UNIVERSITY-AFFILIATED VENTURE CAPITAL FUNDS

by Stephen H. Atkinson

Prologue: Stephen Atkinson likens the lure of investing in developing medical technologies to the goal of a career in popular music: “In both fields there is so much fascination with the fabulous success that a few well-prepared, and often just lucky, individuals have that many people can become blind to the intrinsic irrationality of the marketplace. Unfortunately, for every Bruce Springsteen there are thousands more who, being blind to these market realities, often give up a great deal and have nothing to show for it.” The stakes for investors and guitar players are great, but so too are the stakes for society. Improvements in public health rely heavily on the successful commercialization of university-originated technologies. Atkinson, an insider in the business of technology transfer, has seen his share of successes and failures and has been witness to fundamental changes in the administrative and financial apparatus used in academic/industry relationships. Here he writes about those changes and draws from his considerable experience to offer lessons for future initiatives by evaluating the effectiveness of the early university-affiliated venture capital funds. Atkinson founded Harvard University’s first technology-transfer program in 1976 and Harvard Medical School’s Office of Technology Licensing and Industry-Sponsored Research in 1984, directing each for eight years. He is a former president of the Society of University Patent Administrators (now the Association of University Technology Managers) and has been an international consultant to universities, teaching hospitals, corporations, and inventors.

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Abstract: This paper briefly reviews university/industry licensing and research collaborations and focuses on three university-affiliated venture capital funds, which represent the most direct participation by academic institutions in creating new ventures based on technologies invented by their faculty members. The paper provides an early perspective on these funds as mechanisms for bringing new biomedical technologies into use. Although the new models have not existed long enough to fully evaluate their effectiveness, the early evidence is sufficient to suggest helpful guidelines for development of more efficient initiatives in the future.

The number and diversity of relationships between universities and corporations aimed at commercializing new biomedical technologies have greatly increased during the past decade. These relationships fall into three main categories: technology licenses, joint research collaborations, and new ventures based on university-originated technologies.

Technology licensing. University licensing practices originated in the early 1920s when a group of scientists at the University of Wisconsin established the Wisconsin Alumni Research Foundation (WARF). WARF’s principal objectives were to seek patents to protect inventions made by scientists at the university and to promote the introduction of these discoveries into public use, primarily through licensing arrangements with independent companies. This approach was aimed at achieving a logical and optimal division of labor by exploiting the traditional roles of both academia and industry. Universities would pursue exploratory research, and, in cases where discoveries of potential benefit to the public resulted from that research, they would seek patents and offer licenses to industry, where innovations would be developed into useful technologies.

Several of the first inventions patented and licensed by WARF achieved widespread public use and returned significant revenues to the foundation, enabling it to expand its activities. These activities established a model for effective technology transfer from the university to the market that remains at the heart of most university/industry relationships today. This model is favored because the process of patenting and licensing is the most straightforward approach to technology transfer. While patenting has become more complex and expensive, it still is based on the three long-established statutory concepts of novelty, nonobviousness, and usefulness. Licensing practices also have become more complex, but they still revolve around a small collection of basic negotiation issues such as exclusivity, field of use, territorial rights, and, most persistently, value given for value received.

WARF’s early successes did not immediately spawn imitators, but by the late 1940s several other major academic institutions—primarily technically oriented universities with an emphasis on engineering or agriculture such as the Massachusetts Institute of Technology (MIT), the California Institute of Technology (Caltech), and Cornell University—had established patent programs. Abetted by an enormous expansion of federally funded research
and led by WARF, these institutions laid the foundation for today's technology-transfer community in which almost every academic institution with annual research funding exceeding $15 million has an in-house program to manage relationships with industry.

**New ventures and research collaborations.** In 1974 Stanford University and the University of California, San Francisco, filed a patent application on a groundbreaking discovery made by faculty members Stanley Cohen and Herbert Boyer embodying fundamental methods of genetic engineering and products made through the use of those methods. The scope of the patent application, for which the US. Patent Office eventually granted two broad patents, was bold in any terms. It was the approach to commercializing the technology, however, that created a new model for university/industry technology transfer. Rather than following the traditional route of patenting and licensing, Cohen and Boyer joined with a small group of venture capitalists to form a new company, Genentech, whose principal objective was to commercialize the technology. By combining a group of distinguished academic scientists, an entrepreneurial management team, venture capital financing with rights to the Cohen-Boyer technology, and associated know-how, to create a new company, the new approach built on the vital elements of the WARF model. At the same time, it sought to overcome the slowness associated with licensing to established companies with multiple priorities that frequently superceded commercialization of discoveries that originated in universities.

In the same year Harvard Medical School entered into a twelve-year, $40 million collaborative research agreement with the Monsanto Company for the purpose of developing new approaches to diagnosing and treating cancer. The Harvard-Monsanto agreement provided another new model for commercializing university-originated technology by emphasizing it as a principal objective of the relationship.

The advent of these two new approaches to technology transfer coincided with dramatic advances in biomedical research, steadily increasing funding of that research by the National Institutes of Health (NIH), and the beginnings of the biotechnology industry in the United States. These developments resulted in growing interest in biomedicine and related scientific fields as a focal point for university/industry relationships. While relationships based on technologies in other fields continued to grow at a modest pace, biomedicine took the spotlight and in so doing attracted equal parts of talent, financing, time, and public attention.

Several factors combined to promote the use of the Stanford/California and Harvard models as major alternatives to traditional patenting and licensing practices in the late 1970s and early 1980s. First, they appeared to have significant potential to complement, or possibly surpass, those prac-
tices as mechanisms for the efficient translation of university-originated technologies into beneficial new products. The new models also offered potentially significant new revenue sources for universities at a time when federal funding of research was beginning to slow. Finally, the fact that these approaches were novel and innovative generated significant interest in both the academic and business communities.

As the new models evolved, however, it became clear that the collaborative research agreements would be hard to come by. These agreements often took years to develop because of their dependence on personal relationships between senior academic scientists and corporate executives and the need for significant financial commitments from the corporate partner. By comparison, given the unleashed financial climate of the early 1980s, the new venture alternative seemed eminently achievable—new companies based on university technologies were springing up everywhere.

In this environment, a handful of universities decided to participate proactively in the process of creating new ventures for the same fundamental purposes initially adopted by WARF, with a notable addition: the potential for significantly greater financial return. Among the early participants that played an active role in creating new ventures were Harvard Medical School, The Johns Hopkins University School of Medicine, and the University of Texas (UT) Southwestern Medical Center at Dallas. A comparison of the experiences of these institutions with those of others pursuing the traditional patenting and licensing model or research collaborations with corporate partners provides broad insight into the relative effectiveness of the different approaches to commercializing university-originated technologies.

### University-Affiliated Venture Funds: Three Cases

The medical schools at Harvard, Johns Hopkins, and the University of Texas are geographically separated from the main campuses of their institutions. Harvard Medical School is located amidst five of its affiliated hospitals in Boston, across the Charles River from the original Harvard College campus in Cambridge. The Johns Hopkins School of Medicine is located next to its main affiliated hospital and several other affiliated medical organizations in downtown Baltimore, several miles from the university’s main campus. The UT Southwestern Medical Center is one of fifteen individual institutions that make up the statewide University of Texas system. It is located more than 200 miles away from the original main campus in Austin and is the flagship medical institution in the system.

**Cultural differences.** The separation of these medical schools from their larger institutions is more than geographic—it is profoundly cultural.
Like all U.S. medical schools, these institutions believe that their direct connection with the development and application of new approaches to treating patients makes them substantively different from—and in most cases superior to—the other divisions of their universities, which they view as being more interested in cultivating knowledge for its own sake than in applying it directly to real-world problems.

Thus, it was logical that in the search for new and better approaches to developing university-originated technology for the benefit of patients, these institutions would determine that at least some of the job should be done more directly by them, rather than through traditional arm’s-length patenting and licensing or other models developed by the commercial community. The decisions of Harvard Medical School, UT Southwestern Medical Center, and Johns Hopkins Medical School to proactively create affiliated venture funds amounted to a collective statement of dissatisfaction with the traditional technology-transfer process. This statement was inherently and fundamentally critical of the major players in the process—particularly the pharmaceutical and venture capital communities, despite the fact that these communities had long set the standard for commercializing new biomedical technologies. In making this statement, these schools opened themselves to long-term judgments as to whether their venture funds actually performed better than established approaches.

**Development-gap technologies.** Another event that contributed to the evolution of technology-transfer models was the founding of a small, informal technology-transfer group at Harvard Medical School, which reviewed innovative ideas with significant potential for medical applications. From 1977 to 1980 this group reviewed a steady stream of invention disclosures and proposals for industry relationships. While a significant portion of these were appropriate for traditional patenting and licensing, a pattern emerged for a select category of projects for which that approach was ineffective.

These projects were based on seminal technologies with the potential for broad applications—rather than leading to a single product, they might lead to a class of new diagnostics or therapeutics. Despite their patentability and power, however, they rarely attracted serious interest from established pharmaceutical firms until at least three to five years after initial disclosure. That interest usually took the form of a request for a license, and the technology typically ranked low among corporate priorities compared with other, in-house projects. As a result, license fees offered to the school for these technologies were modest. The industry rationale for its treatment of these early-stage technologies was that they were highly speculative and thus financially risky. The fact that federal agencies and other traditional sources of funding for academic research viewed these technologies as too applied to merit their support often left them in limbo for several years.
Harvard’s technology-transfer group came to view this category of discoveries as “development-gap” technologies and took it upon itself to consider alternative sources of development funds and routes to commercialization, including creation of a venture fund to “bootstrap” new companies based on the Stanford/California model. The group’s discussions on the venture fund approach came to a halt in late 1980, however, when Harvard President Derek Bok withdrew a proposal under which Harvard would have participated directly in the creation of a new company (now the Genetics Institute)–including ownership of a significant share of founders’ equity–based on genetic engineering technology invented by Mark Ptashne. While Bok’s withdrawal statement and subsequent writings on the decision did not formally prohibit future Harvard participation in the creation of new ventures based on technologies invented by its faculty, they effectively tabled such a possibility. In addition, because of Harvard’s national leadership role, several other academic institutions that had been considering similar initiatives dropped such discussions as well.

During the next three years Harvard Medical School, along with several other major research universities, was approached by venture capitalists and other investors about the possibility of establishing a fund similar to that conceived by the school’s technology-transfer group. These proposals did not progress beyond early discussions, due in equal parts to Bok’s action in the Ptashne case and to the lack of a model that would balance the interests and needs of the academic community with those of potential investors.

In spring 1984 Harvard Medical School was approached by Integrated Resources, a large New York-based investment firm, about the possibility of creating a research and development (R&D) limited partnership to fund projects with commercial promise. While these discussions were eventually discontinued because of Integrated Resources’ limited experience in the biomedical field, they provided a stimulus for the technology-transfer group to reexamine the development-gap concept. This reexamination yielded a preliminary decision to initiate discussions with a cross-section of faculty members, administrators, and potential investors about creating a fund or pool of capital to commercialize development-gap technologies through a variety of approaches, including the creation of new companies.

**UT Southwestern.** At the same time, The John A. Hartford Foundation, a New York-based philanthropic foundation, was exploring the possibility of making grants to fund programs aimed at accelerating the development of university-originated biomedical discoveries to benefit patients. The foundation had a solid reputation and background in providing grants for innovative public health programs and specialized clinical research.

After preliminary discussions with several leading medical institutions, the foundation decided to make a formal request for proposals from thirteen
medical centers, including Harvard, Johns Hopkins, and UT Southwestern. The responses reflected a diversity of institutional cultures and provided a number of distinct, detailed plans on how best to go about funding and commercializing development-gap technologies.

The UT Southwestern proposal was the joint product of the medical center and a mayor's task force to stimulate development of a biotechnology industry in Dallas. By joining forces with the task force, UT Southwestern was able to assure Hartford that any funding it provided would at a minimum be matched by contributions from Dallas-area or Dallas-connected venture capital, institutional, and individual investors. The UT Southwestern proposal further stated that contributions from Dallas investors would be used to establish and operate the proposed venture capital pool and that contributions from the foundation would be used only to support research projects at the medical center with exceptional potential for applications in patients. UT Southwestern anticipated that this approach would enable the venture fund to become financially self-sufficient by the end of the proposed five-year grant.

The Johns Hopkins and Harvard proposals were developed and submitted to Hartford by their medical schools. While both proposed the establishment of an affiliated venture capital fund to develop promising technologies for use in patients, neither presented clear scenarios for directly augmenting the foundation's financial contribution, nor did they provide assurance that foundation funding would be used only to support research and development projects at the institutions.

In early 1985 Hartford announced that UT Southwestern would receive a five-year, $3 million award—the largest in the foundation's history—to create a venture capital pool to fund innovative technology projects. The fund was formally established in 1986 as Dallas Biomedical Corporation, an independent entity at arm's length from the medical center. Its operations and funding contributions to research projects at the medical center would be supported by the interest on $12 million in escrowed investments made by private investors, mostly from Dallas; the medical center would contribute to funding of research projects from the Hartford grant. The medical center and Dallas Biomedical expected to commit up to $1 million annually to support jointly selected projects with significant potential.

Despite Hartford's decision to make a single, long-term grant to UT Southwestern, Harvard and Johns Hopkins continued to explore creation of affiliated venture capital funds for development-gap technologies that would operate at arm's length from the institutions. Harvard's concept involved funding research projects at the medical school and its affiliated hospitals and the creation of new ventures to commercialize the results of those projects. Johns Hopkins favored an approach focused on demonstrat-
ing the commercial viability of selected technologies and offering them for licensing but omitted new venture creation as a major activity.

As part of their implementation strategy, Harvard and Johns Hopkins both attempted to build internal faculty and administrative support and to establish credibility for their concepts in the investment marketplace through their influential networks in the business community. They also anticipated that the best market for their funds would be among institutional investors, primarily pharmaceutical companies. As the two institutions moved to implement their similar strategies, however, each showed a distinct combination of personalities, internal politics, decision-making processes, and local infrastructure. These factors would lead the two institutions down different paths with different results.

**Harvard.** Harvard Medical School continued to take the lead in developing and implementing the venture fund concept. Although the medical school was characteristically independent, it devoted significant attention to coordinating efforts with the central university and the school’s affiliated hospitals. The medical school’s proactive approach was counterbalanced by the university’s traditionally conservative decision-making process, which was reinforced by Bok’s concerns about close institutional and faculty involvement in new ventures built on technologies invented by Harvard scientists. These concerns went deeper than the well-reasoned, lawyerly approach that Bok brought to all of his work—they were informed by considerable experience with a number of Harvard-based start-up companies and the 1980 Genetics Institute controversy. Throughout the medical school’s development and eventual establishment of a venture fund, Bok and other like-minded faculty members and administrators provided a careful, moderating influence. This influence would prove critical in distilling an institutional consensus out of a broad variety of often conflicting views about the design and objectives of the fund and its compatibility with the fundamental missions of the university.

The medical school pursued the development of its concept within Harvard and in the investment community in 1985 and 1986. By early 1987 the concept had come into focus: The medical school would seek to raise $35 million to create a traditional, independent venture capital partnership to commercialize technologies invented at Harvard and its affiliated hospitals. The fund would focus solely on commercializing biomedical technologies through the funding of selected innovative research projects and establishment of new ventures. The fund would consist of a general partner responsible for managing it and several limited partners/investors. Harvard would be represented by a newly created not-for-profit subsidiary that would be a passive limited partner in the fund. Harvard would be reimbursed for start-up expenses and would not participate as an investor.
The fund’s operations would be supported by a standard management fee provided by the fund itself, and 85 percent of its investment capital would be committed to Harvard-originated projects. Returns to the fund would be divided as follows: 80 percent to the limited partners/investors, 10 percent to the fund’s managing partners, and 10 percent to Harvard. Any returns to Harvard would be committed to research and teaching. By late 1987 the proposed fund had been approved by the medical faculty and the central university and was viewed as a credible investment vehicle by Harvard’s network of connections in the business community.

The Harvard fund-raising campaign started in mid-1988. The fund, headed by a former pharmaceutical R&D executive, was named Medical Science Partners. It sought investment from pharmaceutical companies, institutional investors, and individuals. The fund-raising goal was set by Harvard at $35 million, with a focus on U.S. investors first, then potential European and Japanese sources. During the months preceding the campaign it became clear that the pharmaceutical industry’s emphasis on exclusive intellectual property rights effectively ruled out the participation of multiple pharmaceutical firms as investors. As a result, Harvard altered the focus of its campaign to include a significantly broader selection of potential institutional investors.

During the course of the campaign, Medical Science Partners recruited a second partner and an agent to manage fund-raising efforts in Japan. The efforts of these individuals were supported by the medical school as well as faculty, administrators, and alumni from other parts of Harvard. Progress was slow initially because of the emphasis on potential US. investors, who were showing characteristic conservatism about investing in early-stage, university-originated technology. By late 1989, however, Medical Science Partners had held two preliminary fund-raising closings and in January 1990 held a final closing at $36 million. The capital was provided by fifteen investors. The $36 million total was made up of one-third each of U.S., European, and Japanese investment.

**Johns Hopkins.** A series of critical events provided the backdrop to the development of the Johns Hopkins venture fund concept. In 1984 The Johns Hopkins University and Johns Hopkins Health Systems, the parent corporation of the Johns Hopkins Hospital, created a for-profit subsidiary, the Dome Corporation, to manage their real estate holdings and provide institutional support services. Dome’s for-profit tax status made it the appropriate entity to take on this task.

Following Hartford’s 1985 decision to make a single grant to UT Southwestern, discussions between Johns Hopkins and Johns Hopkins Health Systems resulted in a decision to add technology commercialization to Dome’s charter. In part, Dome was chosen as the vehicle because of its
for-profit tax status. While Dome’s management team lacked experience for this new assignment, there was a consensus that the board of directors, other Hopkins/Dome connections, and a manager qualified to lead technology commercialization activities would provide the necessary expertise.

These discussions also yielded a decision to transfer responsibility for development and implementation of the venture fund from the medical school to the university and Dome. Although this decision called for continued participation by the medical school as a principal source of technology, the university, Johns Hopkins Health Systems, and Dome were charged with future development of the fund. This shift of responsibility led to a substantive recasting of the venture fund concept that was originally proposed by the medical school and created an institutional split that affected the fund’s development, establishment, and early operations.

Dome’s board of directors was composed of equal numbers of members from the university and Johns Hopkins Health Systems, and also included representatives from the local business community. The Dome board and other persons from Baltimore’s professional communities frequently served as a sounding board for the university and Johns Hopkins Health Systems during the development of the venture fund.

By late 1986 Johns Hopkins, Johns Hopkins Health Systems, and Dome had formulated a new concept that called for creation of a corporation to commercialize technologies invented by Hopkins scientists. This corporation, Triad Investors, would be capitalized by $20 million: $2 million each from nine institutional investors and $1 million each from Johns Hopkins and Johns Hopkins Health Systems. In contrast with the Harvard and UT Southwestern funds, Triad would not be limited to commercializing biomedical technologies, nor would it pursue new company creation as a core objective. Instead, Triad would focus on showing commercial viability for innovative, late-stage technologies drawn from all of Hopkins’s science departments and then offering them for licensing or sale. Johns Hopkins and Johns Hopkins Health Systems would hold 60 percent of the equity in Triad, with the remaining 40 percent distributed among the institutional investors, and revenues would be split according to this distribution.

Triad’s charter, corporate structure, and proposed equity distribution not only differed from the concepts developed by UT Southwestern and Harvard, they also failed to win the unanimous support of the Dome board and the medical school. While there was a consensus that there was sufficient innovative technology at Johns Hopkins to support a new commercialization entity, there was also strong sentiment on the board that a traditional venture capital limited partnership similar to the one being pursued by Harvard would be the most effective approach.

Despite this lack of unanimity, however, Johns Hopkins, Johns Hopkins
Health Systems, and Dome recruited a manager for Triad and initiated fund raising in 1988. The decision to proceed was predicated in part on initial favorable responses from potential institutional investors. However, this early interest was not sustained—several prospective flagship investors held back on making formal commitments.

Triad’s fund-raising campaign encountered other significant challenges as well. In addition to Harvard, two Baltimore-area venture firms—New Enterprise Associates and Zero Stage Capital—were raising capital for new funds focused on university-originated technologies. The New Enterprise Associates and Zero Stage Capital campaigns presented direct competition in the already small investment market for early-stage funds, and financial community interest in biotechnology investments in general was at a low ebb. As Triad’s campaign continued into 1989, almost every prospective investor it approached had already been contacted by Harvard and the two venture firms, and some had made commitments to invest in one or more of them.

While competition and market conditions presented significant challenges, Triad’s organizational structure and equity distribution most seriously handicapped its fund-raising efforts. Triad’s intention to retain 60 percent of equity and distribute the remaining 40 percent among nine institutional investors in exchange for investments of $2 million each did not reflect mainstream practice in the investment community, and the prestige and access to new technologies that investors would receive by participating in a Johns Hopkins-based fund were not enough to compensate for the comparatively small equity share. Triad’s failure to recognize these market realities critically limited its prospects for success. Triad closed fund raising in early 1991 with $5 million from Baltimore-area investors, Johns Hopkins, and Johns Hopkins Health Systems.

**Development of the three models.** As the 1980s drew to a close, UT Southwestern, Harvard, and Johns Hopkins each had established independent affiliated venture funds with three very different approaches. Each had invested significant time, resources, and institutional prestige with the ambitious dual objectives of addressing their individual needs and establishing new models for translating university-originated technology into commercially viable, beneficial products.

Dallas Biomedical’s emphasis on starting new companies was similar to that of traditional venture capital partnerships. Three facets of the fund, however, differed critically from mainstream venture industry practice. First, the $12 million contributed by investors would be put in escrow, and only the interest on it would be available for use by the fund. Second, most of the fund’s investments—which averaged more than $1 million annually—would support projects under the direction of UT Southwestern
faculty investigators. Third, the fund was expected to become financially self-sufficient within five years.

Harvard’s Medical Science Partners was built still more closely on the traditional venture partnership model. Fifteen limited partners provided $36 million for investment by the fund’s managers over a twelve-year term. The use of capital and distribution of profits would be consistent with accepted industry practice. Unlike Dallas Biomedical, almost all of Medical Science Partners’ capital would be invested in establishing and nurturing new companies to commercialize technologies invented at Harvard Medical School and its affiliated hospitals. Only a small portion of the fund’s capital would be used to support projects in academic laboratories.

Johns Hopkins’s Triad Investors chose to focus on a critical component of the traditional patenting and licensing process: demonstrating the commercial viability of specific university-originated technologies. Because of initially limited resources, Triad would be highly selective in taking on projects and would make modest, carefully targeted investments prior to licensing to outside companies. Although Triad’s approach fell within the traditional patenting and licensing model, it differed from both UT Southwestern and Harvard in that it included technologies outside of the biomedical field and eventually opened itself to technologies from other universities in addition to Johns Hopkins.

Dallas Biomedical initiated operations in 1986 with an outreach program to meet with investigators at UT Southwestern Medical Center to identify innovative projects for funding. Between 1986 and 1990 Dallas Biomedical selected and funded thirty research projects in UT Southwestern laboratories and supported international patenting of inventions originating in the projects. The technologies coming out of several of these projects provided the basis for five new companies, along with several traditional licensing arrangements.

From 1986 to 1991 Dallas Biomedical had three presidents and several other changes in management and staff. Despite these changes, most of the projects selected for funding were of high quality and had significant commercial promise. By 1992, however, Dallas Biomedical’s original investors had grown concerned about what they viewed as inadequate project management and progress in technology commercialization. Several ultimately withdrew the capital they had contributed in 1986. Although this did not have a significant impact on the research projects, most of which were winding down, it dealt a serious blow to Dallas Biomedical’s efforts to develop the companies it had started.

The pullout prompted Dallas Biomedical to reorganize into a biotechnology company dedicated primarily to commercializing a new cancer therapy that had come out of the largest project it had funded with UT Southwes-
ern under the Hartford grant. Under new and experienced management, the reorganized Dallas Biomedical immediately was faced with having to raise funds in the range of $10 million to $40 million to take the cancer therapy through early-stage clinical studies. After sustained but unsuccessful efforts to raise these funds, Dallas Biomedical’s board of directors, which included representatives of the remaining original investors, decided to phase out operations and return rights to all of the technologies it had funded to UT Southwestern. The technologies became part of UT Southwestern’s intellectual property portfolio, which it planned to offer to industry under traditional licensing arrangements.

Medical Science Partners began seeking projects in late 1988, prior to completion of its fund-raising campaign, and established its first company in April 1989. At the time of its final closing in January 1990, the fund had established operations and was generating a flow of potential projects from Harvard Medical School and its affiliated hospitals. This flow resulted in the creation of thirteen new ventures between 1989 and 1992, twelve of which continue to operate (one company was acquired in 1992). Medical Science Partners also played an active role in recruiting management and scientific staff, initiating operations, identifying supplementary technologies, and promoting business development. By 1993 all of the Medical Science Partners companies were either developing or introducing competitive commercial products. Medical Science Partners also made modest investments in a small selection of late-stage research projects that continued into 1994, with the long-term objective of providing the basis for new companies or licenses to existing companies.

Triad Investors began seeking projects in 1988, prior to completion of fund raising. Shortly after closing in 1991, Triad merged with Zero Stage Capital-Maryland. The merged fund maintained the name Triad Investors and permitted Triad to create solid investment capital ($5 million from each of the funds) and bring in Zero Stage Capital-Maryland’s experienced management team to run the reconstituted fund. From 1991 to 1993 Triad invested in five major technologies and several smaller projects that either have resulted in licenses to outside companies or are still in progress.

**Initial Lessons**

Biomedical product commercialization commonly requires seven to twelve years. As a result, most of the technologies pursued by Dallas Biomedical (now part of UT Southwestern’s licensing portfolio), Medical Science Partners, and Triad Investors are still in development. Thus, it is not yet possible to fully evaluate these funds as models for commercialization of university-originated technology. However, one can draw some
lessons from the experience of these funds and their affiliated institutions.

**Need for skill in crafting relationships.** First and foremost, it is clear that developing and implementing any independent venture capital fund—particularly a university-affiliated fund focused on early-stage technologies—requires creativity, expertise, experience, and singularity of purpose. While universities readily possess and have access to the first three of these qualities, their organizational, political, and cultural attributes make singularity of purpose difficult to achieve. This is particularly true for the large research universities whose complement of leading investigators and innovative technologies makes them the best candidates for affiliated venture funds. These institutions are made up of multiple faculties with separate missions, budgets, and campuses. Their medical schools tend to view themselves as apart from, and superior to, their central institutions. Their relationships with their affiliated hospitals, other medical institutions, and local business and political communities are fragile and often contentious. The difficulties inherent in these everyday characteristics of institutional life are intensified in the execution of any major project for which the goals and rewards are highly prized. Competition for leadership and credit for an affiliated venture fund dedicated to the dual goals of benefiting patients and generating substantial financial resources can work against the consensus needed to establish and, more importantly, to manage such a fund.

The origins of Dallas Biomedical, Triad Investors, and Medical Science Partners confirm this. Dallas Biomedical was the product of a joint initiative by UT Southwestern and a mayor’s task force. This provided some advantages, including attracting $12 million in investment capital, but it also introduced local interests separate from those of UT Southwestern. These interests sometimes interfered with Dallas Biomedical’s operations and contributed to turnover in management and staff. The establishment of Triad Investors, its fund-raising campaign, and early operations were hampered by the shift of responsibility from the medical school to the university and the Dome Corporation. While Harvard ultimately was able to sustain outward institutional consensus, the cooperation among the medical school, the university, and the affiliated hospitals was fragile throughout.

**Continuity.** Continuity of fund management and institutional governance is essential. Dallas Biomedical experienced repeated turnover at both the chief executive officer and staff levels and the initial Dome/Triad management team was replaced in 1991. Similar changes delayed the closing of fund raising, and, as a consequence, the beginning of operations by Triad.

**Investor support.** Any fund focusing on biomedical technology must be supported by mature, patient, and experienced investors who accept the time frame of seven to twelve years necessary to achieve commercialization
of biomedical technologies. The withdrawal of half of the original Dallas Biomedical investors in 1992 seriously compromised its ability to commercialize the most promising technologies it had pursued.

**Narrow focus.** A fund must be clearly focused on successful commercialization of a small slate of technologies. Stimulating institutional technology-transfer activities and contributing to local economic development are worthy goals, but they must be viewed as secondary, not core objectives. Dallas Biomedical’s origin as a joint initiative of UT Southwestern and a mayor’s task force overburdened the fund with multiple and sometimes conflicting objectives.

**Sufficient capital.** A fund must provide sufficient amounts of capital and other resources, particularly experienced professional expertise, to achieve its major objectives. Dallas Biomedical’s $10 million investment over seven years did not match its objective to simultaneously fund multiple research projects and create and develop several new companies. In contrast, Triad Investors’ $10 million (after the Zero Stage Capital-Maryland merger) matched the fund’s operating approach of selecting a small slate of technology demonstration projects. Medical Science Partners’ $36 million matched its overall objective to create and nurture a group of new companies in tandem with other venture investors.

**Selective support.** Most academic investigators, regardless of their knowledge or support of the commercialization process, are driven by the traditional academic values wherein publication and basic discovery take strong precedence over application of research results. A fund must be very selective about supporting projects in academic laboratories and should expect to allocate the majority of its capital to new ventures or outside commercial laboratories where objectives and incentives are driven solely by commercial success.

**Help from local infrastructure.** A fund must have the assistance of local infrastructure, including experienced investors, entrepreneurs, managers, scientists, technologists, and lawyers, as well as physical assets such as laboratory facilities, and information and transportation systems. Both Medical Science Partners and Triad Investors benefited from such local infrastructures, while Dallas Biomedical was hampered by the lack of local expertise in biotechnology venture financing and development.

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**Perspectives And Outlook**

Dallas Biomedical, Medical Science Partners, and Triad Investors each have made long-term contributions to their affiliated institutions by showing institutional leadership and commitment, encouraging invention disclosures, identifying innovative research projects, attracting funding from
new sources, and accelerating technology commercialization. Beyond these contributions, the evolution and performance of these funds provide perspectives on how a dedicated pool of resources can complement traditional patenting and licensing and university/industry research collaborations in promoting commercialization of university-originated technology.

During the initial development and growth stages of these funds, the number of university/industry relationships in general was growing dramatically. By 1990 almost every university, hospital, and research institute with a research budget of more than $15 million had established a technology transfer program and a separate office to manage it. The traditional patenting and licensing model continued to dominate the activities of these institutions, and numerous new university-originated biomedical products, research materials, and methods entered the commercial marketplace for use in patients and research. In 1992 the Association of University Technology Managers, the leading association for university technology-transfer professionals, reported that a survey of fifty selected universities, teaching hospitals, and other academic institutions showed aggregate royalty income of $260 million from technology licensing for the previous fiscal year.

The period from 1985 to 1993 also saw continued proliferation of university-based biotechnology companies and notable new product successes from first generation companies such as Amgen, Genentech, Biogen, and Genetics Institute. These successes helped establish the viability of university-based companies as a model for commercialization of university-originated technologies. Because all of these first-generation companies had been developed by the established venture capital industry, however, their success did not directly shed light on university-affiliated venture funds as a technology-transfer model. Only the long-term performance of the second- and third-generation companies established by these funds will yield such perspective. It is still too early to judge the performance of these companies or other projects pursued by these funds—or the funds themselves—because even the first among them to be established is young in the context of biomedical product commercialization.

The performance of large-scale university/industry research collaborations, which also proliferated between 1985 and 1993, is equally difficult to judge. These relationships clearly have opened important new avenues of investigation for leading pharmaceutical and chemical companies and have provided substantial funding for research in universities. But they have not directly produced new products. Like the new companies started by university-affiliated funds, the first among the potential new products originating in these collaborations are still young.

Two additional trends directly influencing commercialization of university-originated technologies developed simultaneously between 1985 and
1993. First, the growth of the new venture and long-term research collaboration models had made relationships among universities, university faculty, and industry increasingly close. This closeness raised serious concerns about the impact of these relationships on the quality and integrity of academic science.

These concerns rekindled debate on several basic policy issues surrounding traditional academic standards that had been raised by the earliest of WARF's licensing activities. In addition, the models originating in the Stanford/California and Harvard initiatives of the mid-1970s extended these issues into more complex and subtle areas concerning the relationships among faculty, the university, and industry. These concerns were intensified by a small but significant series of conflict-of-interest episodes that ultimately led to a reexamination and tightening of policies on conflict of interest and of commitment by academic institutions, federal agencies, and Congress. Alongside this trend, concerns about international competitiveness led the federal government to expand its advocacy of commercialization of federally sponsored research in universities, research institutes, corporations, and government agencies such as NIH. The integrity and competitiveness issues are dealt with in greater detail by David Blumenthal elsewhere in this volume.

The apparent and real contradictions raised by these two trends underlined the need for clearer federal, state, and institutional policies on commercialization of university-originated technologies. Research scientists, whether they work in universities, hospitals, or government agencies, will need better guidance on both the technology-transfer goals of their institutions and the limitations on their personal participation in the commercialization process. Over the long term, conflicting signals by the federal government and academic institutions may discourage both innovation and participation in bringing university-originated technologies into use.

Beyond this fundamental need for clarity, there exist a variety of other public policy issues affecting biomedical innovation. These include the requirements and efficiency of the Food and Drug Administration, technology import/export law, regulation of relationships between US. universities and foreign corporations, tax treatment of corporate funding of basic research at universities, and tax law affecting the venture capital industry and start-up companies.

Finally, whether the new models of commercialization of university-oriented technologies are effective has not yet been definitively proven. Such proof is likely during the next five years. However, broad acceptance is still likely to take another decade.