

The University and the Start-Up: Lessons from the Past Two Decades¹

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ABSTRACT. This paper explores one of Edwin Mansfield's enduring interests: the interface between academia and industry. It highlights some key lessons regarding the management of university-based spin-outs, drawing on a variety of sources. I highlight the challenges that the spin-off process poses, the impracticality of directly financing firms through internal venture funds, and the ways in which universities can add value to faculty ventures.

Key words: spin-off, venture, capitalist, entrepreneurship, venture capital

JEL Classification: O31

1. Introduction

One of Edwin Mansfield's enduring interests was the relationship between academic science and industrial development (Edwin Mansfield, 1968, 1991). In recent years, these questions have become even more urgent on many campuses: despite the recent decline in venture funding, there remains enormous interest in start-up activity on the university campuses.

University administrators see new firms as having several key benefits: they can generate considerable revenue for the institution, make the university more attractive to current and potential faculty members, and benefit the community and the nation as a whole. Faculty members often view these ventures as potential sources of both personal wealth and career fulfillment.

Meanwhile, venture capitalists have long viewed universities as a fertile source of investment ideas. The first modern venture capital firm, American

Research and Development (ARD), was designed to focus on technology-based spinouts from the Massachusetts Institute of Technology. As envisioned by its founders, who included MIT President Karl Compton, Harvard Business School Professor Georges F. Doriot, and Boston-area business leaders, this novel structure would be best suited to commercialize the wealth of military technologies developed during World War II. Many of the most successful venture capital-backed firms over the decades—including Cisco Systems, Genentech, and Netscape Communications—had their origins as academic spin-outs.

Despite this interest, however, the effective management of these start-ups poses many challenges. If managed incorrectly, a start-up can cause serious disruption to the institution that spawns it. The dangers can manifest themselves in many ways:

- Boston University's venture capital subsidiary invested in a privately held biotechnology company founded in 1979 by a number of scientists affiliated with the institution. As part of its initial investment in 1987, the school bought out the stakes of a number of independent venture capital investors, who had apparently concluded after a number of financing rounds that the firm's prospects were unattractive. Between 1987 and 1992, the school, investing alongside university officials and trustees, provided at least \$90 million dollars to the private firm. (By way of comparison, the school's entire endowment at the fiscal year in which it initiated this investment was \$142 million.) While the company succeeded in completing an initial public offering, it encountered a series of disappointments

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with its products. At the end of 1997, the University's equity stake was worth only \$4 million.²

- The University of Illinois, having developed the Internet browser, licensed the technology to a Boston-based venture, Spyglass Technologies. When some former university employees begin a separate firm to commercialize a related technology, the University commenced litigation against them. The acrimony of the dispute may have influenced the institution's decision to reject the offer of a large block of stock in the new firm to settle the dispute—instead they demanded (and received) a relatively modest cash payment. The value of the equity in the new firm, Netscape Communications, would have exceeded the cash payment by many hundred-fold. Meanwhile, Spyglass largely abandoned its Internet browser effort and was acquired in 2000.³
- The University of Chicago launched the ARCH initiative in 1987 to encourage commercialization of its own technology and that of Argonne National Laboratory, a federal facility which it managed. The group was given a mandate both to license technologies to established firms and to fund start-ups. The venture fund enjoyed some modest initial successes. Shortly thereafter, however, the relationship between ARCH and the University of Chicago was restructured. The ARCH partners received permission to raise a second, more substantial, venture fund with far more generous compensation for the venture capitalists. As part of the new effort, they were allowed to invest outside the University, while retaining a formal "right of first look" at the University's technology. ARCH rapidly expanded after raising the second fund, and the share of new transactions originating from the University of Chicago and Argonne fell dramatically. Meanwhile, many at the school believed in their eagerness to become established as venture investors, the ARCH partners had neglected the more mundane—but necessary—technology licensing activities.⁴

Thus, the successful management of the relationship between universities and start-up firms is thus not a trivial or routine matter!

This article seeks to highlight some of the key lessons about the management of university-based spin-outs. It highlights a number of lessons, based on a wide variety of sources: traditional academic research, case studies on specific programs, service on advisory panels, and special projects that have sought to address the needs of particular organizations.

I highlight five lessons that emerge from these efforts:

- Starting new ventures based on university technology is hard. Despite the confidence of many academic entrepreneurs and university administrators, the process of creating a sustainable new company is a very challenging one.
- In the vast majority of cases, new firms will not generate enormous wealth for academic institutions. Much more modest returns are the norm.
- Directly financing firms through internal venture capital funds is unlikely to be a successful strategy for universities.
- Nonetheless, universities can add considerable value to young firms that faculty begin.
- Old frameworks about conflicts-of-interest must be rethought in light of the special needs of start-ups.

These issues will be explored in turn in the subsequent sections.

2. The Challenges of New Technology-Based Firms

University technology transfer offices typically focus on nascent firms in high-technology industries with tremendous promise. Unfortunately, these firms are also characterized by uncertainty and informational gaps, which make it difficult for the investors to evaluate business plans or to oversee the entrepreneurs once the investments are made. The consequences are often unfortunate. In some cases, the idea is commercialized, but the return to the academic institution is small; often these information problems discourage outside investors entirely and the discovery languishes.

To briefly review the types of conflicts that can emerge in these settings, conflicts between managers and investors can affect the willingness of both debt and equity holders to provide capital. If the firm raises equity from outside investors, the manager has an incentive to engage in wasteful expenditures from which he may benefit disproportionately—such as lavish offices. Alternatively, the entrepreneur may increase risk to undesirable levels or withhold bad news from the investors. Because providers of capital recognize these problems, outside investors demand a higher rate of return than would be the case if the funds were internally generated.

These information problems have also been shown to exist in debt markets. If banks find it difficult to discriminate among companies, raising interest rates can have perverse selection effects. In particular, the high interest rates discourage all but the highest-risk borrowers, so the quality of the loan pool declines markedly. To address this problem, banks may restrict the amount of lending to risky firms rather than increasing interest rates.

Described in this manner, these problems may appear to be abstract. But they have very real implications for university technology managers, who may find investors and corporations unwilling to invest the time and resources to examine early-stage technologies, or offering only modest payments in exchange for exclusive licenses to innovations that the technology transfer officers believe to be valuable. University-based start-ups may find it impossible to access bank loans or equity investors.

These problems in the debt and equity markets are a consequence of the information gaps between the entrepreneurs and investors. If the information gaps could be eliminated, financing constraints would disappear. Financial economists argue that specialized financial intermediaries, such as venture capital organizations, can ameliorate these problems by intensively scrutinizing firms before providing capital and then monitoring them afterwards.

To address information problems, venture capitalists employ a variety of mechanisms. First, business plans are intensively scrutinized: of those firms that submit business plans to venture capital organizations, historically only 1% have

been funded. The decision to invest is frequently made conditional on the identification of a syndication partner who agrees that this is an attractive investment. Once the decision to invest is made, the venture capitalists frequently disburse funds in stages, forcing the managers of the venture-backed firms to return repeatedly to their financiers for additional capital in order to ensure that the money is not squandered on unprofitable projects. In addition, venture capitalists intensively monitor managers, demanding preferred stock with numerous restrictive covenants and representation on the board of directors. Thus, it is not surprising that the capital provided by venture capital organizations is the dominant form of equity financing for privately held technology-intensive businesses.

3. The Implications for Financial Returns

These difficulties have a stark consequence for universities. Despite the optimistic dreams of many deans, most start-ups will not generate huge returns for the academic institutions from which they spring. This harsh lesson stems from the overall returns from young firms, as well as the special circumstances of the types of firms emerging from academia.

The first reason why substantial returns are unlikely relates to the distribution of outcomes from start-up firms in general: no matter how sophisticated the investors, most start-ups yield disappointing returns. A wide variety of studies has examined the returns from investments in innovative activities, focusing on such measures such as the value of patents, the growth of young firms, and the returns to venture capitalists and to investors in stocks that have recently gone public. Despite the varying measures employed and the different industries under study, the conclusions are remarkably consistent. The returns to investment in innovative activities appear to be remarkably skewed. A small subset of projects generates the bulk of the returns.

The second reason relates to the very early stage of most academic projects. Because they are so high risk, financial investors—whether venture capitalists or individual “angels”—will demand a return commensurate with the risk. This translates to a substantial demand for equity.

Moreover, these investors are only likely to invest if the entrepreneurs are adequately rewarded. Venture capitalists typically argue that the process can only work if the key entrepreneurs in the start-up firm have a substantial equity stake. Without such holdings, these investors argue, managers are unlikely to make the huge personal and financial sacrifices necessary for the success of a new venture.

As a result, these investors are skeptical of potential investments where third parties who are not directly involved in the ongoing success of the venture have large equity stakes. Venture capitalists are likely to reject the argument that a university is entitled to a substantial equity stake in recognition of its contributions of intellectual property to the firm. Rather, they are likely to argue that the past is irrelevant—the allocation of equity should maximize the chances of the company *going forward*.

Consider the experience of a federally funded R&D facility, where an aggressive new CEO launched an initiative to grow revenues through spin-out firms. Mindful of the demands to generate substantial gains for the corporation, the business development staff sought to interest venture capitalists in transactions where the R&D organization would control much of the equity. In a typical proposed transaction, the venture capitalists would receive a 30% stake in exchange for their investment, the management team would control 10%, and the research institution would hold the remainder. Despite considerable effort for over 2 years, the organization was unable to attract any investors into their portfolio of projects.

Thus, universities should not expect rapid returns from their commercialization strategies. The equity stakes they will receive are likely to be modest, and many of the shares are likely to prove worthless. To be sure, there will be exceptions: to cite two extreme examples, the stake that MIT was granted upon the founding of Akamai Technologies was worth 6 months after its initial public offering (when it was free to sell its shares) about \$60 million and Stanford's stake in Google may be worth several times this amount.⁵ While the occasional successful firm is likely to yield substantial returns, the typical returns will be much more modest.

4. The Illusive Promise of University Venture Capital Funds

While the tradition of interactions between venture funds and universities has been a long one, particularly at MIT and Stanford, the relationship has undergone a fundamental change in the past decade. Universities have become increasingly interested in venture capital-backed spinouts as a mechanism to commercialize early-stage technologies and to produce the greatest returns for the institution. This trend has been manifested in numerous ways, such as increases in the staff within academic technology transfer offices devoted to working with professors to establish new firms.

The most dramatic manifestation, however, has been the proliferation of funds dedicated to investing in new firms spawned from these institutions. Increasingly, institutions are seeing internal venture funds as an avenue to generate more wealth for the university, as remarks by Greg Gardiner, at the time the director of Yale's Office of Cooperative Research, illustrates:

It is even more instructive to look at Yale intellectual assets that could have matured into new ventures... like Human Genomic Sciences or Incyte Pharmaceuticals. Each has a market capitalization in excess of 500 million dollars. Though Yale had the ideas, technology and personnel to form such a company a year or two in advance of HGS or Incyte, it did not happen because our development strategies were limited to licensing.⁶

While this vision is a tempting one, the experience of ARCH Venture Partners alluded to in the introduction illustrates a variety of challenges faced by university-affiliated funds. With ARCH, many things went right: substantial barriers to the recruitment of personnel were overcome, regulatory barriers designed to forestall conflicts of interest and informal organizational concerns were addressed, and the investments proved to be reasonably successful. Nonetheless, the structure proved unstable.

This disappointing experience illustrates some of the challenges associated with these efforts:

- *Political interference can doom the effort.* Programs entailing the commercialization of federally funded research always risk hearing

complaints from competitors. For instance, Martin Marietta, the contractor that operated Oak Ridge National Laboratory, drew fire from the U.S. General Accounting Office and Representative John Dingell of Michigan for its venture capital initiative at the laboratory. Martin Marietta had established a venture capital subsidiary, the Tennessee Innovation Center, which sought to establish new businesses around Oak Ridge. Martin Marietta had also invested in a business that later received an exclusive license to develop an Oak Ridge technology. As a result of the congressional criticism, the contractor restructured the relationship with its affiliate in a financially unattractive way. Soon after, Martin Marietta abandoned the effort.⁷

- *Regulations can severely restrict researchers' involvement with start-up firms.* In extreme cases, all formal relationships with outside start-ups are prohibited. More frequently, university or laboratory policies let publicly funded researchers serve as directors of and consultants to spin-off companies, but forbid them from holding equity in these enterprises. These same institutions often make it difficult for employees to take leaves to work with these companies. Granted, these steps may have sought to prevent abuses, but they also stifle efforts to commercialize technologies.
- *Programs may fail to recruit and retain the best talent.* This failure often stems from the limited compensation and autonomy that these programs offer investors. Forced to recruit less experienced managers, these funds suffer when the managers make unwise decisions: for instance, funding firms with limited commercial potential or exhausting the institution's resources on seed investments that they can't support with follow-on financing. In this regard, universities have run into problems similar to corporate venture programs, as corporations have frequently been reluctant to compensate their venture managers through profit-sharing ("carried interest") provisions, fearing that they might need to make huge payments if their investments were successful. Typically, successful risk-taking was inadequately rewarded and failure

excessively punished. As a result, corporations were frequently unable to attract managers who combined industry experience with connections to other venture capitalists to run their venture funds; and all too many corporate venture managers adopted a conservative approach to investing.

A natural question concerns the generality of these examples. Relatively few academic-based funds have reached maturity, and data on their activities are limited to case studies of a number of programs: see Atkinson (1994). But the difficulties that the pioneering funds as faced—as well as those encountered by their closely related cousins, the corporate venture fund—lead to a dubious prognosis.

5. Better Paths to Adding Value

The skepticism expressed in the previous section about university-based venture funds does not imply that there is not an important role for university technology transfer offices in the start-up formation process. On the contrary, these offices can play an important role in alleviating the information problems discussed above. This role has two dimensions: reducing the uncertainty of academic entrepreneurs about the spin-out process and easing outside investors' and strategic partners' doubts about the new venture.

Academic entrepreneurs are frequently bright and charismatic individuals. While they have very deep knowledge of their respective fields, often their confidence outstrips their knowledge in other arenas. Examples abound of brilliant scientists who have made poor choices in managing new ventures. An academic entrepreneur, for instance, may opt for a term sheet from a little known venture capitalist who is willing to invest at a higher valuation instead of that a much more reputable group, not understanding the "stamp of approval" that the relationship with an established organization may bring. Similarly, a university spin-out may enter into a strategic alliance that entails the transfer of its key intellectual property for only a modest consideration.

Moreover, in many cases, academic entrepreneurs lack realistic expectations about their ventures. In particular, they often fail to perceive why

potential investors might hesitate to provide themselves with funds. Alternatively, they may have an inflated impression of the value of their discovery.

By drawing on their experience, and placing the discovery in the context of other similar efforts, university technology transfer officers can help address these problems. This assistance is likely to have two dimensions.

The first of these relates to entrepreneurial education. A number of leading technology transfer offices have come to regard the education of academic entrepreneurs as one of their important objectives. Whether through informal counseling or structured courses, these technology offices have been able to help academic entrepreneurs come “down the learning curve” and avoid costly mistakes or misapprehensions.

The second dimension is addressing the concerns of outside investors. In many cases, venture capitalists and other financiers are inundated with proposals from young firms, many of which may have difficult-to-assess claims. As a result, they may be reluctant to fund ventures that solicit funds without a formal introduction without a trusted intermediary.

The best technology transfer offices have been able to play such an “honest broker” role. These offices have cultivated relationships with key venture capital organizations and corporations over time, building an understanding of the outlook and investment criteria of each group. When they then reach out to one of these groups with an investment opportunity in an academic spin-out, the investors are likely to consider the new venture seriously.

To play these roles effectively, however, is not easy. The effectiveness of these roles is likely to depend critically on the experience level of the technology transfer office staff. Retaining experienced staff has been difficult for many organizations. Few university technology transfer offices can offer compensation approaching the levels that corporate business development groups enjoy, much less independent venture capital firms. As a result, many offices have experienced a “revolving door” phenomenon: new staff, primarily recent Ph.D.s with little business experience, remain at the organization long enough to develop some familiarity with the licensing process, but then leave for the private sector. As a

result, the institution does not glean many returns for its substantial investment in building its staff’s human capital.

In many respects, this is little different from the challenges that other academic functions with private sector analogues face, such as endowment managers. The best organizations have created environments that are pleasant and rewarding workplaces, which attract and retain many talented staff members despite the disparities in financial rewards.

6. Rethinking Conflict-of-Interest Policies

The final section discusses on particular challenge that universities face in playing an active role in fomenting spin-offs: the presence of formal and informal curbs on perceived conflicts-of-interest. The rationales for such policies are easy to understand. Many academic projects are funded with public funds, which are accompanied by a variety of legal and ethical obligations. Moreover, academic institutions are themselves non-profit entities, a special status which brings with it substantial responsibilities. Commercial activities, critics have feared, may subvert the core academic mission of the university, or at least create an unseemly appearance of impropriety.

It can be challenging, however, to reconcile the concerns about conflict-of-interest with effective fomenting of spin-outs. An example of these challenges is the Department of Energy’s national laboratory system, where real and apparent conflicts have been major concerns of senior and mid-level managers for many years. In some cases, managers have insisted on a request-for-proposal process: a technology must be widely publicized and the entrepreneurial team must bid for the rights to it against established concerns. While such a process may appear on the surface “fair,” the long delays associated with the process and the widespread publicity about the technology have often reduced its value considerably. Even when start-up firms have won exclusive rights to a new technology, advocates for competing firms have sometimes challenged their licenses. In extreme cases, researchers who have tried to leave the laboratory with new technologies have been unable to obtain licenses to the key technologies, despite being the only parties

interested in the work. For a variety of illustration of these problems, see Adam B. Jaffe and Josh Lerner (2001).

The degree to which concerns about fomenting innovation or those about avoiding conflicts-of-interest should be paramount has been long debated. While the federal government's policies towards the commercialization of the research it funded were the subject of litigation and Congressional debate as early as the 1880s, the debate assumed much greater visibility with the onset of World War II. The dramatic expansion of federal R&D effort during the War raised questions about the disposal of the rights to these discoveries. Two reports commissioned by President Roosevelt reached dramatically different conclusions, and framed the debate that would follow in the succeeding decades.

The National Patent Planning Commission, an *ad hoc* body established shortly after the Pearl Harbor attack to examine the disposition of the patents developed during the War, opined:

It often happens, particularly in new fields, that what is available for exploitation by everyone is undertaken by no one. There undoubtedly are Government-owned patents which should be made available to the public in commercial form, but which, because they call for a substantial capital investment, private manufacturers have been unwilling to commercialize under a nonexclusive license.⁸

A second report, completed in 1947 by the Department of Justice, took a very different tack. Rather, it argued that “innovations financed with public funds should inure to the benefit of the public, and should not become a purely private monopoly under which the public may be charged for, or even denied, the use of technology which it has financed” (U.S. Department of Justice, 1947). The report urged the adoption of a uniform policy forbidding both the granting of patent rights to contractors and exclusive licenses to federal technology in all but extraordinary circumstances. Over the ensuing 30 years, federal patent policy vacillated back and forth between these two views.

Beginning in the 1980s, policy seemed to shift decisively in favor of permitting exclusive licenses of publicly funded research to encourage commercialization. The Stevenson–Wydler Technology Innovation Act of 1980 explicitly made technol-

ogy transfer a mission of all federal laboratories and created a variety of institutional structures to facilitate this mission. Among other steps, it required that all major federal laboratories establish an Office of Research and Technology Applications to undertake technology transfer activities. At about the same time, the Bayh–Dole Act allowed academic institutions and non-profit institutions to automatically retain title to patents derived from federally funded R&D. The act also explicitly authorized government-operated laboratories to grant exclusive licenses on government-owned patents. These two acts were followed by a series of initiatives over the next decade that extended and broadened their reach.

This wave of legislation did not, however, resolve the debate concerning the extent to which ownership of government-funded R&D ought to be transferred to private sector entities. Congressional and agency investigations of inappropriate behavior during the commercialization process—particularly violation of fairness-of-opportunity and conflict-of-interest regulations during the spin-out and licensing process—continued to be commonplace (Derek Bok, 2003).

It is asking too much for university technology transfer officers to resolve these debates themselves. But it is important that they realize—and communicate to administrators and faculty—the trade-offs at work. To be most effective, they must be allowed to move nimbly, serving as educators to academic entrepreneurs and information brokers to investors. Yet these types of activity are quite different from the cautious approach that substantial concerns about conflict-of-interest policies might engender. Without condoning blatant self-dealing, university administrators must nonetheless recognize that too vigorous limits on potential conflicts can have a chilling effect on entrepreneurial activity.

Notes

1. This essay is based in part on Paul Gompers and Josh Lerner, *The Money of Invention*, Boston, Harvard Business School Press, 2001, and Josh Lerner, “Venture Capital and the Commercialization of Academic Technology: Symbiosis and Paradox” in Lewis M. Branscomb, editor, *Industrializing Knowledge: University-Industry Linkages in Japan and the United States*, Cambridge: MIT Press, pp. 385–409.

2. This account is based on Seragen's filings with the U.S. Securities and Exchange Commission. In a 1992 agreement with the State of Massachusetts' Attorney General's Office, the university agreed to make no further equity investments. The school, however, made a \$12 million loan guarantee in 1995 (subsequently converted into equity) and a \$5 million payment as part of an asset purchase in 1997.
3. This account is based on Goldie Blumenstyk, "Accord in the Mosaic War: U. of Illinois and Private Company Agree on Product for Navigating the Internet," *Chronicle of Higher Education*, 41 (January 6, 1995), A21-A22, "Legal Entanglements in the World Wide Web," *Investors Business Daily*, (December 28, 1995), A6, and interviews with concerned parties.
4. The ARCH Venture Partners experience is documented in Josh Lerner, "ARCH Venture Partners: November 1993," Harvard Business School Case No. 9-295-105, 1995.
5. This calculation is based on an analysis of Akamai's securities filings and daily.stanford.edu/tempo?page=content&id=14315&repository=0001_article.
6. Gregory E. Gardiner, "Strategies for Technology Development: A Presentation to the Board of the Yale Corporation" <http://www.yale.edu/ocr/yalecorp.html>, 1997.
7. The Martin Marietta case is discussed in U.S. General Accounting Office, *Energy Management: Problems with Martin Marietta Energy Systems' Affiliate Relationships* (GAO/RCED-87-70), Washington: U.S. General Accounting Office,

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