Technology Licensing Office help you in your commercialization/transfer efforts?

5. Any issues or conflicts with university relationships and technology transfer?

6. Do you see a real need and growth opportunity for early stage, on-campus venture capital funding?

7. Can technology transfer exist without “people transfer”?

8. How often did you interact with external members of the business community regarding your research?

9. Did you approach your funding partner or did they approach you?

10. How do you see yourself or outsiders connecting with a university like MIT?

11. Would you like to see a central source or “one-stop” location as a guide/shepherd to early stage funding partners?

12. Any suggestions for people to talk to?
V. FINDINGS – PERSONAL INTERVIEWS AND SECONDARY RESEARCH

From an in-depth analysis of my data, it can be inferred that the following 5 areas emerged as central components to answering the query of whether a formal entry point should exist for early stage venture capitalists within MIT:

1. Cultural legacy at MIT and organizational profile
2. Official on-campus formations
3. The “TLO” myth
4. Unofficial social circles and connections
5. Venture Capital needs

I will present direct findings from each question in two different ways. The first will show the common responses, in percentage form, from each sample set of individuals. The secondary data points will be direct quotes, either attributed or anonymous, from members of the sample. These are provided to add context and, in some cases, further definition for the common answers that are presented in percentage form. Finally, I will compare licensing data with the sample set data.

1. CULTURAL LEGACY

In 1860, William Barton Rogers and other incorporators of MIT, proposed the “Objects and Plan of an Institute of Technology.” However, this proposal was not just one for a traditional academic institute. Rather, the founding belief was that “…the interests of Commerce and the Arts, as well as of General Education, call for the most earnest co-operation of intelligent culture with industrial pursuits.” In keeping with this belief the official seal of the university was ultimately created to contain and feature the Latin motto Mens et Manus ("mind and hand"), along with the two volumes, Science and Art, on the seal’s pedestal to reflect “the ideal of
cooperation between knowledge and practical science.”45 This early relationship between industry and applied science, along with the rigor of academia, has set the tone for MIT’s storied entrepreneurial culture. The unique nature of this relationship, solidified on an “official” level through the school’s seal, as well as codified in it’s very earliest and proposed stages, paved the way for a variety of informal and highly efficient entrepreneurial relationships. It is this rooted tie to industry, along with the philosophies associated with being a Land Grant Institution, which has fostered the cultural beliefs, informal relations and overall university “brand” of MIT.

In analyzing the personal interviews of each early stage venture capitalist included in this thesis, it is apparent that the culture of MIT has attracted the attention of financiers just as much as its scientific and academic reputation.

Organizational Profile

According to Tim Rowe, a partner in Draper Fisher Jurvetson’s New England fund and the founder of the Cambridge Innovation Center, “there is stuff coming out of the woodwork at all times at MIT.”46 In reviewing the size and shape of MIT, it can be quite daunting to think about how to thoroughly grasp the kinetic scope of activity within each and every lab. To paraphrase Rowe, MIT is a place where innovation is researched and created on an ongoing and frequent basis. However, as the university is segmented into five schools containing 27 academic departments and over 10,000 students (graduate and undergraduate)47 this would lead most to think that having a reliable and efficient entry point within the university would be desirous and attractive to an external investor. This is not the case according to an overwhelming 60% of the VC’s in my sample. In fact, when answering the following question, “Would you like to see a

45 MIT Web Libraries archival Web site, “The MIT Seal” – see “Exhibit 1” for actual seal in Appendices
46 Personal interview
47 Official MIT Registrar numbers for 2002-2003 indicate 4,178 undergraduate students and 6,139 graduate students.
central source or ‘one-stop’ location as a guide/shepherd to early stage funding partners?”, one respondent simply stated: “no – MIT is a large, decentralized place and should not be seen in a unified light. I would hate to think the proprietary relationships that I have built would be diluted due to formality”. This ideology will be captured later in other sections throughout this paper, but it does illustrate that an imbalance exists in regard to MIT’s sprawling and decentralized culture and the desire to form a central, cohesive entry point.

**Faculty Policy**

Of the small sample of MIT educators and administrators or influencers surveyed, 30% referred to formal faculty policies and working environment as a catalyst towards a symbiotic relationship between industry and the university. By asking the question “are there any issues or conflicts with university relationships and technology transfer?” a number of intriguing responses were elicited. However, one particular professor stated: “Note the way that the agreement between professor and university is worded in regard to MIT. In most universities, outside consulting is ‘permitted’ while at MIT outside consulting is ‘expected. This is an imperative difference in the culture here. The belief is that if you teach surgery, you should practice surgery…”

Another component that is interesting in this regard, and will surface when we analyze a select collection of TLO licenses from 1997-2003, is the amount of professors that move on from academia to hold executive roles (while not functioning in an official role at MIT). This is also addressed in our brief review of “Idea Carriers” and social networks at MIT.

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48 Personal interview with MIT Sloan Professor, April 2003.
Student Profile

Of the full survey sample (both groups 1 and 2), 27% actually pointed towards student attitude and culture at MIT as a significant factor in driving campus startup activity. Anthony Ives, a former MIT undergraduate student and currently a manager at the MIT Entrepreneurship Center, stated that “upon entering MIT, one of the first informal conversations that I had with some of my classmates was about what type of company we had all expected to start.”\textsuperscript{49}

Professor James Utterback of the Sloan School of Management at MIT commented that, outside of the business school, “every student at MIT has to get involved with research and a funded project.” Accordingly, Utterback believes, students learn about sourcing projects, raising money and working within a setting similar to that of an entrepreneur.

Another engaging aspect of student life at MIT is the amount of discourse on the past successes of student entrepreneurs. In speaking with both internal and external sources from the combined sample set of VC’s and administrators, a few company case studies emerged. Although these companies will not be traced within the body of this research, names of MIT spinoffs such as Akamai, Ember, Lotus and 3Com were mentioned. In most cases these startups were recalled from two standpoints: the students who spearheaded them and the traction and financial success they have since gained in the marketplace. It appears that this socially-oriented positive feedback loop continues to permeate the culture and student mindset at MIT.

2. OFFICIAL ON-CAMPUS FORMATIONS

100% of the first sample group identified at least one formal, on-campus entity that was a potential “connector” for them regarding new research, startup activity or campus influencers.

\textsuperscript{49} Personal interview, April 2003
This was queued up through questions #1 on survey #1 — "Where Are Your Points of Reference on a University Campus like MIT?" In almost 80% of the cases, the TLO was mentioned. Although, as we will see in a related section of this paper, the TLO is not necessarily seen as a strong point of entry for most of the VC’s within this sample. After the TLO, and a surprising discovery (as it is a new entity on-campus), came the Deshpande Center. Officially formed in January of 2002, the “Center’s mission is to improve the innovation process and ensure that good ideas become a reality, by:

- Promoting the earliest stages of technology development with flexible funding.
- Connecting MIT’s inventors with investors and the business community (particularly in New England) via symposia, education and other efforts.
- Tying MIT’s technological research into market needs.  

60% of the first sample referred to the Deshpande Center as a potential source for deals, while 80% of the second sample weighed in with at least a reference to this organization. One early stage VC suggested that “the Deshpande Center has an opportunity to be a unique central source for innovation occurring at MIT. If the Center can establish the right processes and metrics in determining their own success, there is a chance that this organization could be the prime liaison between the private equity world and MIT.”

Indeed, the Center is seeking to formalize partnerships within the venture community and presents this concept on their Web site:

The Deshpande Center maintains close contact with venture capitalists and angel investors interested in early-stage technology. We encourage them to provide feedback and play an advisory role, in return for being invited to Deshpande Center events and being kept abreast of projects at the Center.

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50 Deshpande Center Web site, http://web.mit.edu/deshpandecenter/
51 Personal Interview with Jeff Fagnan, Seed Capital Partners, April 2003
Additionally, the Center seems to be focused on forming strong strategic ties with other on-campus organizations that have a direct interest in university technology transfer and spinouts. I did find it curious, however, that the Deshpande Center has only been in formal existence for less than a year, yet a majority of the first sample see it as such a strong entry point.

The third most common group mentioned as a key reference point, or what might be deemed an entry point at MIT, is the Venture Mentoring Service (VMS) in the Office of the Provost. 40% of the first sample group mentioned this group, with one VC in particular placing an enthusiastic endorsement – “the Venture Mentoring Service seems to have a good handle on the maturation process of promising early stage MIT-related commercial endeavors.”

This group is available for MIT students who are seeking seasoned help and guidance when porting an idea from the University to a funded entity.

Where the two samples departed similarities was in regard to the alumni network of MIT. Although each touched upon this area, either in a direct or indirect fashion, it was the first sample group of VC’s that placed more weight in this area. 30% of this group spoke of sourcing actual deals from the university through alumni ties. HubAngels, a group of MIT alumni who have brought together a small fund to invest in early stage ventures, rely heavily on this particular channel: “From the get-go, we have sourced deals from our network of MIT alums. As we are composed of a group of MIT alumni this makes a great deal of sense.” Interestingly enough, when queried about “formal” entry points, both sample groups considered the alumni network “formal” when it actually appears that this type of channel has a looser set of boundaries.

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52 Personal Interview, Charlie Cameron, HubAngels, an angel group. April 2003.
53 Cameron interview
than actual formalities. However, for the purposes of this paper, we will consider this area as a formal organization based upon sample responses.

Beyond the four formal entry points mentioned, the following tables show additional areas of consideration:

**Group #1 – Venture Capitalist**

<table>
<thead>
<tr>
<th>MIT FORMAL ENTRY POINT</th>
<th>PERCENTAGE OF SAMPLE</th>
</tr>
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<tbody>
<tr>
<td>Alumni Network</td>
<td>3 out of 10 mentioned this or 30%</td>
</tr>
<tr>
<td>The Deshpande Center</td>
<td>6 out of 10 mentioned this or 60%</td>
</tr>
<tr>
<td>Entrepreneurship Center</td>
<td>2 out of 10 mentioned this or 20%</td>
</tr>
<tr>
<td>The MIT “50K” Business Plan Competition</td>
<td>2 out of 10 mentioned this or 20%</td>
</tr>
<tr>
<td>The Technology Licensing Office (TLO)</td>
<td>8 out of 10 mentioned this or 80%</td>
</tr>
<tr>
<td>The Industrial Liaison Program</td>
<td>2 out of 10 mentioned this or 20%</td>
</tr>
</tbody>
</table>

**GROUP #2 – MIT Faculty & Administrators**

<table>
<thead>
<tr>
<th>MIT FORMAL ENTRY POINT</th>
<th>PERCENTAGE OF SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alumni Network</td>
<td>1 out of 5 mentioned this or 20%</td>
</tr>
<tr>
<td>The Deshpande Center</td>
<td>4 out of 5 mentioned this or 80%</td>
</tr>
<tr>
<td>Entrepreneurship Center</td>
<td>1 out of 5 mentioned this or 20%</td>
</tr>
<tr>
<td>The MIT “50K” Business Plan Competition</td>
<td>0 out of 5 mentioned this or 0%</td>
</tr>
<tr>
<td>The Technology Licensing Office (TLO)</td>
<td>4 out of 5 mentioned this or 80%</td>
</tr>
<tr>
<td>The Industrial Liaison Program</td>
<td>1 out of 5 mentioned this or 20%</td>
</tr>
</tbody>
</table>

To sum up the notion of a formal entry point, one professor from Sloan stated, “The formal is the product of the informal and not the other way around when it comes to MIT.” It appears that it is the blending of the two that spawns multiple entry points within MIT.
3. THE TLO MYTH

Upon initiating this research, I originally had focused quite a bit of time in reviewing the Technology Licensing Office at MIT. In fact, a great deal of university TLO’s claim that they interface on a regular basis with early stage venture capitalists. My assumption had been that perhaps the TLO was the proper formal entry point for any cast member in early stage private equity to uncover the “best-of-breed” in MIT research and innovation. This assumption was based on the idea that MIT has a well-established technology transfer process in place and that the TLO, by definition, must be exposed to most of the best research. In fact, it made sense that most VC’s mentioned the TLO early on in our conversations. Additionally, in reviewing Hsu and Bernstein’s theoretical arguments around the “weighting” of discoveries, it appeared that the TLO has a chance to be the formal entry point for private equity. However, in general, there appears to be a misconception of the stage that venture capitalists actually work with the TLO. Although, 80% of the sample identified the TLO as a formal entry point, it was clear that most did not believe it to be a source for early stage deal flow or social connectivity. In the case of three VC’s, each claimed to spend time “once a year” working with the Director of the TLO, Lita Nelson. However, in each case, not one could identify a funded deal that directly resulted from an initial dialogue with the TLO. This does, in fact, correspond with Lita Nelson’s stance on early stage investors working with the TLO, but also reflects that the TLO may be more of an administrative group that handles the “check-out” procedure of licensing vs. the “check-in” procedure of locating a an early licensing source within the venture community:

Nelson said the types of professionals who contact the office are sometimes VC’s, but only a fraction of the VC community. Investors who should contact the
technology transfer office are people who are willing to get in before A round financing.\textsuperscript{54}

A variety of sources were recommended to me in pursuing interviews with each sample group as well as exploring the TLO’s relationship to early stage venturing. Of the first group, one recommendation that came forward was to explore a company called AmberWave Systems. This is an electronic materials spin-out from MIT. In this particular example, Bill Frezza, a venture capitalist with Adams Capital Management in Boston, had been seeking out a particular type of technology to invest in:

We had been searching for investment opportunities generated by the expected end of the “silicon roadmap” and came across Eugene Fitzgerald, an MIT professor who had spent the prior 15 years investigating enhanced electron mobility in strained silicon. We were attracted by the extent to which this new material technology could leverage the billions of dollars of prior investment complementary metal oxide semiconductor (CMOS) design and manufacturing facilities, as well as the strong patent position Fitzgerald had established. Starting with a modest $600,000 seed investment, we helped Fitzgerald and his lead graduate student, Mayank Balsara, structure the business, working with MIT’s technology licensing office to obtain an exclusive license on the core patents. That done, we helped recruit an experienced CEO, coached the team through the writing of the business plan, and led the first institutional funding round of $20 Million.\textsuperscript{55}

What is intriguing to note here is how Frezza references the TLO – it is only in regard to obtaining an exclusive license rather than being the actual source of the research and social connection. Although this is only one example of the TLO’s role in the formation of an MIT-spinout, a similar belief is voiced by one General Partner at an early stage fund that has specific

\textsuperscript{54} Sandra Helsel, “From Lab to Fab: The Ins and Outs of Technology Transfer”, The Nano Circuit, NanoElectronicsPlanet.com, September 27, 2002.
ties to MIT: "The TLO does not intersect well with our process of scoping out commercial technologics. Its main role in the process occurs once the actual commercialization process has been initiated by other forces. The TLO dialogue does not happen at the beginning, it always happens at the end."56

Another valid reason for overlooking the TLO as a source for early stage deals and innovations, is that certain portfolios have areas of focus that are not nearly as connected to the technology transfer process. One example of this is in regard to software, which is not usually empowered with rigorous intellectual property laws and barriers, and, therefore, a license from the TLO tends not to be worth a great deal in this regard. Hence, a venture firm spending time on MIT’s campus may find it more productive to work with the Laboratory for Computer Science ("LCS") as opposed to the TLO.

Finally, by Director Lita Nelson’s own admission, the TLO really is not a great place for all early stage VC’s to seek investments: "I’m talking about very, very early stage investors," Nelson said. "Only a small fraction of venture capitalists can take the lead in pre-A round. This is when a technology is little more of a gleam in the professor’s eye and the graduate student interested in working with the idea."57

4. UNOFFICIAL SOCIAL CIRCLES AND CONNECTIONS

The following questions helped uncover a variety of informal entry points into MIT:

- "Where are your points of reference on a university campus like MIT?"
- "Do you see universities as a strong source of deal “flow” or more relevant to the due diligence process?"

56 Unnamed VC, interview, March 26th, 2003 via phone
57 Helsel, NanoEletronicsPlanet.com
"How much impact do you think the Technology Licensing Office has on early stage venture capital?"

By far, the most prominent informal channel mentioned by each sample group has to do with proprietary relationships and referrals. 80% of the first sample referenced institutional professors as a source of deals and referrals, while 60% of this sample named specific professors by name. Two professorial names that surfaced at least 3 times within each sample was Professor Robert Langer (holder of over 380 patents licenses to 80 companies\textsuperscript{58}) of the Department of Chemical Engineering and Professor John Guttag of the Department of Electrical Engineering and Computer Science (and leader of the Laboratory for Computer Science). One venture capitalist also referenced an unnamed professor who consistently provided recommendations to his fund and, at last count, had passed along "approximately 10 interesting" deals/prospects to the firm. This seems to align well with the earlier days of the first venture capital firm, American Research and Development, where senior advisors to the fund were also professors at MIT.

The third most common source for deals within the first sample set was informal ties with the various research labs. Both the Laboratory for Computer Science along with the Media Lab tended to surface the most. LCS was mentioned by 40% of the venture capitalists in sample group #1, while the Media Lab yielded a 30% mention rate. In a latter section of this thesis I compare the strength of research labs based upon executed TLO licenses.

The fourth variable that proved common in the first sample group was the identification of influencers via question #11 of the first sample "Do you have any suggestions of people I should talk to?" One name in particular that surfaced four times is Kenneth Morse, the Director

\textsuperscript{58} James Camp, "The Tech" from MIT, July 11\textsuperscript{th}, 2001.
of The Entrepreneurship Center at MIT. "If Ken does not have his finger on it, then it probably does not have a real heartbeat" said a member of the first sample. This element of individual influence tends to exist in a number of circles at MIT. Although a direct link cannot be shown in this paper other than through conjecture, it does appear than certain individual “influencers” are seen as a source of information and potential commercial vehicles within MIT. One well known influencer at MIT is Joost Bonsen, a graduate student at the Sloan School of Management, and an undergraduate of MIT. Bonsen hosts a variety of informal gatherings to connect people both internal and external to MIT. According to Bonsen, at MIT “informal, personal connections are hugely important in getting things done. Such has always been true, but what's curious is how much it persists even with the "professionalization" of the formal mechanisms”59

Although it appears that a popular route to gain entry into the inner circles of MIT research is through an official member of the community, clearly either a Professor or Senior Administrator, this is not necessarily a scalable methodology or a long-term one. At least 2 venture capitalists both stated that professors who understood the technology and science of an innovation, along with its true commercial potential, are extremely “rare.” Åsa Aulin Ahlberg of IDG Ventures, and Peter Rothstein of Allegro ventures concur with this sentiment. According to Ahlberg, “We wish there were 100 Bob Langers at MIT, but there simply is not.” As Ahlberg spends at least two hours a week identifying influential individuals at MIT and finding potential "advocates, “along with “doing the work, spending the time and forming the relationships” it appears that firms cannot be reliant upon one or two unique individuals. Likewise, Rothstein echos this sentiment by stating how “important” it is to have relationships with leading professors and “star scientists” but how very rare these individuals are. Hence, Ahlberg believes

59 Personal e-mail interview between the author and Mr. Bonsen, April 26th, 2003
that constantly paying attention to new research movements (such as the recent creation of MIT’s Computational and Systems Biology Initiative – “CSBi”) and “walking the halls” is imperative to success in tracking MIT innovations and offsetting the lack of multiple “star scientists” for each discipline.

Another interesting element of the professorial relationships is in the way that venture firms harness and develop these unique relations. Jeff Fagnan at Seed Capital Partners in Cambridge, MA spoke of how his firm holds regular unpaid “white board” sessions with members of the Media Lab as well as other departments at MIT. These sessions are meant to try and grasp an understanding of where specific “pockets” of research are focused and just what types of commercial markets these areas could address. However, according to Fagnan, informality does not necessarily bring about the best results. He hypothetically poses the story of how technologists can connect with the wrong type of funding partners or executives and waste years of intensive research and know-how on a misaligned commercial endeavor. Also, just assuming you can penetrate MIT on an informal level simply by walking the halls and seeking to gain relations is a fallacy. According to Tim Rowe, and as exhibited as early as the formation of American Research and Development, “foreign bodies will be dispelled fairly quickly if they cannot blend well within the environment.” Hence, while it may appear that an informal path is one of the most productive, it is also one that should be carefully tuned.

Other informal entry points that were mentioned within each sample set are as follows:
Group #1 – Venture Capitalists

<table>
<thead>
<tr>
<th>INFORMAL ENTRY POINT</th>
<th>PERCENTAGE OF SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Relations</td>
<td>8 out of 10 mentioned this or 80%</td>
</tr>
<tr>
<td>Research Lab Relations</td>
<td>6 out of 10 mentioned this or 60%</td>
</tr>
<tr>
<td>Idea Carriers or Influencers</td>
<td>4 out of 10 mentioned this or 40%</td>
</tr>
<tr>
<td>Scientific Advisory Roles</td>
<td>2 out of 10 mentioned this or 20%</td>
</tr>
<tr>
<td>“Walking the Halls”</td>
<td>1 out of 10 mentioned this or 10%</td>
</tr>
</tbody>
</table>

GROUP #2 – MIT Faculty & Administrators

<table>
<thead>
<tr>
<th>MIT FORMAL ENTRY POINT</th>
<th>PERCENTAGE OF SAMPLE</th>
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<tr>
<td>Idea Carriers or Influencers</td>
<td>4 out of 5 mentioned this or 80%</td>
</tr>
<tr>
<td>Research Labs</td>
<td>1 out of 5 mentioned this or 20%</td>
</tr>
<tr>
<td>Advisory Roles</td>
<td></td>
</tr>
<tr>
<td>“Walking the Halls”</td>
<td>0 out of 5 mentioned this or 0%</td>
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</tbody>
</table>

5. VENTURE CAPITAL NEEDS

Understanding the true nature of what early stage funding means is important when reviewing the various data points within this paper. In many cases, the word “seed” can mean as little as $50,000 and as much as $750,000 or more. VC’s tend to have a focused agenda when it comes to an investment profile. Hence, it is important on a much broader level to also understand the desires of specific VC’s. This can help to understand if a formal entry point really should exist within the walls of MIT.

First and foremost, an early stage investor “should be prepared to stay alive through three rounds of funding in today’s market” according to Tim Rowe of DFJ New England. “A funding gap for seed investments at the university level may exist but not because funds are not interested. In today’s economic world, the seed investor gets crammed down. Seed companies
take 3-4 years to get to revenue, so seed tends to get squashed” adds Rowe. Ted Dintersmith of Charles River Ventures echoes this sentiment: “Seed investors always get crammed down first” In order for a venture capitalist to reap the benefits of seed stage investing, they need to make sure they can preserve their equity investments (or a portion thereof) throughout the entire private equity funding cycle. This can be accomplished in one of two ways, either by having a deep-pocketed Limited Partner or a strategic investment with a broader fund. In exploring MIT, it seems that Polaris along with a couple of other early stage venture funds have aligned with small venture development groups, such as Ignition Ventures or PureTech Ventures, to scout out MIT-related investments. In the case of Ignition, they were instrumental in bringing a well-known wireless company out of the Media Lab, Ember, and transforming it into a venture-funded and promising commercial venture. Second, having a formal entry point may not be a desirable thing in the eyes of many VC’s. “I have proprietary relationships. They help me look at proprietary deal flow” comments Åsa Aulin Ahlberg of IDG Ventures. Should a one-stop entry point exist, this may not be desirous to the VC world. In fact, the very nature of venture capital revolves around access and relationships. Should a formal entry point or central source exist, VC’s may all see the same type of research and innovation and will also be at the mercy of that central source to be in constant touch with each lab, individual scientist and innovator.

VI. LICENSE FINDINGS

Reviewing the licensing data in contrast to the personal interviews shows some interesting similarities. I reviewed 46 licensing arrangements from the MIT Technology Licensing Office (see Exhibit for full list of licenses and accrued data). Of the 46, I have gone on to analyze a subset of 33 to look for common funding partners. I then looked to see if there was any instance

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60 Panel discussion, The Nantucket Conference, May 2003
of multiple investments by specific firms. In addition, I have also traced 24 licenses directly to their original research laboratory\textsuperscript{61}. In reviewing each of these sets of data, along with the set of interview data previously discussed, potential conclusions can be drawn. However, prior to the conclusions, it is important to look at the actual findings.

\textbf{# 1 - Laboratory Spin-offs}

<table>
<thead>
<tr>
<th>MIT RESEARCH LAB OR DEPARTMENT</th>
<th># OF UNIQUE LICENSES EXECUTED 1997-2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media Lab</td>
<td>8</td>
</tr>
<tr>
<td>EE/CS</td>
<td>4</td>
</tr>
<tr>
<td>Brain and Cognitive Sciences</td>
<td>3</td>
</tr>
<tr>
<td>Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>Lab for Computer Science</td>
<td>2</td>
</tr>
<tr>
<td>Material Sciences</td>
<td>2</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>2</td>
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</tbody>
</table>

It is apparent from the specific licenses analyzed, that the Media Laboratory holds the top spot in terms of unique number of licenses executed within this six year time frame. In fact it represents 33.3\% of the tracked licenses. This corresponds rather well to the sample set of interviews in group \#1 that showed a 30\% reference to the Media Lab. Additionally, the Department of Electrical Engineering and Computer Science (EE/CS) showed a 16.6\% representation of executed licenses. And, in keeping with the comments made by one member of the first sample group, the Laboratory for Computer Science (LCS) ends up tied in distant 4\textsuperscript{th} place with only an 8.3\% representation. Meanwhile, LCS was mentioned as a potential source of “deal flow” by early stage VC’s in 40\% of those interviewed. It can be inferred both from the interview comments regarding LCS, along with the licensing data, that the TLO does not have nearly as much influence with this particular type of research at MIT. Yet LCS is responsible for

\textsuperscript{61} After reviewing the 46 licenses, I am only documenting labs or departments that have more than 1 license executed in this time frame (1997-2003)
such “spin-off” companies as Aladdin Systems, 3Com, Akamai, Infocom, Lotus and RSA Data Security.

Another interesting similarity that appears in both the interview sample and the licensing data is the prominence of EE/CS. As mentioned previously, one faculty member that was referred to by 30% of the initial sample is Professor John Guttag of EE/CS. In fact, he is listed as a co-founder of Vanu, Inc. one of the licenses that I investigated. Guttag is not only a professor in the Department of EE/CS, but is also the head of the Laboratory for Computer Science.

Hence, we now see three specific examples of how each set of data points toward some common characteristics.

1) A small set of labs and departments at MIT represent the bulk of non-life science, commercially-oriented technology transfer activities.

2) Within this small set of labs, such as the Media Lab, EE/CS or the Department of Brain and Cognitive Sciences, there are significant social influencers and “connectors” such as John Guttag.

3) When a department that is not in need of intellectual property resources from the TLO, the TLO may not be the best source for understanding the breadth and depth of research at that particular lab. This is exemplified with the Laboratory for Computer Science.

Comparable trends also exist within the findings related to the funding of these licenses. Although a good portion of funding data has been kept confidential, or in many cases, the company is self-funded at the time of the executed license, I was able to track 11 significant funding examples from the original sample of 46.

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\[62\] MIT’s Laboratory for Computer Science’s Web site, “Spinoffs”
The most compelling data point is the fact that Atlas Ventures has invested in 3 of these 11 deals. In reviewing the background of this firm, there are direct ties to MIT. Laura Barker Morse, Atlas’ Human Capital Principal, is also the wife of Kenneth Morse of the MIT Entrepreneurship Center – previously mentioned in this research paper. In addition, Atlas has a number of MIT Alumni employed as Associates, Principals and General Partners at the firm.

Second to Atlas in venture activity (where the sample n=11) at MIT is Adams Capital Management. In exploring this group, I found that Bill Frezza leads their Boston office and holds 3 MIT degrees. Hence, he is someone who is quite familiar with the MIT campus, departments and faculty. As previously mentioned, he is familiar with working at a pre-A round stage of funding when it comes to MIT research and innovations.

Ignition Ventures, the third most active funding source, is run by Amy Salzhauer, a Sloan School graduate. In addition to being a member of the alumni network, Salzhauer’s firm has been located at the Cambridge Innovations Center just 50 yards away from the MIT campus. Although numerous works have been done to look at geographical economic spillovers from university research, Ignition appears to be focused specifically on MIT by setting up shop so close to the actual campus.

Another interesting element that surfaced within this analysis was the amount of self-funded companies that emerge from MIT. Out of the 46 licenses that I looked at, I was only able to trace specific funding lineage to 11. Many times this was due to the fact that the company was not willing to reveal its investors, had individual investors that were not publicly mentioned or generated enough money to startup without raising capital. It’s the latter element, along with the
notion that a professor or researcher may be able to cover the initial startup costs, that raise two interesting possibilities:

1. A number of companies leaving MIT do not have enough validation for a venture capitalist to invest, or;

2. VC’s do not position the actual value that their money, resources and services will bring to a university startup (and hence, alternative funding methods are sought out).

# 2 - FINANCING RESULTS

<table>
<thead>
<tr>
<th>VENTURE CAPITAL OR FUNDING SOURCE</th>
<th># OF UNIQUE DEALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlas Ventures</td>
<td>3</td>
</tr>
<tr>
<td>Adams Capital Management</td>
<td>2</td>
</tr>
<tr>
<td>Applied Technology Ventures</td>
<td>2</td>
</tr>
<tr>
<td>Ignition Ventures</td>
<td>2</td>
</tr>
<tr>
<td>MTDC</td>
<td>2</td>
</tr>
</tbody>
</table>

VII RECOMMENDATIONS AND CONCLUSION

Although informality tends to drive a high degree of the ties to innovation and venture capital, it was indeed formal legislation that helped shape this environment. The passage of early legislation such as the Morrill Act to establish Land Grant colleges and universities or the alignment of the Bayh-Dole Act and The Prudent Man Rule, all helped to pave the way for a strong entrepreneurial culture where opportunity thrives. As shown, MIT is a large entity with quite a bit of activity dedicated to applied science and industrial context.

In this paper I asked the question of whether a formal entry point exists within MIT, or, for that matter, should exist when seeking the “best-of-breed” in university innovations. It was
originally my intention to prove that this was possible and it should exist. What I have found, however, is that informality rules at MIT and that the combination of formal organizations along with proprietary relationships is really how early stage MIT research transitions from an academic setting into a venture-backed company.

Although this may appear to be an obvious statement, in reviewing both the data as well as successful funding initiatives and tracing the roots of several companies, one can start to see some significant patterns. In discussing my research with many prominent venture capitalists, it became apparent that a series of recommendations might help this group when thinking about an entity as large and as decentralized as MIT. To this end, I will conclude with eight recommendations in regard to the investigation of MIT research.

1. **Informality May Rule, But It is Not Always The Best Path.** Like any organization that presents multiple, attractive business opportunities, MIT is also a place where informality can breed inconsistent pairings. As pointed out by Jeff Fagnan of Seed Capital Partners, a promising technology can hit a wall if the wrong funding partners or mentoring occurs. In his hypothetical case (which likely masked a true situation), Fagnan points out that informality plays a key role in connecting “bad” money with naive business partners.

2. **Spend “Other People’s Money”**. One potential way to source “stronger” deals that are based on research and lead scientists or researchers, is to track funded research. That is, how much money has been spent in bringing the research to prototype or an applied scenario?

3. **“Map” The Organization.** Borrowing a page from sales and marketing theory, one way of understanding the inner-workings of research at MIT is to create an organizational map of the campus. By outlining the departments, research, key “influencers” along with each of their success rates in spinning out commercial entities, certain visual patterns will
emerge. One VC offered the idea that a constant updating of such a map would show the changing levels of “heat” associated with each laboratory, department and relevant campus organization. It would also then point out who the strongest social influencers are.

4. **“Dedicate A Body”** – It appears that in order to truly harness MIT’s dearth of research and commercial potential, a venture firm should have one individual that can focus on mapping the organization, building relationships and doing more than just “subscribing to the right e-mail list.” In much the same way that a large-account salesperson focuses on a specific target company, so should the early stage VC focus on an entire campus and body of research labs.

5. **Align With “Deep-Pockets”** – As the marketplace continues to drive down early/seed stage valuations, angels and pre-A round funding partners need to make sure that they are in the strategic position to provide follow-on capital and remain “whole” in future rounds of finance. An interesting number of suggestions cropped up in discussing this point with the first sample group in this research paper. The two most prominent options were to either align with a well-funded and “deep pocketed” fund who needs a partner to strategically source less mature deal flow or to make sure to have a well known limited partner willing to help with new capital infusions at the appropriate time.

6. **Track New Initiatives** – Should an early stage fund be unable to dedicate a full-time principal to track MIT via an organizational map and series of relationships, then at the very least, the firm should keep tabs on new organizations and initiatives at the school. One such example is the Deshpande Center.

7. **Circumvent The TLO Until Needed** – It is now readily apparent to me that the TLO plays a valuable function on behalf of MIT. However, this entry point is not a proper starting point when scoping out early stage ventures. In fact, it is much more efficient to

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63 Interview with Asa Ahlberg, IDG Ventures,
source technologies and innovations through informal lab relationships than an administrative body such as this.

8. Position Your “Value Add” Upfront – As discovered through licensing data and personal interviews, not every researcher or professor will welcome a venture capitalist into the fabric of their research or startup company. VC’s need to correctly espouse the benefits of their money, their time and their resources in order to build a reputable brand at MIT.

Overall, I have attempted to explore the implications of discovering the best possible formal entry point at MIT for early stage financiers. While my original hypothesis was that such an entry point did exist (and should exist), I have discovered through a variety of sources that this is not true nor, in many cases, is it desirable. Hopefully this thesis has piqued the interest of the venture community along with the research community at MIT.

VIII. FUTURE RESEARCH

In reviewing multiple references in regard to MIT and university-based technology transfer, it became obvious to me that a number of avenues of focus exist in regard to this area of research. However, I did find that the examination of early stage venture capital and its relationships with formal and informal university bodies is actually rather sparse. I believe that future research should focus on whether seed-stage investment in university technologies is actually a scalable commercial model or if alternative methodologies to financing university spin-offs should be sought out. In addition, I believe that the suggestion of “heat mapping” MIT would prove to be quite valuable to those internal to MIT to further understand the universities social dynamic and pockets of commercialization. Additionally, this would be a source of useful, pragmatic data to the outside investment community.
Lastly, I would like to recommend that further study of a larger base of executed licenses at MIT (for instance, since the inception of the official TLO at MIT) may yield overall visibility into how many MIT spin-off companies opt-out of working with venture capital partners. This may help further refine some of my recommendations.
EXHIBIT #1 - “Official MIT Seal”
MIT unveils new center supporting technological innovation in New England
$20M gift from Sycamore founder and wife to link venture capital, research and high tech communities

January 3, 2002

CAMBRIDGE, Mass.-The Massachusetts Institute of Technology (MIT) today announced the creation of a new center for technological innovation, established through a generous gift from Jaishree Deshpande and Desh Deshpande, the co-founder and chairman of Sycamore Networks Inc.

Their gift of $20 million will establish the initial phase of the Deshpande Center for Technological Innovation (DCTI), which will be a part of MIT's School of Engineering. The center will be dedicated to supporting leading-edge research on novel technologies in collaboration with the high technology and venture capital communities of New England and will support undergraduate education in engineering practice.

MIT President Charles M. Vest said, "It gives me great pleasure to accept Desh and Jaishree's gift. Desh is an extraordinary leader in the entrepreneurial community. His 'disruptive' idea to connect MIT faculty, students and researchers with the high-tech and venture capitalist communities will give MIT undergraduates practical experience in the engineering field and provide a stimulus for technology innovation in the region, and more broadly, in the nation."

"Our hope in creating this resource is to give creative new entrepreneurs and companies the ability to translate their ideas into innovative companies and products," said Dr. Deshpande. "MIT has always provided a fertile ground where its students and faculty can break through technology barriers, fuel new areas of research and development, and fundamentally transform whole industries. We can think of no better place to begin this work."

The Deshpande Center was created to serve as a catalyst for innovation and entrepreneurship by supporting research and collaboration among entrepreneurs, young companies and MIT students, alumni and faculty.

The idea for the center arose from the realization that the limited research and development funds available to young companies restrict their ability to collaborate with leading universities. The center will provide these companies with the opportunity to collaborate with MIT faculty, staff and students on quality research of academic interest to MIT and of potential commercial interest to the company.

The research programs supported by the center will provide flexible research funds that permit MIT faculty and students to investigate and create new technologies, and support the transfer to young companies of new knowledge and technologies from university research. In its first year, the center plans to award five seed 'ignition' grants of $50,000 and three research grants of

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$250,000 that will support research on new technologies that have the potential to fuel groundbreaking businesses or products.

It is hoped that the Deshpande Center will act as a stimulus to economic growth and help New England maintain its position as a leader in the field of new technology. "The Deshpande Center will enable the local entrepreneurial community to capitalize on the resources of MIT to further research and lay the foundation for the next wave of new technology," said Alex D'Arbeloff, Chairman of the MIT Corporation.

As the center grows and receives support nationally and even internationally, it is expected that its scope will broaden beyond the New England region.

In addition, the center will provide significant funding to the School of Engineering's new Undergraduate Practice Opportunities Program (UPOP). In part, this support will offer MIT undergraduates meaningful work experience in industry and government. It will also improve student and faculty understanding of the practical application of new knowledge and technology in those settings.

"The vision for DCTI is very strongly aligned with the School of Engineering's mission of 'Leadership through Technical Excellence and Innovation'," said Thomas Magnanti, Dean of the School of Engineering. "The Deshpande Center will provide much needed funding for research on incipient technologies and, through UPOP, also offer MIT undergraduate students the opportunity to apply their knowledge in real-world settings."

The fund to support the Deshpande Center will be administered by an oversight committee that will include venture capitalists and entrepreneurs, in addition to senior MIT faculty. The Deshpande Center will be complementary to other research centers, laboratories and programs at MIT, including the MIT Entrepreneurship Center, located at the MIT Sloan School of Management. The center will also support special seminars and courses that focus on technology innovation.
Definious

In an attempt to make the growing process of technology transfer more accessible, the author offers the following definitions. Realizing that not all terms in this process are listed or defined within this appendix, it is important that other sources be consulted in addition to this paper.

AUTM – The Association for University Technology Managers. This is an association dedicated to understanding the “best practices” for university technology transfer. It currently has 3,200 members. Their annual licensing survey is drawn upon regularly in this thesis.

Bayh-Dole Act – Formally known as the “Patent and Trademark Act Amendments of 1980”, this law established a uniform patent policy among the many federal agencies that are involved in funding research. Specifically, this allowed universities to retain title to internally generated research and inventions.

Idea Carriers – used both by Roberts (1991) and Casper and Murray (2002) as well as others when describing actors in the technology transfer process who possess knowledge of particular research and entrepreneurial efforts.

Inventor – the creator, or co-creator, of a particular piece of research or technology innovation.

MIT Entrepreneurship Center – A center dedicated to entrepreneurial pursuits at MIT. From their Web site: “The MIT Entrepreneurship Center team provides content, context, and contacts that enable entrepreneurs to design and launch successful new ventures based on innovative technologies. We help MIT students, alumni, and colleagues access an array of educational programs, networking opportunities, technologies, and resources, both at MIT and around the world.”

MIT “50k” Business Plan Competition – a student run business plan competition formed in 1990 to take advantage of MIT’s strong mix of engineering and business studies. Formed by the MIT Entrepreneurs Club and the Sloan New Ventures Association.
**MIT Industrial Liaison Program** – a formal organization at MIT dedicated to bridging the gap between commercial entities (typically large companies make up their “member companies”) and MIT research.

**MIT Venture Mentoring Service** – from the official Web site: “VMS supports innovation and entrepreneurial activity throughout the MIT community by matching prospective entrepreneurs with volunteer mentors who can boost the probability of a start-up’s success”

**Social Capital** – according to Burt, this metaphor is “that people who do better are somehow better connected. Certain people or certain groups are connected to certain others, trusting certain others, obligated to support certain others, dependent on exchange with certain others”. (Burt, 2000)

**Social Networks** – In the context of work by Burt, Shane & Cable and Casper & Murray, this represents clusters of key actors that can transfer information efficiently, offer referrals, define reputation and demonstrate obligations.

**Seed Stage** – when a company is at its infancy. Typically has more of an idea than an established operation and customer base.

**Technology Transfer** – This is the name for the formalized process of assigning technology licenses and/or ownership from one research body to a commercial entity.

**Invention Disclosure** – This defines the process of officially filing academic research with a Technology Licensing Office (see “TLO”).

**ERISA**– Employee Retirement Income Security Act. Amended via the “Prudent Man” rule in 1979 allowing pension funds to invest in higher-risk assets, such as venture capital.

**The “Prudent Man” rule** – A rule amended in 1978 to favor riskier investments by pension funds in such vehicles as private equity Limited Partnerships. See ERISA.
Technology Licensing Office (TLO) – The administrative body at a university that processes and helps commercialize in the transferring of technology and inventions.

Venture Capital – In the context of this paper, it is a financing vehicle leveraged in seed-stage commercialization. Lerner has shown that this has increased dramatically due to lifting of restrictions regarding pension funds.

Venture Capitalist ("VC") -- an external actor who may be involved in funding, as well as fostering, the growth of a university-born startup.

WARF – Wisconsin Alumni Research Foundation. Considered by many to be the “progenitor of university technology transfer.”
References


Friedman, Joseph and Silberman, Jonathan. “University Technology Transfer: Do Incentives, Management and Location Matter?” Journal of Technology Transfer (Forthcoming)


