ACCELERATING TECHNOLOGY TRANSFER IN GREATER PHILADELPHIA

Identifying Opportunities to Connect Universities with Industry for Regional Economic Development

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Prepared by CEO Council for Growth

CEO COUNCIL FOR GROWTH™
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Dear Proponent of Greater Philadelphia's Economic Prosperity:

The CEO Council for Growth (CEO Council), a tri-state, eleven county business leadership organization, is excited to present the following report, entitled "Accelerating Technology Transfer in Greater Philadelphia: Identifying Opportunities to Connect Universities with Industry for Regional Economic Development." It provides a roadmap for capitalizing on the tremendous potential of Greater Philadelphia to become one of the top regions in the country for commercial development based on its research strengths.

Conceived by its Venture Capital Working Group, the CEO Council commissioned the Economy League of Greater Philadelphia to analyze the gap between the region's relatively robust science and technology research and its lagging new private sector development.

Based on a literature review, benchmarking against peer regions, and interviews with stakeholders, the study identifies several strategies for advancing the area's commercialization potential:

- Foster a culture of entrepreneurship in the region;
- Accelerate connections between researchers and entrepreneurs; and
- Build the talent and capital resources to support research and grow new companies.

The report makes targeted recommendations on the ways in which stakeholders in the private, public/non-profit, and academic sectors can contribute to accelerating technology transfer.

The Greater Philadelphia region has a tremendous opportunity to become an economic leader. It possesses a strong commercialization infrastructure, one of the nation's largest and richest life sciences industry clusters, and one of the world's leading collections of colleges and universities.

The CEO Council for Growth will provide leadership in bringing together the major stakeholders involved, including universities, technology transfer offices, venture capital groups, and life sciences and other industries, to achieve the goals of accelerating knowledge and technology transfer and enhancing Greater Philadelphia's considerable economic potential. I look forward to participating in that process.

Sincerely,

Russel Kaufman MD

Russel E. Kaufman, M.D.
President & CEO, The Wistar Institute
Chair, Venture Capital Working Group, CEO Council for Growth

Accelerating Technology Transfer in Greater Philadelphia

Identifying Opportunities to Connect Universities with Industry for Regional Economic Development

I. Executive Summary

Like perhaps no other time in the region's recent history, Greater Philadelphia is poised for sustained economic momentum. The rest of the world is just now starting to understand what Philadelphians have known for a long time — that Greater Philadelphia is one of America's great regions, combining a high quality of life, world-class attractions and assets, a large and diverse economy, and one of the world's leading collections of colleges and universities.

However, despite the excitement, Greater Philadelphia continues to lag in key indicators of new company formation, and struggles to connect the innovative ideas of its universities and research centers to new private sector development and growth, a commercialization process commonly referred to as technology transfer. By advancing technology transfer practices, Greater Philadelphia can leverage and better connect science and technology research with regional economic development efforts, thereby taking full advantage of one of the region's preeminent economic strengths.

Accelerating the region's commercialization potential will require attaining several outcomes related to technology transfer:

- A streamlined process by which knowledge is transferred;
- A reduced cultural gap between industry and academia;
- A reduced funding gap between research grants and seed money;
- A coordinated regional marketing campaign; and
- An enhanced effort at celebrating regional scientific and commercialization success.

To achieve these goals, the CEO Council for Growth™ (CEO Council) set out to identify ways to cultivate technology transfer and enhance the region's commercialization potential. The CEO Council is comprised of over 70 CEOs from the tri-state region who are dedicated to making Greater Philadelphia one of the nation's top business locations. To that end, the CEO Council is focused on several high impact initiatives that will help make the region more competitive. They are promoting strategic transportation and infrastructure investment, improving our human capital and fostering an entrepreneurial environment that enhances innovation and commercialization and marketing the Greater Philadelphia region.

The CEO Council commissioned the Economy League of Greater Philadelphia to conduct a gap analysis. The Economy League analyzed best practices, benchmarked Greater Philadelphia against peer U.S. regions, and solicited regional stakeholders' input. The research and analysis suggested several ways to advance the region's commercialization potential. They are to:

- Foster a culture of entrepreneurship in the Greater Philadelphia region;
- Accelerate connections between researchers and entrepreneurs; and
- Build the talent and capital resources to support research and grow new companies.

From these strategies, targeted recommendations were highlighted to identify ways in which key stakeholders can play a role in accelerating technology transfer. Stakeholders were grouped into three categories: 1) the private sector; 2) the public and non-profit sectors; and 3) the academic sector. Summary recommendations for each group are as follows:

⇒ Private sector

- Advocate for increased federal, state, foundation and private funding to support scientific research, entrepreneurship and launch companies;
- Market the Greater Philadelphia region as a center of innovation to attract venture capital and entrepreneurs; and
- Foster partnerships among the business community, public and non-profit sectors.

⇒ Public & non-profit sectors

- Create a venue or venues to serve as the "clubhouse" for innovation in the region and provide programming to attract researchers, entrepreneurs and investors to the venue;
- Provide affordable incubator and lab space for start up and early stage companies; and
- Develop collaborations to: 1) improve accessibility of information about funding and support services; 2) aid funding applications; 3) market technologies; and 4) highlight successes using awards and recognition programs.

⇒ Academic sector

- Establish a clear institutional goal to create a culture of entrepreneurship and encourage technology transfer;
- Facilitate connections within universities among researchers and entrepreneurs and expand opportunities to showcase innovative technologies and intellectual property to venture capitalists and entrepreneurs; and
- Foster faculty technology and knowledge transfer and entrepreneurial support by valuing this work.

The CEO Council will provide leadership in achieving regional outcomes targeted at accelerating knowledge transfer and enhancing Greater Philadelphia's economic potential. In so doing, the CEO Council will pursue a series of priority action items:

- Explore raising capital for a "proof-of-concept" research fund;
- Work with leaders in Delaware, New Jersey, and Pennsylvania to create a priority list for federal and state funding;
- Provide the CEO Council with specific opportunities to connect with the entrepreneurial community, share insights, and act as mentors;
- Re-convene a working group of stakeholder organizations to refine the region's objectives and agenda and coordinate roles and responsibilities; and
- Recruit additional CEO leaders to participate in the implementation of an action plan to accelerate the region's technology transfer and commercialization potential.

The CEO Council has agreed to provide assistance to accomplish the following:

- Increase the Greater Philadelphia region's ratio of venture capital to NIH funding;
- Complete a plan for identifying resources for a 'Proof of Concept' fund;
- Along with partner organizations, present a list of regional funding and policy priorities to Greater Philadelphia's tri-state Congressional delegation and state legislatures;
- CEO Council members will participate in six events/meetings that bring together entrepreneurs, venture capitalists and researchers; and
- Create and convene a regional stakeholder group four times in pursuit of implementing an action plan.

II. Introduction

In today's knowledge-based economy, technology transfer is a critical element of regional economic development, providing a mechanism for leveraging university research to promote industry growth.

The practice of technology transfer is a multifaceted, complex enterprise. For this reason, significant research has been devoted simply to defining the elements, scope, and context of technology transfer, developing a comprehensive and coherent model for understanding the commercialization process, and determining ways to assess its effectiveness.

However, the commercialization of innovations is just one of many ways that universities and other research institutions impact regional economic development. Indeed, the concept of *knowledge transfer* has taken hold as a more common way to analyze an expanded and truly comprehensive set of means by which information is disseminated for use in the private sector. While more indirect and abstract than technology commercialization, knowledge transfer is a more accurate perception of how research institutions impact the regional economy.

Delineating the difference between technology transfer and knowledge transfer is often a matter of semantics. Experts in the field recognize that technology transfer encompasses more than just commercialization. However, there is a need to differentiate between the commercialization process and a broader scope of transfer mechanisms. Therefore, for the purposes of this review, technology transfer will refer to commercialization, while knowledge transfer will refer to all forms of innovation dissemination.

While studies have tended to focus on how research institutions should cultivate knowledge transfer to accelerate regional economic development, the onus is not only on universities and laboratories to pursue these efforts. It is integral that all regional stakeholders – the private sector, public and non-profit sectors, as well as the academic sector – play a supportive role in tightening the links between research and industry. A collaborative effort must be forged to pursue these efforts and ensure the region fully capitalizes on its intellectual assets.

This study represents a comprehensive effort to analyze how stronger and more productive working relationships between centers of innovation and industry can be cultivated and solidified to promote regional economic development. The report is divided into the following sections, highlighting key findings at each stage of analysis:

A. Technology and knowledge transfer: conceptualizing the impact of innovation

B. Benchmarking Greater Philadelphia against peer U.S. regions

C. Operationalizing lessons to accelerate technology and knowledge transfer in Greater Philadelphia

III. Methodology

Research and analysis was conducted in three stages. First, best practices were analyzed through a literature review of 32 national studies. Second, the Greater Philadelphia region was benchmarked against nine peer U.S. regions. In the report, the definition of each benchmark region varies slightly across indicators due to inconsistencies among data sources. However, unless otherwise noted, analysis employs the following definitions:

- Baltimore, MD: Baltimore-Towson Metropolitan Statistical Area (MSA);
- Boston, MA: Boston-Cambridge-Quincy MSA;
- New York, NY: Former PMSA Counties – Bronx (NY); Kings (NY); New York (NY); Putnam

(NY); Queens (NY); Richmond (NY); Rockland (NY); Westchester (NY).

- Greater Philadelphia: 11-county Philadelphia region — Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania; Burlington, Camden, Gloucester, Mercer, and Salem Counties in New Jersey; and New Castle County, Delaware;
- Pittsburgh, PA: Pittsburgh MSA;
- Raleigh-Durham, NC: Raleigh-Cary-Durham Combined Metropolitan Statistical Area (CMSA);
- San Diego, CA: San Diego-Carlsbad-San Marcos MSA;
- San Francisco, CA: San Francisco-Oakland-San Jose CMSA;
- Seattle, WA: Seattle-Tacoma-Bellevue MSA; and
- Washington, D.C.: Washington-Arlington-Alexandria MSA.

In all cases, mention of a city name refers to that city's corresponding metropolitan region.

Third, regional perspectives were solicited through 21 interviews with president and provost level academics, technology transfer professionals, scientists, and principals at quasi-government service provider organizations. Additional feedback was also received at a meeting that convened over 30 of the region's technology transfer stakeholders.

Finally, analysis highlights specific industry clusters, detailing trends in the life sciences and physical sciences so as to not mask sector-specific developments.

IV. Analysis

A. Technology & Knowledge Transfer: Conceptualizing the Impact of Innovation

In general, technology transfer refers to the movement of knowledge and technology via some channel from one individual or organization to another. While this most fundamental conceptualization is universally accepted, reality suggests that theoreticians and practitioners approach technology transfer in a variety of ways.

Some stakeholders focus on technology commercialization, a process by which technologies that originate in universities are ultimately used by industry. A potential explanation for this narrow focus is simply one of practicality: commercialization is a direct, concrete process with a set of material indicators that are relatively straightforward and readily available.

Others define technology transfer as the dissemination of innovations and ideas, a process by which knowledge is channeled from academic institutions into the private sector. In the past, this broader conceptualization has been overlooked, as the inclusion of more abstract impacts diminished the effectiveness and completeness of indicators. However, more recent studies have begun to operationalize knowledge transfer factors in an attempt to understand the full impact of academia on economic development.

For the sake of clarity, this analysis will delineate these two approaches by referring to the commercialization process as technology transfer and the dissemination of innovations and ideas as knowledge transfer.

⇒ Assessing the actors in technology transfer

Successful commercialization of a new technology fundamentally depends on the collaborative abilities of key actors in the process. As Figure 1 illustrates, university scientists, technology transfer professionals, and private sector firms and entrepreneurs converge on technology transfer with an array of perspectives.

University scientist. Universities hire scientists to increase institutional expertise in highly specialized fields. However, institutional resources available for scientific research are limited. It is not uncommon for research-intensive universities to fund a portion or none of an untenured scientist's anticipated salary, expecting the scientist to generate the remainder from grant awards. For this reason, most university scientists' primary motivations are: 1) to secure grants, which fund additional research, graduate student assistants, and laboratory equipment; and 2) to publish papers, which university administrators and grant writers typically employ as the key indicator of scientific productivity.

Technology transfer office (TTO). University administrators hire technology transfer profession-

Figure 1: Key actors in the technology transfer process

Stakeholder	Actions	Primary Motives	Secondary Motives	Organizational Culture
University scientist	Discovery of new knowledge	Recognition within the scientific community-publications, grants (especially if untenured)	Financial gain & additional research funding (mainly for graduate students and lab equipment)	Scientific
Technology transfer office	Works with faculty members and firms/ entrepreneurs to structure deals	Protect and market the university's intellectual property	Facilitate technological diffusion and additional research funding	Bureaucratic
Firm/ entrepreneur	Commercializes new technology	Financial gain	Maintain control of proprietary technologies	Organic/ entrepreneurial

Source: Siegel et al. (2004)

als to serve a dual purpose: 1) to protect the university's intellectual property; and 2) to market its technologies to potential licensees. In these roles, the TTO serves as a surrogate for the administration, an agent for scientists, and a point of contact for firms and entrepreneurs. In short, the office is expected to serve the needs of everyone. However, a variety of institutional restrictions impede the TTO's ability to execute each of these functions at full capacity.

Firms and entrepreneurs. The primary aim of the private sector is to run a business and turn a profit. Firms and entrepreneurs engage in technology transfer to leverage the development of new technologies for financial gain. For this reason, a lengthy commercialization process can be prohibitive for the private sector, increasing costs and diminishing the attractiveness of a new technology.

Generally referred to as the university-industry culture clash, divergent perspectives characterizing the academic and private sector worlds hinder the development of collaborative relationships necessary to successfully commercialize a technology. As Figure 2 illustrates, there is a natural incompatibility between the mission of universities and industry, creating conflict that threatens to stymie technology transfer.

Despite their differences, universities and industry understand the mutually beneficial qualities of commercialization. Research institutions see technology transfer as a potentially lucrative endeavor. Success stories, such as Silicon Valley (Stanford University) in California and the Route 128 Corridor (MIT, Harvard University, etc.) outside of Boston, Massachusetts have provided the impetus and model for technology transfer advancement worldwide. These centers of innovation have generated considerable wealth and notoriety for the universities that have established and promoted their existence.

For private sector, there is intrinsic value in leveraging the market value of technological innovations. For established firms, successfully integrating a new technology can mean large profits. For entrepreneurs, investing in new scientific discoveries can lead to a successful start-up company and a sizable long-term return.

⇒ Modeling technology transfer

The practice of commercializing a new technology for use in the private sector is a complex, multifaceted endeavor that encompasses a multidirectional sequence of events. Significant research has been devoted simply to reaching a comprehensive – and coherent – model for understanding how various elements and relationship dynamics affect the practice.

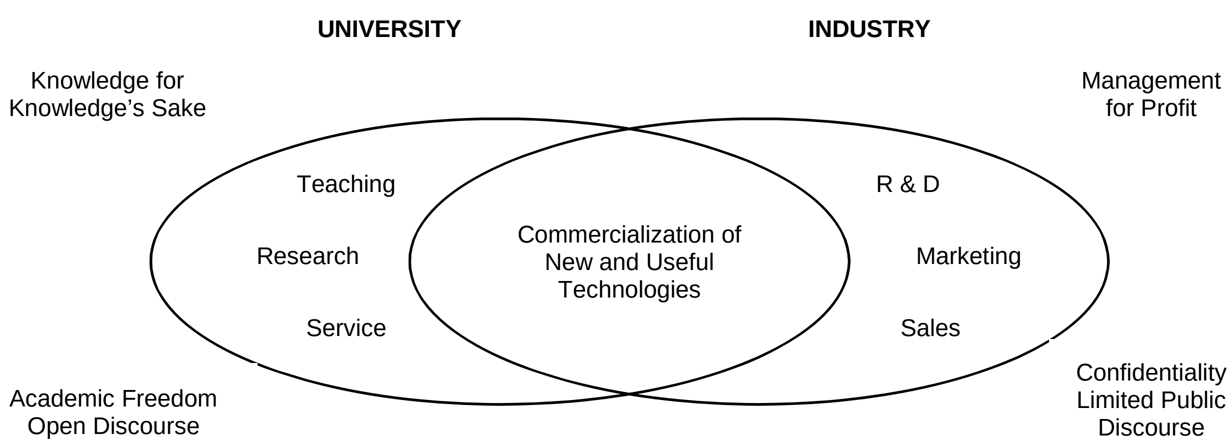
Traditionally, the process begins with the disclosure of a university scientist's innovation to the institution's TTO. The TTO then makes a series of decisions that by in large determine the technology's fate. First, the TTO evaluates the product for patenting. If the evaluation is favorable, the TTO then decides whether to pursue a patent, a lengthy and costly process in itself.

Upon receiving a patent, the TTO begins to market the technology. Interested firms and entrepreneurs respond, and licensing negotiations commence. If negotiations are successful, the firm or entrepreneur gains access to the new technology. In turn, the university receives an initial payment for the license and continues to collect royalties for use of the technology. To complete the cycle, transferred technologies often spur further discoveries, perpetuating the scientific process and multiplying the true impact of commercialization.

As Figure 3 illustrates, this basic framework is impacted by a number of institutional factors that shape the commercialization process:

- University rewards systems;
- Resources devoted to technol-

Figure 2: The university-industry culture clash



Source: Berneman (2003).

ogy transfer;
- Cultural understanding;
- TTO skill set; and
- University flexibility.

University reward systems. University-based incentives for faculty involvement stimulate technology transfer.

University resources dedicated to technology transfer. Allocation of resources to the TTO for patenting and marketing costs increases patent and license production.

Cultural understanding. Cultural misunderstanding between universities and industry reduces the effectiveness of technology marketing and impedes license negotiations.

TTO skill set. Technology transfer officers with outreach, marketing and negotiation experience enhance collaborative relationships with industry representatives.

University flexibility. Risk-averse universities tend to protect intellectual property and develop rigid conflict of interest standards. These policies stymie licensing, company formation, and create an unfriendly environment for faculty entrepreneurialism.

Each factor impacts different stages of the technology transfer continuum. Understanding and addressing the influence of each on the process is fundamental to successfully commercializing a technology.

⇒ Measuring technology transfer

Universities and industry assess technology transfer with a series of indicators describing output at various stages of the continuum. These measures can be grouped into five categories:

- Research and development (R&D) expenditures;
- Invention disclosures received;
- Patents;
- Licenses;
- Start-up companies; and
- Venture capital investment.

R&D expenditures. As an indicator of research prominence, universities and industry track both the source — government, institution, or industry — and subject focus — life sciences, physical sciences, engineering, etc. — of R&D funds.

Invention disclosures received. As an indicator of research productivity, universities track the number of preliminary invention submissions made by scientists.

Patents. As an indicator of innovation, universities track both institutional patents filed and awarded.

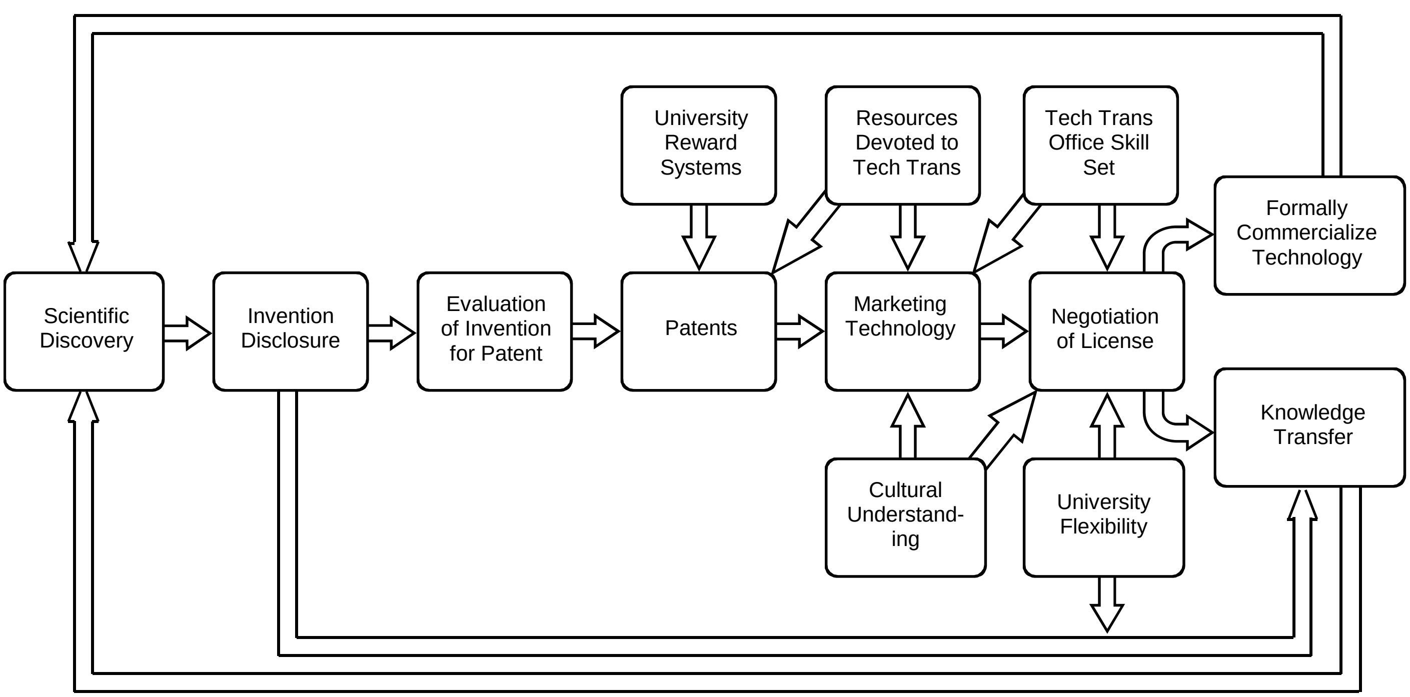
Licenses. As an indicator of successfully commercialized technologies, universities track both number of license agreements consummated and annual license revenue.

Start-up companies. As a secondary indicator of successfully commercialized technologies, universities track the number of start-up companies derived from discoveries originating at the institution.

Venture capital investment. As an indicator of entrepreneurialism, regions track overall and sector-specific venture capital as well as the number of venture capital deals consummated.

⇒ Assessing knowledge transfer's broader set of impacts

Figure 3: Factors influencing the technology transfer process



Source: Siegel et al. (2004).

Increasingly, assessments of technology transfer's capacity to promote economic development have been altered to include a broader set of impacts. Recognizing that commercialization is just one of many mechanisms through which research institutions transfer knowledge into the private sector, this more comprehensive approach underscores academia's profound role in promoting and accelerating regional economic development.

In general, there are three mechanisms by which knowledge transfer occurs:

- Local networks of university and industry professionals;
- Formalized business relations; and
- Utility of university physical facilities.

Local networks of university and industry professionals. Knowledge transfers can occur through any number of different university-industry collaborative relationships, including: research partnerships; workforce development initiatives; faculty consulting; university seminars; conferences; student internships; local professional associations; and the continuing education of employees.

Formalized business relations. Knowledge transfer can occur through university spin-off companies and technology licensing.

Use of university physical facilities. Knowledge transfers can be facilitated by the presence of libraries, scientific laboratories, computer facilities, and research parks on university campuses.

Through these mechanisms, research institutions promote economic development in two ways. First, by transferring tacit knowledge, research institutions provide a forum for intimate contact between entrepreneurs and scientists. Close-contact relationships are essential to leverage scientific breakthroughs that are often difficult to otherwise codify; without these relationships, many scientific discoveries would never reach private sector utilization. This geographical constraint also increases the likelihood that the benefit of many scientific innovations will be realized locally.

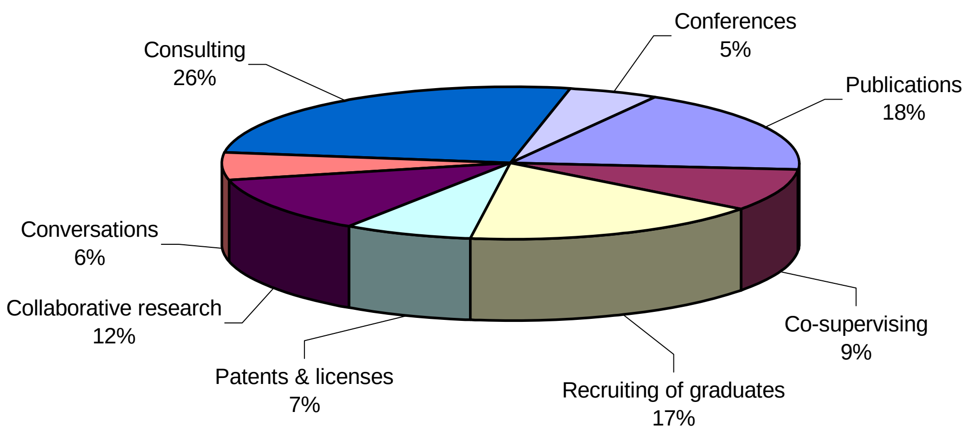
Second, by generating a highly qualified and specialized stream of graduates to be absorbed into specialized markets, research institutions provide a well-educated workforce. Workforce development is perhaps the most vital component of a university's role in stimulating economic development.

A recent poll of MIT faculty patentholders supports the notion that commercialization is just one piece of academia's transfer impact on economic development. As Figure 4 illustrates, MIT faculty patentholders awarded patents and licensing only seven percent in a measure of relative importance of knowledge transfer channels, compared to 26 percent for consulting, 18 percent for publications, and 17 percent for graduate recruiting.

The concept of knowledge transfer has provided a fresh perspective on the economic impact of academia by shifting analysis away from the universities and onto the indus-

> "Universities need a stronger awareness of the pathways along which local industries are developing and the innovation process that are associated with those pathways. They should seek to align their own contributions with what is actually happening in the local economy. This strategic approach to local economic development is fully compatible with the pursuit of excellence in the university's traditional primary missions of education and research."
>
> *Richard Lester*
> *MIT Industrial Performance Center*

Figure 4: MIT patentholder perspectives of relative importance of knowledge transfer channels



Source: Lester (2006).

trial development process. Instead of focusing on changes to university processes, analysis has centered on strengthening local capabilities for innovation.

Richard Lester, Director of the MIT Industrial Performance Center and a pioneer of this approach, argues that focusing on local economies allows analysis to assess the role of universities in the context of the many forces that drive economic development.

According to Lester, despite the fact that universities are key engines of industry growth, research should not focus on what universities can do, but rather on "what kind of transformation is occurring in the local economy." This reorientation is not to diminish the role of research institutions in economic development, but rather to suggest that a university will only be successful in development efforts if the relevant economic forces are appreciated.

⇒ Measuring knowledge transfer

Developing a set of indicators to gauge knowledge transfer is a challenge because its products are relatively abstract. For this reason, any compilation of measures tapped to describe a set of knowledge transfer impacts will tend to underestimate the full extent of an institution's innovative value.

However, a number of indicators can be legitimately employed to quantify some facets of knowledge transfer. In addition to the standardized set of commercialization measures, outputs that can be tracked include:

- Number of publications;
- Conferences;
- Consulting agreements;
- Graduate student recruits; and
- Collaborative research partnerships.

While such evaluations are sure to fail in comprehensively assessing the extent of a university's role in economic development, developing a set of indicators to analyze knowledge transfer is still useful for stakeholders and policymakers to understand the impact academic activity and the diffusion of knowledge has on the economy.

B. Benchmarking Greater Philadelphia Against Peer United States Regions

Within a given region, universities, government, quasi-government service providers, private sector firms and entrepreneurs, non-profits, and the economic development community all play a role in moving a technology from laboratory to commercial use. Given the plethora of factors that impact commercialization, it is no surprise that regions have experienced varying degrees of success at accelerating a process defined by several critical stages of technology development. Each stage is associated with key indicators that measure successful technology transfer. These include:

- Research and development;
- Invention disclosure;
- Patenting;
- Licensing;
- Company formation; and
- Venture capital.

Along this continuum, various barriers inhibit successful technology transfer. In general, these impediments can be grouped into three categories:

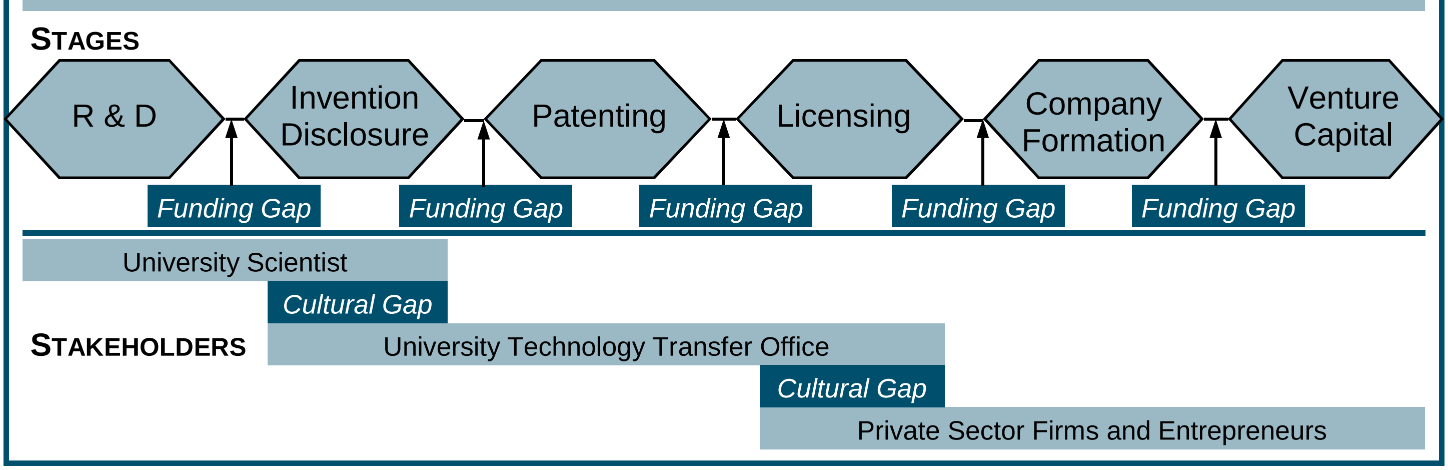
- Funding gaps;
- Cultural gaps; and
- Incentive misalignments.

Funding gaps. Transition points feature a risk for funding gaps that frequently hinder technology transfer. Limited resources on both sides of these transition points can prematurely halt technology development and inhibit commercialization efforts.

Cultural gaps. Where stakeholder groups interact, cultural gaps can represent an impediment to technology transfer. Fundamental differences between stakeholders regarding organizational culture and professional motivations can prove to be a significant barrier.

Incentive misalignments. Stakeholder incentives that run counter to technology transfer stymie the development of promising technologies and frequently represent a pro-

Figure 5: Stages & gaps along the technology transfer continuum



hibitive factor for engaging in the technology transfer process at all.

⇒ Research & development

For a region to successfully commercialize technologies, it must have a significant research base that promotes scientific enterprise.

With 88 colleges and universities, Greater Philadelphia is one of the largest centers of academia in the country. The National Science Foundation tracks degrees granted by subject at American institutions of higher education. As Figure 6 illustrates, in 2004, over 67,000 students graduated from the region's colleges and universities, trailing only New York, Boston, and San Francisco. Twenty-six percent of Greater Philadelphia's graduates completed a degree in a science or engineering field.

For this knowledge base to translate into productive research, scientists apply for grants to fund investigative processes. These monies are typically referred to as R&D funds.

The NSF also tracks academic R&D funding both by source and subject area. As Figure 7 illustrates, the majority of R&D funds are provided by the federal government. In 2005, federal agencies funded 68 percent of Greater Philadelphia's R&D, a lower federal portion than many other regions. Baltimore, Boston, Pittsburgh, and Seattle each collected over 80 percent of their R&D funds from the federal government.

Figure 7 also details R&D funds by subject area. In 2005, Greater Philadelphia devoted 62 percent of its total R&D funds to life sciences, followed by engineering (14 percent) and physical sciences (8 percent). New York devoted the highest percentage of R&D funds to life sciences (79 percent), while Baltimore devoted the highest percentage to engineering (24 percent) and San Francisco the highest to physical sciences (13 percent). Overall,

Figure 7: Financing of academic R&D, 2005

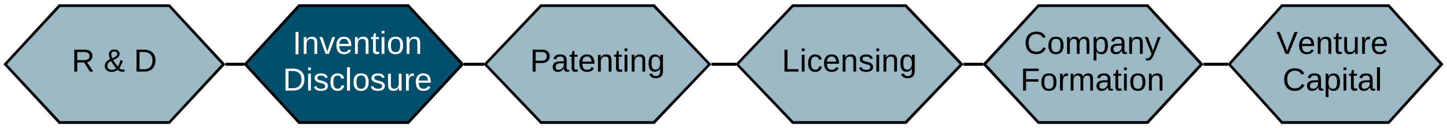
Region	By Source ($000s) Federal	State/Local	Industry	Institution	Other	TOTAL
Baltimore	1,468,735	45,934	83,833	118,245	118,216	**1,834,963**
Boston	1,453,050	40,782	124,232	62,071	135,009	**1,815,144**
New York	1,237,098	25,629	43,557	202,408	151,088	**1,659,780**
Greater Philadelphia	**923,523**	**40,800**	**70,737**	**200,750**	**123,005**	**1,358,815**
Pittsburgh	613,677	25,148	21,240	56,804	30,001	**746,870**
Raleigh-Durham	698,994	40,567	141,286	153,601	39,606	**1,074,054**
San Diego	776,507	26,479	51,638	174,100	111,244	**1,139,968**
San Francisco	1,405,285	78,517	96,516	333,659	278,696	**2,192,673**
Seattle	607,666	9,860	45,303	29,822	16,598	**709,249**
Washington, D.C.	521,950	19,754	24,362	148,740	44,231	**759,037**
Region	**By Subject Area ($000s) Engineering**	**Physical Sciences**	**Geo Sciences**	**Life Sciences**	**Other**	**TOTAL**
Baltimore	448,555	154,985	58,645	992,151	180,627	**1,834,963**
Boston	306,637	218,959	78,429	997,518	213,601	**1,815,144**
New York	54,065	94,631	67,122	1,313,843	130,118	**1,659,780**
Greater Philadelphia	**194,676**	**104,084**	**38,168**	**841,050**	**180,837**	**1,358,815**
Pittsburgh	84,196	37,033	3,448	460,897	161,296	**746,870**
Raleigh-Durham	34,337	41,648	36,079	869,614	92,376	**1,074,054**
San Diego	88,431	56,394	130,935	752,689	111,519	**1,139,968**
San Francisco	340,339	285,320	74,050	1,327,377	165,587	**2,192,673**
Seattle	72,050	36,744	82,347	485,357	32,751	**709,249**
Washington, D.C.	112,178	87,816	21,440	333,225	204,378	**759,037**

Source: National Science Foundation.

Figure 6: Degrees conferred by subject area, 2004

Region	Engineering	Physical Sciences	Geo Sciences	Life Sciences	Other S&E	TOTAL S&E	Arts & Humanities	TOTAL
Baltimore	1,265	321	100	4,063	2,878	8,627	16,844	**25,471**
Boston	3,873	876	132	8,267	7,088	20,236	57,517	**77,753**
New York	1,573	502	92	9,580	8,989	20,736	85,940	**106,676**
Greater Philadelphia	**2,402**	**610**	**76**	**8,742**	**5,779**	**17,609**	**49,868**	**67,477**
Pittsburgh	1,207	270	71	2,866	4,002	8,416	19,809	**28,225**
Raleigh-Durham	2,076	487	54	3,483	2,012	8,112	14,237	**22,349**
San Diego	1,202	388	60	2,436	2,121	6,207	31,616	**37,823**
San Francisco	3,995	816	205	6,615	8,702	20,333	57,043	**77,376**
Seattle	1,044	646	111	3,067	6,010	10,878	30,496	**41,374**
Washington, D.C.	2,239	318	37	4,315	6,388	13,297	35,673	**48,970**

Source: National Science Foundation.



Greater Philadelphia's $1.36 billion R&D expenditures ranked fifth out of the ten peer regions, at a similar level as Raleigh-Durham, San Diego, and New York, but well behind Baltimore, Boston, and San Francisco.

Barriers to R & D. Life sciences and federal R&D funding has lagged in recent years due to cutbacks at the National Institutes of Health (NIH). The grant process has become increasingly competitive, and grants awarded are smaller than they have been in the past. According to one interviewee, the NIH has begun skimming as much as $25,000, or ten percent, from grants even before they are awarded.

The increasingly competitive grant process has put more pressure on scientists, who must spend additional time writing grant proposals to simply cover laboratory costs. As a result, publications have become more important as an indicator of scientific productivity, leaving scientists little time to even consider commercialization.

Moreover, grants typically expire before an innovation has developed into a commercializable product. A funding shortage for proof-of-concept research has inhibited the marketability of many technologies with commercialization potential, a major gap in technology transfer efforts.

Opportunities to accelerate R&D. To increase R&D expenditures in Greater Philadelphia, regional leaders could step-up efforts to lobby government, advocating for increased federal and state funding to support scientific research. Additionally, recruiting world-class scientists would attract additional research dollars to the region.

Perhaps most importantly, the region can enhance its R&D profile by supporting proof-of-concept research. This could be accomplished by pooling university dollars to create a "proof-of-concept fund". Dedicating dollars as such would help move promising technologies to a point of commercializability.

⇒ Invention disclosure

To set commercialization in motion, scientists with a promising innovation complete a disclosure form that describes the technology's basic elements, including how the idea was conceived, how the product works, and what its market might be. The disclosure is then sent to the institution's TTO.

Invention disclosures are a useful measure of scientific engagement in commercialization. The Association of University Technology Managers (AUTM) tracks invention disclosures by institution. Aggregating institution totals allows for regional comparison. However, only select institutions respond to the AUTM survey each year. For this reason, institutional aggregations are likely to understate the actual number of regional invention disclosures (AUTM survey respondent institutions are listed by region in Appendix C).

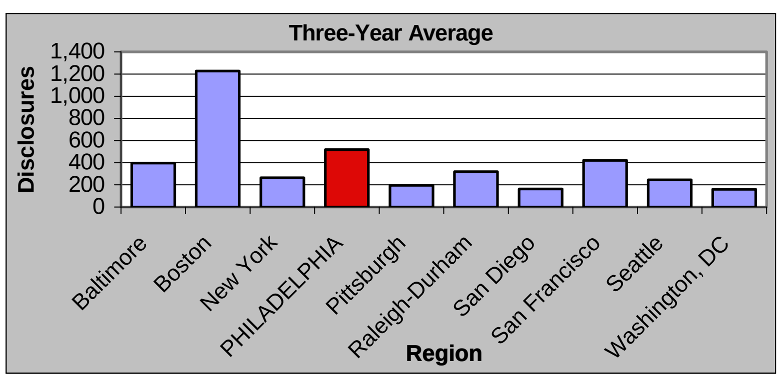
Moreover, variable institutional response rates have lead to large annual fluctuations in regional totals. For this reason, invention disclosures are reported for the years 1996, 2000, and 2004 and then averaged, limiting the impact of annual fluctuations on regional comparability.

As Figure 8 illustrates, Boston respondent institutions more than doubled any other region in invention disclosures with an average of 1,226. Greater Philadelphia was second among peer regions with a three-year average of 520 disclosures, a higher average than both San Francisco (423) and Baltimore (397).

Barriers to invention disclosure. In general, the culture of universities is a significant impediment to invention disclosure. As one interviewee explained, the academic environment is one of a perpetual search for new knowledge. Traditionally, entrepreneurialism has not factored into this discovery process. For this reason, technology transfer

Figure 8: Invention disclosures received (1996, 2000, 2004)

Region	1996	2000	2004	Average
Baltimore	276	445	469	397
Boston	807	1,209	1,662	1,226
New York	250	310	229	263
Greater Philadelphia	**408**	**496**	**655**	**520**
Pittsburgh	132	216	243	197
Raleigh-Durham	91	439	423	318
San Diego	147	112	229	163
San Francisco	282	408	578	423
Seattle	254	235	247	245
Washington, D.C.	130	168	187	162



Source: Association of University Technology Managers.

professionals have found it difficult to convey the benefits of commercialization to scientists.

Moreover, the alignment of institutional incentives discourages scientists from engaging in technology transfer. To sustain employment, a scientist will focus on publications, a key indicator of research productivity and influential factor in tenure review. Very few institutions consider technology transfer in tenure decisions. To finance research, a scientist will focus on grant applications, as awards typically comprise over fifty percent of a scientist's salary. Royalty payments, even from a successfully commercialized technology, often go realized for years.

Simply put, there are few reasons for a researcher to take a personal interest in technology transfer. For this reason, many scientists, even those with promising innovations, disregard invention disclosure altogether.

Opportunities to accelerate invention disclosure. Technology transfer professionals able to establish and maintain a level of connectivity with scientists build trust and interest among faculty members in the mission of commercialization. Constant communication is critical. Holding seminars, networking events, or even simply showing interest in laboratory research can aid this process and motivate scientists to disclose innovations.

Universities and research centers can also motivate scientists by developing a pervasive institutional culture of entrepreneurship. More specifically, institutions can create incentives for invention disclosure and foster technology transfer by valuing the work. This reform could accelerate commercialization simply by increasing the pool of potentially commercializable technologies.

Regions themselves can incentivize technology transfer by establishing awards events that recognize commercialization excellence. Such acknowledgement would not only reward productive scientists but motivate other researchers to pursue commercialization for their own technologies, a process that begins with invention disclosure.

⇒ Patenting

A disclosed technology will be reviewed by a university's TTO to gauge patenting potential. Due to budgetary limitations, technology transfer professionals must be selective in this process, pursuing patents for only the most promising technologies.

Universities are not the only institutions that patent technologies. In fact, between 2000 and 2004, the top four patenting institutions in Greater Philadelphia were private corporations (See Appendix A for a list of the top 30 patenting institutions in Greater Philadelphia and each of its benchmark regions).

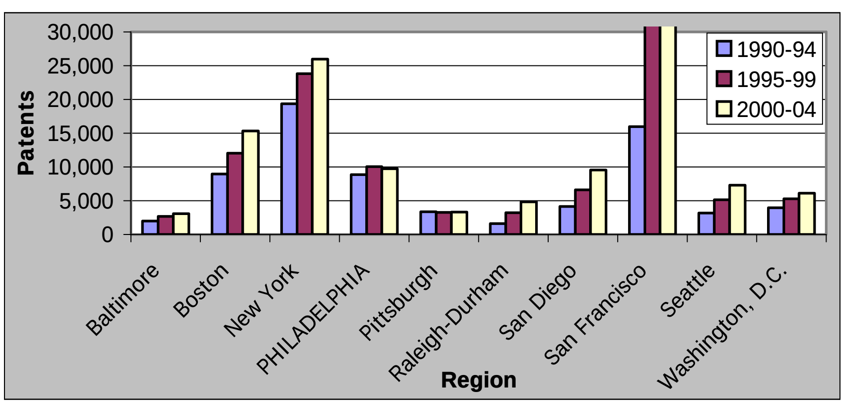
The Institute for Strategy and Competitiveness at the Harvard Business School tracks regional patents granted to universities, research centers, and corporations. To account for annual fluctuations, regional patent totals from 1990 through 2004 were aggregated into five-year intervals.

As Figure 9 illustrates, the San Francisco-Bay Area has far outpaced any other region in patent production, patenting over 50,000 technologies between 2000 and 2004, twice that of the next highest region. Greater Philadelphia patented nearly 10,000 technologies during that time, behind San Francisco, New York and Boston. Interestingly, Greater Philadelphia was the only region analyzed to experience a decline in total patents from 1995-1999 to 2000-2004.

Barriers to patenting. Skyrocketing legal costs have imposed a significant impediment to patenting ef-

Figure 9: Patents granted, five-year intervals (1990-2004)

Region	1990-94	1995-99	2000-04
Baltimore	2,027	2,709	3,078
Boston	8,948	12,057	15,333
New York	19,376	23,832	25,959
Greater Philadelphia	**8,864**	**10,036**	**9,736**
Pittsburgh	3,403	3,274	3,339
Raleigh-Durham	1,613	3,216	4,849
San Diego	4,182	6,600	9,581
San Francisco	15,973	33,149	52,815
Seattle	3,197	5,148	7,298
Washington, D.C.	3,952	5,310	6,137



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.
Notes: Patent totals for Philadelphia region are for MSA only, and does not include patentholders in Mercer County, NJ.

forts. University TTOs typically operate under tight budgets and are frequently forced to shelve technologies with commercialization potential due to lack of funding.

Scientists unfamiliar with funding limitations tend to grow frustrated with the TTO's unwillingness to pursue a patent for their innovations. Additionally, one stakeholder suggested that scientists often have an inflated view of the market for their innovations. Such disconnects can serve as a strong disincentive for invention disclosure in the future.

Another difficulty is that patenting costs are highly variable and are problematic for budgeting on an annual basis. At least one university in Greater Philadelphia has experimented with separating patent expenditures from fixed office operating costs, essentially creating a second technology transfer budget that matches patenting costs to licensing revenues. However, this introduces a new funding dilemma as licensing revenues also fluctuate and are frequently unrealized for many years.

Limited funds for patenting is not just a dilemma for U.S. institutions or regions competing against each other, but for the nation as a whole. American patent production has lagged relative to our international rivals, putting the United States at a competitive disadvantage in the global market where the commercialization potential is enormous. As this globalization trend continues, federal and state officials will be forced to address this issue and re-evaluate the ways in which the government invests in technology commercialization.

Opportunities to accelerate patenting. By increasing TTO funds for patenting, an institution can grow its portfolio of marketable technologies, thereby increasing commercialization potential.

Government can also play a role to help stem rising patent costs. By expanding the flexibility of current technology investments, lawmakers can afford institutions the ability to allocate dollars where needs are most pressing. For many institutions, this would include patenting purposes. This investment realignment would increase U.S. patent production and improve America's competitiveness in international technology markets.

⇒ Licensing

The TTO markets its portfolio of patented technologies to relevant industry sectors. Interested firms and entrepreneurs will engage with licensing professionals and license negotiations commence.

License negotiations represent a critical linkage between academia and industry, an explicitly co-dependent activity with the potential for a mutually beneficial result.

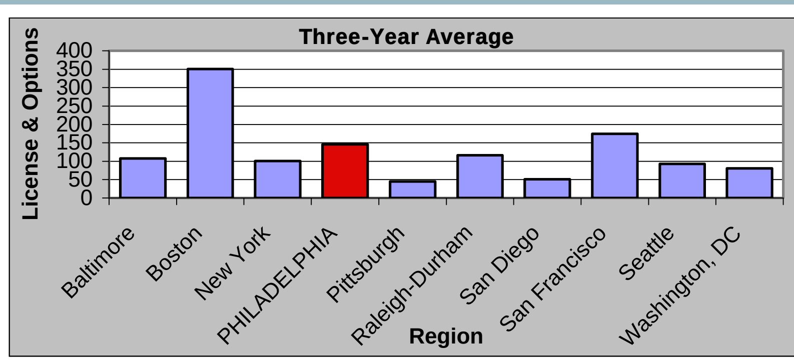
AUTM tracks the total number of licenses and options executed at universities and research centers across the country (An "option" refers to an agreement in which a potential licensee is granted a time period during which it may evaluate the technology and negotiate the terms of a license agreement). As with invention disclosures, aggregating AUTM respondents likely understates the actual number of licenses and options executed in each region. Still, the data is useful for comparing licensing productivity across regions.

As Figure 10 illustrates, Boston's three-year average of 351 licenses and options executed far outpaced any other region, more than doubling San Francisco's average of 174. Greater Philadelphia's average of 146 licenses and options ranked third among benchmark regions. Raleigh-Durham (116), Baltimore (108), and New York (101) also averaged more than one hundred licenses and options executed per year.

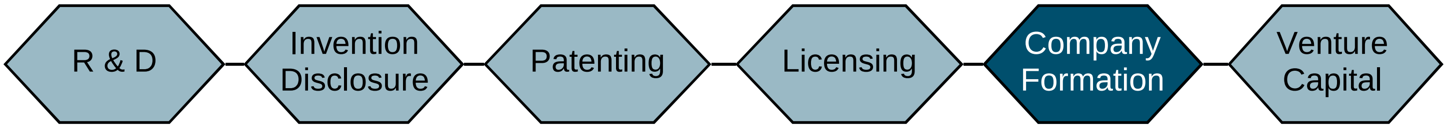
Barriers to licensing. As stated previously, licensing negotiations represent a direct linkage between academia and industry. For this

Figure 10: Licenses and options executed (1996, 2000, 2004)

Region	1996	2000	2004	Average
Baltimore	63	134	127	108
Boston	220	371	461	351
New York	101	102	99	101
Greater Philadelphia	**79**	**206**	**152**	**146**
Pittsburgh	16	45	75	45
Raleigh-Durham	37	151	161	116
San Diego	38	41	75	51
San Francisco	161	221	140	174
Seattle	57	133	89	93
Washington, D.C.	130	51	61	81



Source: Association of University Technology Managers.



reason, the culture gap between licensees and licensors is a particularly acute barrier to technology transfer. Academic licensing officials typically operate within a more risk-averse culture than the business world. Such inherently divergent perspectives threaten to hinder license negotiations and stymie the commercialization process.

In particular, university protection of intellectual property (IP) can become a prohibitive factor in licensing negotiations. Licensing officials are charged first and foremost with protecting the university's IP, which frequently slows negotiations. Especially for industry representatives, time is money, and slow negotiations may frustrate firms and entrepreneurs into withdrawing from the process altogether.

Additionally, while firms and entrepreneurs stand to make large sums of money on successfully licensing a technology, few licensors see a financial reward. Licensing officials without monetary incentives to aggressively pursue and execute a deal may instead focus on the role of protecting institutional IP and disengage in licensing negotiations.

Opportunities to accelerate licensing. Both universities and industry have an opportunity to accelerating licensing negotiations by bridging the university-industry cultural gap. Universities can hire licensing officials with industry experience and an understanding of the financial pressures associated with the private sector. In turn, industry can hire technology representatives with university experience and an understanding of the constraints associated with the academic environment. Both groups can improve licensing by hiring officials with negotiation experience.

Universities can also improve the rate of successful licensing negotiations by providing incentives — monetary or otherwise — for officials to strike license deals. Creating a licensing bonus pool could motivate officials to pursue a deal that otherwise may have stalled.

⇒ Company formation

Local business growth is at the heart of economic development. Company formation based on university research is a highly sought after form of business growth, representing the potential for rapid development of well-paying jobs in highly specialized fields. Many regions have focused efforts to stimulate commercialization on promoting the growth and development of these new companies.

AUTM tracks the number of companies formed based on university research. As with invention disclosures and licenses, institutional aggregations may understate the actual number of university-based start-ups in each region. Still, data is useful for comparing company formation across regions as a measure of commercialization success.

As Figure 11 illustrates, Boston's three-year average of 40 university-based start-ups was nearly three times that of any other peer region, and 26 more than Greater Philadelphia's second place average of 14. San Francisco (13) and Raleigh-Durham (10) also averaged double-digit university-based start-ups per year.

Barriers to company formation. Entrepreneurs frequently have difficulty generating sufficient funds to subsist with a newly formed business. Start-ups typically require tens of thousands of dollars in up-front venture capital investment, a prohibitive cost for most.

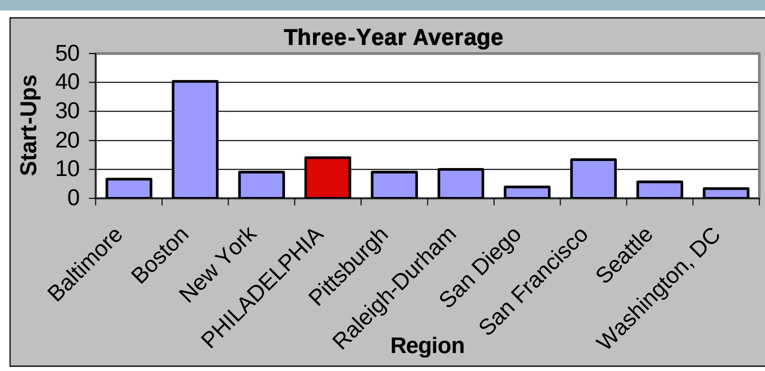
Entrepreneurs able to generate requisite capital face a new dilemma finding adequate incubator and laboratory space for technology development. Key attributes of attractive incubator space are affordability, accessibility, and physical co-location within relevant centers of innovation. Without available space that meets these characteristics, start-ups will be at a competitive disadvantage.

Entrepreneurs also find it chal-

Figure 11: Start-up companies formed from university research (1996, 2000, 2004)

Region	1996	2000	2004	Average
Baltimore	2	11	7	7
Boston	19	54	48	40
New York	3	15	9	9
Greater Philadelphia	**13**	**10**	**19**	**14**
Pittsburgh	4	9	14	9
Raleigh-Durham	0	13	17	10
San Diego	3	6	3	4
San Francisco	17	13	10	13
Seattle	3	7	7	6
Washington, D.C.	0	4	6	3

Source: Association of University Technology Managers.



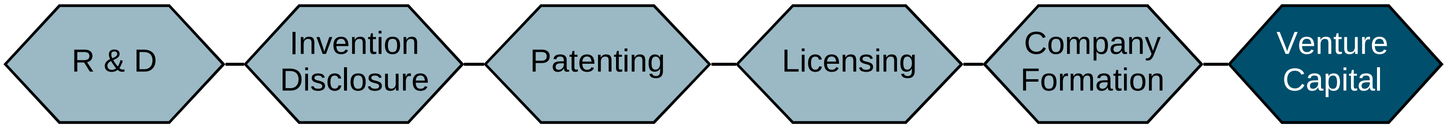
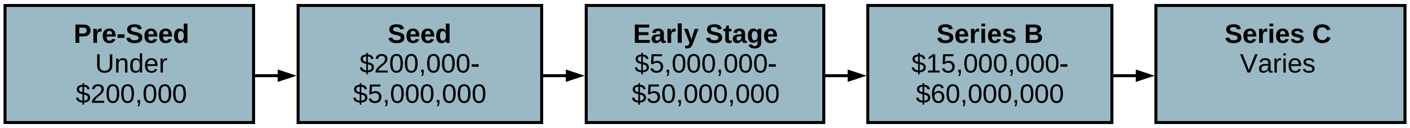


Figure 12: Stages of venture capital investment



lenging to recruit qualified executive leadership. Hiring a seasoned CEO improves a start-ups' growth potential. However, leaders with the experience, knowledge, and willingness to manage a new technology-based company are often hard to locate.

Opportunities to accelerate company formation. Expanding the resources available to prospective entrepreneurs and new businesses can accelerate overall company formation. These resources could be generated from the private sector, foundations, non-profits, or government entities.

Additionally, identifying and/or creating attractive and affordable incubator and laboratory space in close proximity to centers of innovation would promote company formation. This space should adequately address the numerous needs of technology-based start-ups.

Finally, generating a list of available CEOs with the wherewithal to grow technology-based start-ups would streamline the process of finding appropriate leadership, thereby accelerating company formation and business growth.

⇒ Venture capital

Venture capital (VC) represents a pervasive element of successful commercialization. A strong venture capital presence encourages entrepreneurial activity at all levels, which in turn attracts additional VC. Encouraging such investment is perhaps the best thing a region can do to accelerate technology commercialization.

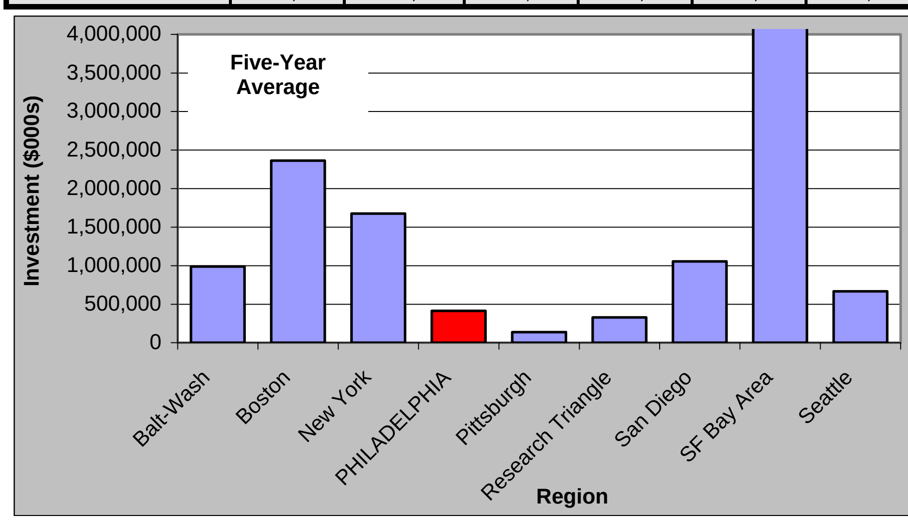
As a technology moves from the laboratory to a marketable product, it will go through several rounds of venture capital funding. Funding levels are commensurate with both the need and risk associated with technologies at each stage of development. Figure 12 provides typical funding ranges for these stages of VC investment.

PricewaterhouseCoopers' MoneyTree report tracks total regional VC investment. To account for large annual fluctuations, investment totals are reported and averaged for the years 2002 through 2006. MoneyTree regional definitions vary slightly from those employed elsewhere, grouping Baltimore and Washington, D.C. into one region, including all of New England in the Boston region, and including all of North Carolina as its "Research Triangle" (Raleigh-Durham) region.

As Figure 13 illustrates, San Francisco has far outpaced any other region in VC investment, averaging over $7.6 billion per year, almost triple the next highest region. Boston ($2.4 billion), New York ($1.7 billion), and San Diego ($1.1 billion)

Figure 13: Venture capital investment, 2002-2006 ($000s)

Region	2002	2003	2004	2005	2006	Average
Baltimore-D.C.	1,072,707	823,664	926,202	998,554	1,125,276	989,281
Boston	2,123,497	2,314,635	2,681,772	2,151,096	2,552,531	2,364,706
New York	1,522,384	1,417,957	1,573,133	1,921,612	1,945,046	1,676,026
Greater Philadelphia	**324,437**	**440,014**	**461,064**	**339,833**	**507,383**	**414,546**
Pittsburgh	140,703	116,415	96,464	77,543	256,177	137,460
Research Triangle	458,645	279,530	197,775	378,053	327,549	328,310
San Diego	933,725	799,411	1,247,957	1,055,377	1,229,886	1,053,271
San Francisco	6,974,247	6,372,420	7,948,294	7,971,848	9,054,347	7,664,231
Seattle	503,596	371,015	735,135	756,946	966,071	666,553



Source: PriceWaterhouse Coopers Moneytree reports.

also averaged over a billion dollars in VC from 2002 through 2006.

Greater Philadelphia has experienced very little success in stimulating VC, however a substantial uptick in 2006 may signal future gains. Between 2002 and 2006, Greater Philadelphia averaged just $414 million in total VC investment, third least among benchmark regions. Only Research Triangle ($328 million) and Pittsburgh ($137 million) had lower five-year averages.

Barriers to venture capital. The most significant barrier to a strong venture capital presence is a weak entrepreneurial culture and a lack of serial entrepreneurialism that perpetuates VC investments. This has a particularly profound impact on riskier early stage technologies, which tend to lose out to technologies at a later stage of development. In response, quasi-government organizations must also fund more developed technologies. In effect, this shift widens the funding gap for early stage technologies, a significant impediment to the overall rate of commercialization.

Opportunities to accelerate venture capital. Location is a critical factor for firms in deciding where to make investments. Typically, investors utilize a "two-hour rule" as the standard benchmark of acceptable geographical proximity.

For this reason, regions like Greater Philadelphia have a tremendous opportunity to attract VC dollars that already exist within the two-hour range. However, to best leverage these funds regions first need to develop a pervasive culture of innovation and entrepreneurialism. Marketing efforts, like those of Select Greater Philadelphia's, that promote a region as such are powerful mechanisms for building this environment.

In the meantime, regions can target an existing funding gap by growing a pool of private and public dollars for early stage technology development. Such funds could provide a match for additional venture capital, mitigating risks to firms associated with investing in relatively undeveloped technologies. The availability of additional early stage capital would help close an existing funding gap and accelerate the entire commercialization process.

C. Operationalizing Lessons to Accelerate Technology & Knowledge Transfer in Greater Philadelphia

⇒ Summary of Key Findings

Quantitative analysis illustrates that Greater Philadelphia has performed well in several aspects of technology transfer. Among benchmarked regions, Greater Philadelphia was among the top four in the following indicators:

- Degrees conferred (4th);
- Invention disclosures received (2nd);
- Patents granted (4th);
- Licenses & options executed (3rd); and
- Start-up companies formed based on university research (2nd).

Still, analysis indicates that Greater Philadelphia lags well behind peer regions in venture capital investment, suggesting a significant disconnect between technology development and actual commercialization. Stakeholders confirmed this finding, noting that a lack of venture capital – and, more broadly, a lack of an entrepreneurial culture – is the greatest impediment to technology commercialization in Greater Philadelphia.

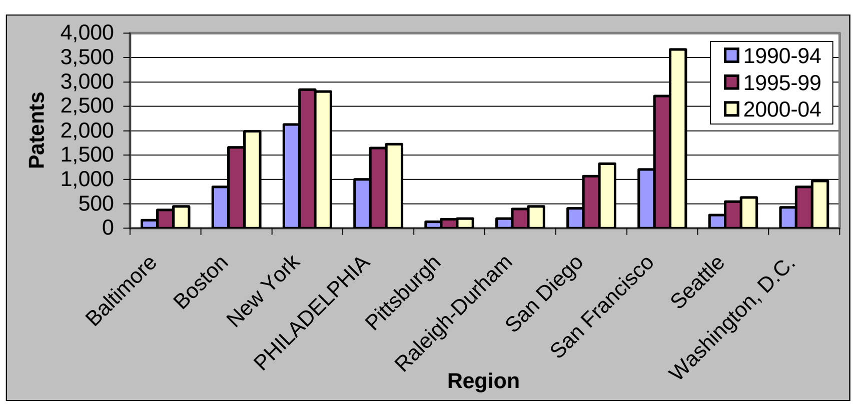
However, aggregating region-wide indicators without separating sectors masks important industry-specific trends. In Greater Philadelphia, the life sciences and physical sciences sectors differ with respect to their approach and utility of technology transfer processes. These unique tendencies are highlighted below in Figure 14.

⇒ Highlighting life sciences

The life sciences sector is one of Greater Philadelphia's preeminent economic strengths. A 2005 study by Ross DeVol et al. at the Milken Institute analyzed Greater Philadelphia's life sciences and concluded that the region boasted one of the

Figure 14: Life sciences patents granted, five-year intervals (1990-2004)

Region	1990-94	1995-99	2000-04
Baltimore	164	371	443
Boston	846	1,659	1,988
New York	2,130	2,842	2,802
Greater Philadelphia	**999**	**1,640**	**1,723**
Pittsburgh	134	184	195
Raleigh-Durham	196	394	446
San Diego	408	1,066	1,323
San Francisco	1,206	2,711	3,664
Seattle	271	545	630
Washington, D.C.	424	845	966



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Figure 15: Ratio of life sciences early stage VC to NIH funding at medical schools (2001-2005)

$M's	Greater Philadelphia			Boston			New York			Research Triangle			San Diego			San Francisco		
Year	Early Stage VC	NIH Funding to Med Schools	Ratio	Early Stage VC	NIH Funding to Med Schools	Ratio	Early Stage VC	NIH Funding to Med Schools	Ratio	Early Stage VC	NIH Funding to Med Schools	Ratio	Early Stage VC	NIH Funding to Med Schools	Ratio	Early Stage VC	NIH Funding to Med Schools	Ratio
2001	47.5	439.1	1:9	194.0	338.5	1:2	163.5	709.7	1:4	60.0	374.3	1:6	174.0	163.9	1:1	366.5	495.9	1:1
2002	70.5	468.0	1:7	188.5	374.8	1:2	86.0	768.9	1:9	28.5	264.5	1:10	151.0	220.0	1:1	237.0	587.0	1:2
2003	51.0	467.0	1:9	222.0	526.1	1:2	42.5	839.8	1:20	17.5	504.5	1:25	102.0	185.0	1:2	256.0	529.0	1:2
2004	94.0	520.7	1:6	198.5	416.7	1:2	86.5	899.3	1:10	42.5	517.6	1:13	100.0	231.0	1:2	331.0	645.4	1:2
2005	193.0	519.5	1:3	114.5	418.3	1:3	51.0	914.4	1:18	84.5	567.3	1:7	91.0	238.0	1:3	304.0	662.6	1:2

Source: BioAdvance.

largest and richest industry clusters in the country. Many of the report's key findings highlighted the impact of life sciences on the regional economy, including:

- With 53,000 workers, Greater Philadelphia was second only to New York in core life sciences industry employment;
- Greater Philadelphia life sciences supporting industries employed 310,200 people;
- Greater Philadelphia's life sciences industry is responsible for 11.4 percent of total regional employment and or 12.8 percent of total regional earnings; and
- On the overall "Life Sciences Composite Index", a measure of economic impact, Greater Philadelphia ranked third, just behind Boston and San Francisco.

As was the case with overall patent totals, Greater Philadelphia ranked fourth among benchmark regions in life sciences patents granted from 2000 to 2004, a total that includes biopharmaceutical and medical device patents. As Figure 14 illustrates, San Francisco (3,664), New York (2,802), and Boston (1,988) outpaced Greater Philadelphia (1,723), however each of these four regions far outpaced any other benchmark region.

While Greater Philadelphia's life sciences patenting has mirrored overall patenting, the region's upward trend in early stage life sciences venture capital seems to buck Greater Philadelphia's lagging region-wide VC totals. Figure 15 reports regional early stage life sciences VC and NIH funding to medical schools from 2001 through 2005. As this figure illustrates, Greater Philadelphia's life sciences industry experienced marked improvement in early stage VC, increasing by $145.5 million, over 300 percent, in that time period. Only Research Triangle, NC also increased its early stage VC total.

Greater Philadelphia also raised its ratio of early stage VC to NIH funding to medicals schools by three-fold, indicating a significant uptick of investment in the region's life sciences research. Greater Philadelphia's 2005 ratio of 1:3 was on par with Boston and San Diego, and within range of San Francisco at 1:2.

⇒ Highlighting physical sciences

While Greater Philadelphia has firmly established itself as a leader in the life sciences, less attention has been paid to the development of the region's physical sciences sector.

Physical science industry development differs from the life sciences in that it is primarily focused on "going concerns" of established companies, whereas life sciences typically focus on stand alone technologies ready to be commercialized.

Traditionally, going concerns have considered the commercialization of new technologies a secondary objective. Instead leveraging innovations for product enhancement, companies have focused on gains to be made in organizational processes. While such procedural enhancements have enriched and promoted business development, this narrow focus has limited industry growth potential.

In recent years, however, technology transfer has surfaced as an increasingly important mechanism for industrial development. While life sciences commercialization typically focuses on start-ups and venture capital investment, commercialization of physical science innovations allow businesses to enhance the characteristics of existing products, thereby increasing efficiency and industrial productivity.

Therefore, while the measures of success may differ from those in the life sciences, technology transfer is and will continue playing an increasingly important role in the development of physical science fields.

⇒ Models for accelerating technology transfer

Philip Auerswald of the George Mason University Center for Science and Technology Policy has been quoted as saying that in technology transfer: "It's not the 'R'. It's not the 'D'. It's the '&'."

Heeding Auerswald's words, several regions have implemented organizations with the expressed purpose of developing collaboration as a way to accelerate technology transfer. While these models have distinct structures and programmatic focus, they share a characteristic interconnectivity, institutionalizing a mechanism for universities and industry to work together. In so doing, regions have been able to leverage new and existing resources for efforts such as workforce development, education, business development, and commercialization.

Analysis identified many examples of regional organizations across the United States pursuing these goals. Three stand out as exemplary models:

- UCSD-CONNECT (San Diego, CA);
- North Carolina Biotechnology Center (Research Triangle Park, NC); and
- The Technology Collaborative (Pittsburgh, PA).

UCSD-CONNECT. Founded in 1985 at the urging of the San Diego business community, UCSD-CONNECT fosters entrepreneurship and catalyzes the development of technology and life sciences businesses throughout the San Diego region.

Over the last two decades, the San Diego business community has taken ownership of a wide variety of CONNECT services, playing a pivotal role in the organization's development. Top-level CEOs and industry leaders have, among other things, stepped forward to sponsor programmatic endeavors, mentor aspiring entrepreneurs, engage in educational workshops, and participate in networking events and forums.

CONNECT has four primary areas of programmatic focus:

- New company creation;
- Education;
- Networking; and
- Recognition.

CONNECT has five distinct programs that promote new company creation: Springboard; Accelerators; Venture Roundtable; Tech Coast Angels; and the Tech Transfer Forum. The Springboard program offers assistance to life sciences and high-tech start-up companies at all stages of development. As an extension of this program, Accelerators provides Springboard graduates with additional coaching and mentoring to enhance product commercialization potential. The Venture Roundtable aims to connect and inform venture capitalists with existing and developing technologies, building a pipeline for investment to occur at all stages of technology development. Tech Coast Angels is a group of private investors affiliated with CONNECT who invest in and assist early stage technology development. Finally, the Tech Transfer Forum facilitates information exchange between San Diego's research institutions and private sector companies by identifying strategic "pairings" of promising technologies and corporate partners.

> "It's not the 'R'. It's not the 'D'. It's the '&'."
>
> *Philip Auerswald*
> *Director*
> *Center for Science and Technology Policy, George Mason University*

CONNECT also emphasizes entrepreneur education. Through its FrameWorks Workshops, CONNECT trains entrepreneurs in half-day sessions with targeted information needed to start and grow a technology-based company. Its Frontiers in Science and Technology lecture series also aims to educate entrepreneurs about new developments in cutting edge fields. The San Diego MIT Enterprise Forum, an affiliate of CONNECT, hosts similar educational events. Finally CONNECT distributes a newsletter every other week to inform stakeholders of CONNECT's activities and entrepreneurial opportunities in the region.

CONNECT also provides networking opportunities through its Connect with CONNECT program, a regularly occurring event that convenes industry and business leaders in an informal setting. CONNECT also hosts a leadership dinner series that allows entrepreneurs to engage in discussion regarding common issues.

Finally, CONNECT recognizes excellence in commercialization and entrepreneurialism through several annual awards, events, and its Entrepreneur Hall of Fame.

North Carolina Biotechnology Center (Research Triangle Park, NC). Established by the State in 1984, the North Carolina Biotechnology Center was the world's first government-sponsored organization dedicated to developing the biotechnology industry.

The Center works to promote North Carolina's entire biotechnology industry. Its mission is comprised of six goals:

- To strengthen North Carolina's academic and industrial biotechnology research capabilities;
- To foster North Carolina's biotechnology industrial development;
- To Work with business, government and academia to move biotechnology from research to commercialization in North Carolina;
- To inform North Carolinians about the science, applications, benefits and issues of biotechnology;
- To enhance the teaching and workforce-training capabilities of North Carolina's educational institutions; and
- To establish North Carolina as a preeminent international location for the biotechnology industry.

This wide-reaching set of objectives makes the Center a one-stop-shop for North Carolina's biotechnology industry, a collaborative "clubhouse" for government, universities, businesses, and entrepreneurs.

The Center provides a comprehensive array of resources to promote biotechnology development. Its programmatic focus is on improving commercialization through networking, research, public education, business services, and workforce development. Its Business and Technology Development Program helps entrepreneurs and young companies with financing, technical advice, professional referrals and networking. Its Science and Technology Development Program enhances North Carolina's research capabilities through grant programs and intellectual-exchange activities. Its Education and Training Program sponsors grants programs, teacher-training workshops and workforce training activities to educate the public about biotechnology and prepare workers for jobs in the industry. Finally, its Library and Information Services helps people in business, academia and government stay abreast of the rapidly changing biotechnology industry. The library provides information about the business, scientific, educational and societal aspects of biotechnology.

What the Center does not provide — namely, incubation or laboratory space — can be found elsewhere in Research Triangle Park, created by North Carolina business and academic leaders in the 1950's to promote collaboration between academia, industry and government in pursuit of technological development. The Center is a critical element of Park initiatives and actively engages with other Research Triangle organizations.

Most importantly, the State has supported the Center throughout its existence. For this reason, the Center has represented a single access point for state grants and loans. Since inception, the State has invested over $170 million through the Center in statewide biotechnology infrastructure. These investments have made North Carolina a preeminent location for global biotechnology industry development.

The Technology Collaborative (Pittsburgh, PA). In December 2004, the Pittsburgh Digital Greenhouse and Robotic Foundry merged to form The Technology Collaborative (TTC), a single organization dedicated to enhancing the Pittsburgh region's technology-based economy.

TTC's mission is to develop an ideal environment for business expansion by leveraging the region's high-tech base, and combining it with resources and support from local universities, private foundations, regional economic development organizations, industry, and federal, state, and local governments. In this way, TTC enables regional economic growth by utilizing a business friendly environment to attract new companies to the region, help local companies grow, and foster start-ups.

TTC's ability to build relationships among regional stakeholders is predicated on its membership-based model. Universities, industry, government, development organizations, and foundations are en-

Figure 16: Models of regional collaboration

UCSD Connect
San Diego, California

What it is
- University-based non-profit organization
- Founded in 1985 by university & business leaders
- Membership-based
- Fully self-supporting (through dues, fees, and corporate underwriting)

What it does
- Links entrepreneurs with resources
- Start-up support services
- Education programs
- Business networking opportunities
- Awards & recognition events

North Carolina Biotechnology Center
Research Triangle Park, North Carolina

What it is
- Government sponsored, private non-profit organization
- Created by the State in 1984
- "Clubhouse" for all things biotechnology
- Part of collaborative Research Triangle environment

What it does
- Grants & loans
- Workforce development
- Commercialization
- Public education
- Enhance research capabilities
- Promote state as biotech

The Technology Collaborative
Pittsburgh, Pennsylvania

What it is
- Merging of Pittsburgh Digital Greenhouse and Robotics Foundry
- Non-profit economic development organization
- Membership-based (universities, government, foundations, industry)

What it does
- Commercialization
- Workforce development & training
- Talent recruiting
- Incubation space & business start-up services
- Business networking

gaged as either members or partners in the TTC, promoting a truly collaborative environment.

Members and partners have driven TTC's programmatic focus, which includes:

- Commercialization;
- Education and training;
- Business support services;
- Networking opportunities; and
- Employee recruiting services.

For instance, TTC's Technology Commercialization Initiative (TCI) identifies challenges associated with early-stage technologies with commercialization potential. TCI, along with its Technology Commercialization Advisory Board, directs and funds research to address challenges and accelerate commercialization. TCC also initiated the National Center for Defense Robotics, which counsels member organizations and promotes technology development by facilitating, funding, and managing supportive programs.

Workforce development initiatives, including the University Education, Professional Development, and Digital Sandbox programs provide opportunities for continuing education and technical training to enhance the region's talent pool. To further enhance this pool, the Talent Recruitment Program attracts world-class scientists and researchers to member organizations.

Finally, TTC offers a set of programs to promote business growth and development. The Jump Start program supports start-up company development by subsidizing fully equipped incubation space and providing access to venture capital in the region. Additionally, the Research/Design Center Starter Kit promotes new business growth, targeting companies outside the Pittsburgh area looking to establish a research or design center in the region.

⇒ A model effort in Greater Philadelphia

In recent years, Greater Philadelphia has also seen an uptick in collaborative enterprise. Recognizing the benefits of working together, several universities and organizations have partnered to develop new institutions dedicated to accelerating technology commercialization.

The Nanotechnology Institute (NTI) is one example of such a partnership. Founded in 2000, NTI is a comprehensive resource for the development of the nanotechnology industry. Led by the Ben Franklin Technology Partners of Southeastern Pennsylvania, the NTI represents a collaborative effort between the University of Pennsylvania, Drexel University, and seven other universities. Its mission is to facilitate nanotechnology research and to focus on transferring and commercializing discoveries from universities to industry for economic development. It pursues this mission through a comprehensive set of programmatic objectives, including:

- Multi-institutional and interdisciplinary research and development;
- Entrepreneurial development and commercialization;
- Risk capital;
- Community of interest networks;
- Education and workforce development; and
- Economic research and policy development.

NTI's ability to focus the resources of a large collection of regional stakeholders around industry-specific goals has had a significant impact on efforts to streamline commercialization efforts, providing uniform confidentiality, intellectual property, and sponsored research agreements for all member institutions. In turn, the NTI has acted as a single point of contact for industries and entrepreneurs looking to license and commercialize promising technologies.

In 2005, the Nanotechnology Commercialization Group (NCG) was created to further accelerate the commercialization of member institution technologies. An outgrowth of the NTI, the NCG pools the resources of member universities to facilitate commercialization of nanotechnology discoveries. Specifically, NCG staff evaluates technologies' commercial potential, devises a strategy for commercialization, markets technologies, facilitates company formation, and negotiates licenses.

Such a high degree of collaboration — best exemplified by institutional willingness to jointly contribute money into a common fund — has established Greater Philadelphia as a leader in nanotechnology development. The region's already strong base of research, the commercialization infrastructure provided by NTI and NCG have vaulted Greater Philadelphia into a position to leverage the economic benefits of a field with tremendous growth potential.

Figure 17: Example of collaboration in Greater Philadelphia

The Nanotechnology Institute

What it is	What it does
♦ Collaboration led by Ben Franklin Technology Partners, Penn, & Drexel ♦ Founded in 2000 ♦ Funded by DCED ♦ Nine university partners ♦ Single point of contact	♦ R&D ♦ Entrepreneurial development ♦ Commercialization ♦ Risk capital ♦ Networking ♦ Workforce development ♦ Economic & policy research ♦ Uniform forms & agreements

V. Key Lessons & Recommendations

A. Key Lessons

Recognizing the potential of commercialization to spur economic development, many regions have aggressively sought to identify opportunities for accelerating technology transfer. While efforts like the Nanotechnology Institute signify Greater Philadelphia's efforts in this regard, significant work remains for the region to realize its commercialization potential.

In recent years, several studies have provided guidance for regions looking to enhance both the culture and process of technology transfer. A study by Innovation Associates (2005) for the Connecticut Technology Transfer and Commercialization Advisory Board brought together key lessons, which are summarized as follows:

- *A strong and focused university research base feeds the pipeline for commercialization;*
- *Federal R&D funding provides a critical base for technology transfer efforts;*
- *Champions catalyze most successful technology-based economic development;*
- *Private corporations and foundations can play a major role;*
- *Early-stage capital is a critical ingredient in launching university start-ups;*
- *Innovation centers can provide a focal point for technology-based activities;*
- *The entrepreneurial culture of a university is key to its technology transfer success;*
- *Networking is key;*
- *Entrepreneurship programs can add value to technology transfer efforts; and*
- *Incubators and research parks provide a visible technology presence.*

Each stakeholder group — the private, public, non-profit, and academic sectors — will undoubtedly apply these lessons with varying degrees of engagement. Nevertheless, by employing a collaborative approach to a unified objective, regions can mitigate the ill effects of cross-sector differences and actually leverage divergent perspectives to allow for a more comprehensive approach in addressing the wide spectrum of issues related to accelerating technology transfer.

> "The two worlds—university and industry—can be bridged. In fact, their widely divergent missions and institutional obligations can be complementary, synergistic, and beneficial to all."
>
> *Dr. Louis Berneman*
> *Former Managing Director*
> *Center for Technology Transfer, University of Pennsylvania*

B. Recommendations

Based on key lessons, specific recommendations for each stakeholder group are as follows:

⇒ Private sector

- Advocate for additional pre-seed, seed, and early stage funding to the region;
- Advocate for maintaining or increasing NIH funding to the region;
- Mitigate cultural gaps by hiring technology managers with university experience;
- Tap into social networks to connect with scientists and better understand technologies;
- Market the region as a center of innovation to attract venture capital and entrepreneurs;
- Attract and support serial entrepreneurialism in the region; and
- Encourage collaboration, fostering partnerships among the business community, public and non-profit sectors.

⇒ Public & non-profit sectors

- Continue to support business development programs, such as Delaware's First State Innovation program, New Jersey's Small Business Development Center, and Pennsylvania's Keystone Innovation Zones.
- Develop a clearinghouse for processing funding applications, marketing available technologies, and highlighting commercialization successes;
- Create opportunities for scientists to showcase technologies and interact with potential investors;
- Institute an awards ceremony to recognize scientific achievements in the region;
- Provide attractive, affordable, and accessible incubator space for startup companies;
- Maintain or increase grant funding levels, and maintain or increase support of support agencies in the region; and
- Aggressively pursue improvements to the region's business climate by promoting assets and reducing the tax burden on businesses.

⇒ Academic sector

- Establish a clear institutional vision consistent with the mission of technology transfer;
- Promote faculty in technology transfer by valuing the work;
- Mitigate cultural gaps by hiring technology transfer professionals with marketing and negotiation experience;
- Develop alumni networks in order to build closer relationships with graduates working in the business community;
- Recognize the value of networking within academia, cultivating relationships with less well-established research universities and technical colleges in research areas where there is a mutual interest;
- Structure fair and reasonable but also flexible practices of licensing, start-up, sponsored research, and faculty consulting agreements; and
- Think strategically about technology transfer, aligning education, research, and workforce development programs with opportunities for technology-based business growth.

Drexel University

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Applications Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$ 258,999	3	33	8	34	1	n/a
FY 2003	$526,907	2	33	8	28	2	n/a
FY 2004	$1,872,618	8	59	5	40	4	n/a
FY 2005	$2,229,549	7	60	3	64	0	n/a
FY 2006	$298,000	5	95	5	92	4	n/a
FY 2002-06	**$5,186,074**	**25**	**273**	**29**	**213**	**11**	**n/a**

Source: Drexel University.

Financing of R & D Expenditures

Source ($000's)	1996	2000	2004
Federal	$11,613	$14,292	$54,963
State/Local	$744	$1,163	$3,254
Industry	$4,343	$3,137	$2,344
Institutional	$2,622	$6,284	$13,071
Other	$0	$0	$2,488
Total Expenditures	**$19,322**	**$24,876**	**$76,120**

Source: National Science Foundation.
Notes: Based on NSF Survey of R&D Expenditures.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	642	566	583
Physical Sciences	46	26	36
Life Sciences	99	67	676
Other S & E	172	304	663
Total S & E	959	963	1,958
Total Degrees	**1,940**	**1,951**	**3,534**

Source: National Center for Education Statistics.
Notes: Other S&E includes interdisciplinary degrees, mathematics, & computer science.

Technology Transfer Office Profile

Tech Transfer Program Launch	1997
Full-Time Equivalent Licensing Employees	3
Full-Time Equivalent Other Employees	2
Total Active Licenses	16

Source: Drexel University.

University At A Glance

Total University Enrollment	18,466
Undergraduate Students	12,357
Graduate Students	6,109
Have A Medical School?	Yes

Source: Drexel University.

Temple University

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Applications Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$556,500	5	27	11	30	0	1
FY 2003	$487,500	0	15	14	27	1	1
FY 2004	$324,750	6	28	19	24	1	1
FY 2005	$397,500	13	24	40	24	0	4
FY 2006	$487,242	4	22	19	24	0	1
FY 2002-06	**$2,253,492**	**28**	**116**	**103**	**129**	**2**	**8**

Source: Temple University.
Notes: MTAs are not normally processed through the technology transfer office, therefore MTA is an underestimate; license income is reported for net income.

Financing of R & D Expenditures

Source ($000's)	1996	2000	2004
Federal	$28,720	$38,213	$50,456
State/Local	$583	$658	$3,025
Industry	$5,173	$188	$6,202
Institutional	$19,699	$6,657	$9,456
Other	$2,358	$6,750	$6,916
Total Expenditures	**$56,533**	**$52,466**	**$76,055**

Source: National Science Foundation.
Notes: Based on NSF Survey of R&D Expenditures.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	217	135	114
Physical Sciences	71	52	42
Life Sciences	845	1,078	1,219
Other S & E	185	273	288
Total S & E	1,318	1,538	1,663
Total Degrees	**5,635**	**5,608**	**6,898**

Source: National Center for Education Statistics.
Notes: Other S&E includes interdisciplinary degrees, mathematics, & computer science.

Technology Transfer Office Profile

Tech Transfer Program Launch	1989
Full-Time Equivalent Licensing Employees	2
Full-Time Equivalent Other Employees	1
Total Active Licenses	49

Source: Association of University Technology Managers.

University At A Glance

Total University Enrollment	33,865
Undergraduate Students	24,674
Graduate Students	9,191
Have A Medical School?	Yes

Source: Association of University Technology Managers; Temple University.

Thomas Jefferson University

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Applications Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$856,651	2	27	34	82	1	107
FY 2003	$1,548,052	8	29	22	43	3	142
FY 2004	$1,682,203	24	34	21	36	4	237
FY 2005	$7,484,546	5	41	13	18	2	222
FY 2006	$1,047,395	1	31	3	17	1	349
FY 2002-06	**$12,618,847**	**40**	**162**	**93**	**196**	**11**	**1,057**

Source: Thomas Jefferson University.

Financing of R & D Expenditures

Source ($000's)	1996	2000	2004
Federal	$51,475	$67,448	$92,296
State/Local	$54	$3,229	$6,512
Industry	$9,553	$12,324	$8,035
Institutional	$68	$1,563	$1,954
Other	$8,004	$5,062	$3,281
Total Expenditures	**$69,154**	**$89,626**	**$112,078**

Source: National Science Foundation.
Notes: Based on NSF Survey of R&D Expenditures.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	0	0	0
Physical Sciences	0	0	0
Life Sciences	578	572	623
Other S & E	79	48	61
Total S & E	657	620	684
Total Degrees	**663**	**628**	**692**

Source: National Center for Education Statistics.
Notes: Other S&E includes interdisciplinary degrees, mathematics, & computer science.

Technology Transfer Office Profile

Tech Transfer Program Launch	1984
Full-Time Equivalent Licensing Employees	4.5
Full-Time Equivalent Other Employees	1.5
Total Active Licenses	55

Source: Association of University Technology Managers; Thomas Jefferson University.

University At A Glance

Total University Enrollment	2,832
Undergraduate Students	1,041
Graduate Students	1,791
Have A Medical School?	Yes

Source: Thomas Jefferson University.

University of Delaware

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Applications Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$143,673	0	46	7	15	n/a	n/a
FY 2003	$258,181	1	37	10	24	n/a	n/a
FY 2004	$269,196	6	63	3	21	n/a	n/a
FY 2005	$141,466	2	32	11	18	n/a	n/a
FY 2006	$215,254	2	35	6	27	n/a	n/a
FY 2002-06	**$1,198,917**	**17**	**251**	**40**	**120**	**n/a**	**n/a**

Source: University of Delaware.

Financing of R & D Expenditures

Source ($000's)	1996	2000	2004
Federal	$29,509	$37,716	$76,583
State/Local	$2,410	$4,032	$3,269
Industry	$2,964	$3,757	$2,984
Institutional	$13,074	$19,430	$23,415
Other	$6,197	$9,776	$3,734
Total Expenditures	**$54,154**	**$74,711**	**$109,985**

Source: National Science Foundation.
Notes: Based on NSF Survey of R&D Expenditures.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	264	264	285
Physical Sciences	71	55	62
Life Sciences	611	636	524
Other S & E	194	186	190
Total S & E	1,140	1,141	1,061
Total Degrees	**4,081**	**4,208**	**4,243**

Source: National Center for Education Statistics.
Notes: Other S&E includes interdisciplinary degrees, mathematics, & computer science.

Technology Transfer Office Profile

Tech Transfer Program Launch	1997
Full-Time Equivalent Licensing Employees	2
Full-Time Equivalent Other Employees	0
Total Active Licenses	27

Source: Association of University Technology Managers.

University At A Glance

Total University Enrollment	20,380
Undergraduate Students	15,849
Graduate Students	4,531
Have A Medical School?	No

Source: Association of University Technology Managers; University of Delaware.

University of Pennsylvania

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Applications Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$6,435,000	24	288	42	213	7	614
FY 2003	$12,340,000	16	321	47	268	9	764
FY 2004	$9,104,000	16	393	34	247	25	907
FY 2005	$7,495,000	17	335	35	209	9	1,113
FY 2006	$8,157,000	20	287	49	193	3	1,064
FY 2002-06	**$43,531,000**	**93**	**1,624**	**207**	**1,130**	**53**	**4,462**

Source: University of Pennsylvania.

Financing of R & D Expenditures

Source ($000's)	1996	2000	2004
Federal	$216,167	$312,434	$435,343
State/Local	$7,267	$1,830	$3,642
Industry	$9,445	$32,632	$27,678
Institutional	$25,346	$40,981	$47,909
Other	$30,205	$42,512	$82,184
Total Expenditures	**$288,430**	**$430,389**	**$596,756**

Source: National Science Foundation WebCASPAR database.
Notes: Based on NSF Survey of R&D Expenditures.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	405	430	438
Physical Sciences	79	88	109
Life Sciences	973	911	1,162
Other S & E	136	116	261
Total S & E	1,593	1,545	1,970
Total Degrees	**5,878**	**6,094**	**6,874**

Source: National Center for Education Statistics.
Notes: Other S&E includes interdisciplinary degrees, mathematics, & computer science.

Technology Transfer Office Profile

Tech Transfer Program Launch	1986
Full-Time Equivalent Licensing Employees	8
Full-Time Equivalent Other Employees	10
Total Active Licenses	385

Source: Association of University Technology Managers.

University At A Glance

Total University Enrollment	22,043
Undergraduate Students	10,431
Graduate Students	11,612
Have A Medical School?	Yes

Source: Association of University Technology Managers; University of Pennsylvania.

Princeton University

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Applications Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FY 2003	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FY 2004	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FY 2005	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FY 2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FY 2002-06	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**

Financing of R & D Expenditures

Source ($000's)	1996	2000	2004
Federal	$11,613	$14,292	$54,963
State/Local	$744	$1,163	$3,254
Industry	$4,343	$3,137	$2,344
Institutional	$2,622	$6,284	$13,071
Other	$0	$0	$2,488
Total Expenditures	**$19,322**	**$24,876**	**$76,120**

Source: National Science Foundation.
Notes: Based on NSF Survey of R&D Expenditures.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	274	316	309
Physical Sciences	165	119	109
Life Sciences	161	181	109
Other S & E	56	59	69
Total S & E	656	675	596
Total Degrees	1,791	1,739	1,791

Source: National Center for Education Statistics.
Notes: Other S&E includes interdisciplinary degrees, mathematics, & computer science.

Technology Transfer Office Profile

Tech Transfer Program Launch	n/a
Full-Time Equivalent Licensing Employees	n/a
Full-Time Equivalent Other Employees	n/a
Total Active Licenses	n/a

University At A Glance

Total University Enrollment	7,085
Undergraduate Students	4,790
Graduate Students	2,295
Have A Medical School?	No

Source: Princeton University.

Children's Hospital of Philadelphia

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Application Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$135,000	3	37	12	58	0	96
FY 2003	$196,000	2	39	3	87	0	105
FY 2004	$269,000	3	26	7	52	0	125
FY 2005	$865,000	2	29	10	43	0	157
FY 2006	$1,189,000	2	33	8	50	0	168
FY 2002-06	**$2,654,000**	**12**	**164**	**40**	**290**	**0**	**556**

Source: The Children's Hospital of Philadelphia.

Technology Transfer Office Profile

Tech Transfer Program Launch	1992
Full-Time Equivalent Licensing Employees	2
Full-Time Equivalent Other Employees	6
Total Active Licenses	15

Source: Association of University Technology Managers; The Children's Hospital of Philadelphia.

Lankenau Institute of Medical Research

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Application Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$2,500	2	1	0	0	0	16
FY 2003	$3,150	2	0	0	0	1	9
FY 2004	$6,500	0	4	1	2	0	5
FY 2005	$20,000	1	2	1	1	0	18
FY 2006	$68,000	0	1	0	1	0	16
FY 2002-06	**$100,000**	**5**	**8**	**2**	**4**	**1**	**64**

Source: Lankenau Institute for Medical Research.

Technology Transfer Office Profile

Tech Transfer Program Launch	1995
Full-Time Equivalent Licensing Employees	1.5
Full-Time Equivalent Other Employees	n/a
Total Active Licenses	n/a

Source: Association of University Technology Managers; Lankenau Institute.

Wistar Institute

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Application Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$1,997,000	14	11	10	23	1	n/a
FY 2003	$2,091,000	17	19	6	21	0	84
FY 2004	$1,872,000	11	5	4	13	0	147
FY 2005	$2,649,000	13	6	2	15	0	158
FY 2006	$3,064,000	21	10	3	11	0	181
FY 2002-06	**$11,673,000**	**76**	**51**	**25**	**83**	**1**	**575**

Source: Wistar Institute.

Technology Transfer Office Profile

Tech Transfer Program Launch	1991
Full-Time Equivalent Licensing Employees	2
Full-Time Equivalent Other Employees	1
Total Active Licenses	129

Source: Association of University Technology Managers; Wistar Institute.

Fox Chase Cancer Center

Technology Transfer Activity

Fiscal Year	License Income	License Agreements	Invention Disclosures Received	U.S. Patents Issued	Patent Application Filed	Startup Companies Formed	Material Transfer Agreements
FY 2002	$439,616	0	29	2	20	0	76
FY 2003	$519,992	5	40	0	10	1	82
FY 2004	$561,985	7	52	4	33	0	72
FY 2005	$470,169	4	40	1	19	1	46
FY 2006	$529,977	2	41	2	17	1	72
FY 2002-06	**$2,521,739**	**18**	**202**	**9**	**99**	**3**	**348**

Source: Fox Chase Cancer Center.

Technology Transfer Office Profile

Tech Transfer Program Launch	1984
Full-Time Equivalent Licensing Employees	2
Full-Time Equivalent Other Employees	1
Total Active Licenses	145

Source: Association of University Technology Managers; Fox Chase Cancer Center.

Baltimore

Regional Economic Indicators

Metropolitan Population (2005)	2,655,675
Number of Universities (2001)	32
Patents per 10,000 Employees (2004)	5.34 (Nat'l: 7.29)
Employment Growth (1990-2004)	1.09% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	3.99% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	3.50% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	Johns Hopkins University	313
2	Black and Decker, Inc.	231
3	United States of America, Army	112
4	Ciena Corporation	103
5	United States of America, Navy	91
6t	Guilford Pharmaceuticals, Inc.	62
6t	Northrop Grumman Corporation	62
8t	Becton, Dickinson & Company	59
8t	University of Maryland	59
10	W.R. Grace & Co.—Conn.	50
11	United States of America, National Security Agency	41
12	Corvis Corporation	37
13	GPI Nil Holdings, Inc.	36
14	Paratek Microwave, Inc.	27
15	Datex-Ohmeda, Inc.	25
16	United States of America, Health & Human Services	22
17	Osiris Therapeutics, Inc.	20
18t	Millennium Inorganic Chemicals, Inc.	16
18t	United States of America, NASA	16
20t	Alcatel	14
20t	University of Maryland Biotechnology Institute	14
20t	Ibiquity Digital Corporation	14
20t	Procter & Gamble Company	14
24t	Honeywell International, Inc.	13
24t	Human Genome Sciences, Inc.	13
26	Allied-Signal, Inc.	12
27t	Axcelis Technologies, Inc.	11
27t	Mower Family CHF Treatment Irrevocable Trust	11
27t	Lever Brothers Company, Division of Conopco, Inc.	11
27t	Gray Matter Holdings LLC	11

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	1,191	1,100	1,265
Physical Sciences	336	331	321
Geo Sciences	53	61	100
Life Sciences	2,758	3,275	4,063
Other S & E	2,508	2,808	2,878
Total S & E	6,846	7,575	8,627
Arts & Humanities	14,676	14,865	16,844
Total Degrees	21,522	22,440	25,471

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$782,531	$914,600	$1,468,735
State/Local	$21,251	$27,811	$45,934
Industry	$29,705	$48,034	$83,833
Institutional	$34,930	$85,657	$118,245
Other	$49,999	$86,910	$118,216
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$218,305	$262,100	$448,555
Physical Sciences	$119,735	$102,740	$154,985
Geo Sciences	$33,237	$43,662	$58,645
Life Sciences	$396,396	$619,323	$992,151
Other	$150,743	$134,187	$180,627
Total Expenditures	$918,416	$1,163,012	$1,834,963

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	352	377	410	428	459	398	472	529	639	670	633	652	624	589	579

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	254	187	169	165	196	204
VC ($000's)	2,118,122	1,072,707	823,664	926,202	998,554	1,125,276

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.
Notes: Venture capital data is presented for the Baltimore-Washington Metroplex and is not separated into individual regions; therefore, this data corresponds with data presented for the Washington, D.C. region.

Boston

Regional Economic Indicators

Metropolitan Population (2005)	4,411,835
Number of Universities (2001)	101
Patents per 10,000 Employees (2004)	13.35 (Nat'l:7.29)
Employment Growth (1990-2004)	0.67% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.65% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	2.64% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	Massachusetts Institute of Technology	462
2	EMC Corporation	330
3	Millennium Pharmaceuticals, Inc.	276
4	Sun Microsystems, Inc.	249
5	Mass General Hospitals	237
6	Sci-Med Life Systems	199
7	Analog Devices, Inc.	185
8	Heidelberger Druckmaschinen Ag	177
9	Harvard College, President & Fellows	141
10	General Electric Company	140
11	Brigham and Woman's Hospital	129
12	Nortel Networks Limited	128
13	Raytheon Company	124
14	Koninklijke Philips Electronics N.V.	107
15	Compaq Computer Corporation, Inc.	106
16	International Business Machines Corporation	104
17t	Gillette Company	94
17t	Verizon Laboratories, Inc.	94
19	Children's Medical Center Corporation	91
20	Cognex Corporation	89
21	AGFA Corporation	88
22	Polaroid Corporation	86
23	Vertex Pharmaceuticals, Inc.	83
24	Genetics Institute, Inc.	82
25	Sepracor, Inc.	81
26	Osram Sylvania, Inc.	80
27	Boston Scientific Corporation	73
28	Avid Technology, Inc.	71
29t	Mitsubishi Electric Research Laboratories, Inc.	68
29t	Shipley Company, Inc.	68

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	3,944	3,757	3,873
Physical Sciences	990	884	876
Geo Sciences	167	162	132
Life Sciences	8,736	8,277	8,267
Other S & E	6,843	6,454	7,088
Total S & E	20,680	19,534	20,236
Arts & Humanities	51,114	51,985	57,517
Total Degrees	71,794	71,519	77,753

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$725,422	$946,782	$1,453,050
State/Local	$7,189	$32,994	$40,782
Industry	$84,808	$131,056	$124,232
Institutional	$75,052	$56,949	$62,071
Other	$115,081	$126,244	$135,009
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$199,045	$207,514	$306,637
Physical Sciences	$162,824	$173,395	$218,959
Geo Sciences	$29,702	$46,964	$78,429
Life Sciences	$441,501	$647,627	$997,518
Other	$174,480	$218,525	$213,601
Total Expenditures	$1,007,552	$1,294,025	$1,815,144

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	1,634	1,663	1,856	1,878	1,917	1,823	2,045	2,226	2,950	3,014	2,977	3,181	2,885	3,273	3,017

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	439	316	321	320	299	328
VC ($000's)	4,026,736	2,123,497	2,314,635	2,681,772	2,151,096	2,552,531

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.
Notes: Venture capital data for the Boston region includes all of New England.

New York

Regional Economic Indicators

Metropolitan Population (2005)	18,747,320
Number of Universities (2001)	172
Patents per 10,000 Employees (2004)	5.91 (Nat'l:7.29)
Employment Growth (1990-2004)	0.47% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.25% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	2.15% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	Lucent Technologies, Inc.	2,405
2	International Business Machines Corporation	1,970
3	AT&T Corporation	1,071
4	Koninklijke Philips Electronics N.V.	406
5	Merck & Co., Inc.	389
6	Columbia University	237
7	Colgate-Palmolive Company	219
8t	Agere Systems Guardian Group	204
8t	Symbol Technologies, Inc.	204
10	Avaya Technology Corporation	200
11	Schering Corporation	199
12	Agere Systems, Inc.	197
13	Interdigital Technology Corporation	181
14	Sarnoff Corporation & Co., Ltd.	157
15t	Honeywell International, Inc.	152
15t	Philips Electronics North America Corporation	152
17	Unilever Home & Personal Car USA, Div. Of Conopco	146
18	Becton, Dickinson & Company	131
19t	Ethicon, Inc.	128
19t	United States of America, Army	128
21	Engelhard Corporation	125
22t	Micron Technology, Inc.	124
22t	National Starch & Chemical Investment Holding Corp	124
24	Rockefeller University	112
25	Research Foundation of State University of New York	109
26	ISP Investments, Inc.	107
27	New York University	104
28	Sony Corporation	102
29	Bristol-Myers Squibb Company	101
30	Allied-Signal, Inc.	100

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	1,983	1,353	1,573
Physical Sciences	520	460	502
Geo Sciences	103	106	92
Life Sciences	9,760	9,109	9,580
Other S & E	6,364	8,148	8,989
Total S & E	18,730	19,176	20,736
Arts & Humanities	66,439	71,417	85,940
Total Degrees	85,169	90,593	106,676

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$557,189	$751,727	$1,237,098
State/Local	$18,109	$19,417	$25,629
Industry	$31,107	$37,789	$43,557
Institutional	$87,706	$150,078	$202,408
Other	$125,837	$119,977	$151,088
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$34,680	$32,919	$54,065
Physical Sciences	$53,634	$55,362	$94,631
Geo Sciences	$44,165	$52,517	$67,122
Life Sciences	$623,335	$850,712	$1,313,843
Other	$64,134	$87,478	$130,119
Total Expenditures	$819,948	$1,078,988	$1,659,780

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	3,812	4,010	3,754	3,811	3,990	3,877	4,346	4,367	5,547	5,694	5,663	5,581	5,256	4,980	4,479

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	434	225	190	209	173	249
VC ($000's)	3,611,227	1,522,384	1,417,957	1,573,133	1,921,612	1,945,046

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.

Greater Philadelphia

Regional Economic Indicators

Metropolitan Population (2005)	6,068,845
Number of Universities (2001)	88
Patents per 10,000 Employees (2004)	6.36 (Nat'l: 7.29)
Employment Growth (1990-2004)	0.82% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	3.85% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	2.95% (Nat'l 3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School. Copyright © 2005 Presidents and Fellows of Harvard College. All rights reserved.
Notes: Metropolitan population and universities based on Select Greater Philadelphia's 11-county region; other indicators based on U.S. Census Philadelphia MSA.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	2,420	2,276	2,402
Physical Sciences	767	638	610
Geo Sciences	112	110	76
Life Sciences	8,633	8,117	8,742
Other S & E	4,699	4,782	5,779
Total S & E	16,631	15,923	17,609
Arts & Humanities	40,416	42,992	49,868
Total Degrees	57,047	58,915	67,477

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$432,342	$608,253	$923,523
State/Local	$17,322	$26,153	$40,800
Industry	$51,956	$69,324	$70,737
Institutional	$107,594	$130,021	$200,750
Other	$59,211	$87,277	$123,005
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$85,896	$114,801	$194,676
Physical Sciences	$68,908	$79,473	$104,084
Geo Sciences	$20,736	$28,674	$38,168
Life Sciences	$397,527	$575,672	$841,050
Other	$95,359	$123,172	$180,837
Total Expenditures	$668,426	$921,792	$1,358,815

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	E.I. DuPont De Nemours & Co.	1,028
2	SmithKline Beecham Corporation	592
3	Rohm & Haas Company	292
4	Merck & Co., Inc.	232
5	University of Pennsylvania	153
6	Thomas Jefferson University	111
7	Bristol-Myers Squibb Pharmaceutical Company	101
8	Unisys Corporation	96
9	Metrologic Instruments, Inc.	92
10	Arco Chemical Technology, L.P.	89
11	General Instrument Corporation	81
12	Dupont Pharmaceuticals Company	77
13t	Bristol-Myers Squibb Company	74
13t	Hercules Incorporated	74
15t	Lucent Technologies, Inc.	68
15t	Rodel Holdings, Inc.	68
17	American Home Products Corp.	67
18	Wyeth	65
19	Ortho-McNeil Pharmaceutical, Inc.	63
20	Mobil Oil Corporation	61
21	Atofina Chemicals, Inc.	54
22	Lockheed Martin Corporation	49
23	Sarnoff Corporation & Co., Ltd.	47
24	McNeil-PPC, Inc.	44
25	Agilent Technologies, Inc.	41
26t	3-Dimensional Pharmaceuticals, Inc.	40
26t	Cell Pathways, Inc.	40
26t	Certain-Teed Corporation	40
29	Air Products & Chemicals, Inc.	37
30	Southco, Inc.	36

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School. Copyright © 2005 Presidents and Fellows of Harvard College. All rights reserved.
Notes: Patentholders in Philadelphia MSA only, and does not include Mercer County, NJ.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	1,582	1,770	1,779	1,887	1,846	1,779	1,983	1,864	2,164	2,245	2,173	2,187	1,961	1,799	1,616

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School. Copyright © 2005 Presidents and Fellows of Harvard College. All rights reserved.
Notes: Patentholders in Philadelphia MSA only, and does not include Mercer County, NJ.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	91	68	66	72	65	72
VC ($000's)	773,397	324,437	440,014	461,064	339,833	507,383

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.
Notes: Venture capital in Philadelphia MSA only, and does not include Mercer County, NJ.

Pittsburgh

Regional Economic Indicators

Metropolitan Population (2005)	2,386,074
Number of Universities (2001)	48
Patents per 10,000 Employees (2004)	6.19 (Nat'l:7.29)
Employment Growth (1990-2004)	0.70% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	3.15% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	2.46% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	PPG Industries Ohio, Inc.	321
2	Eaton Corporation	198
3	Alcoa, Inc.	128
4	University of Pittsburgh	115
5	Carnegie-Mellon University	97
6	Bayer Corporation	86
7	Siemens Westinghouse Power Corporation	65
8	Medrad, Inc.	63
9t	Kennametal, Inc.	53
9t	Seagate Technology LLC	53
11t	Respironics, Inc.	40
11t	Westinghouse Air Brake Company	40
13	Westinghouse Electric Co LLC	36
14t	Claritech Corporation	24
14t	United States of America, Department of Energy	24
16t	Sony Corporation	22
16t	Westinghouse Air Brake Technologies Corporation	22
16t	Tyco Electronics Corporation	22
19t	Calgon Corporation	20
19t	Duquesne University of the Holy Ghost	20
21	Mine Safety Appliances Co.	19
22t	Calgon Carbon Corporation	17
22t	Kennametal PC, Inc.	17
22t	Union Switch & Signal, Inc.	17
25t	Bayer Polymers LLC	16
25t	Marconi Communications, Inc.	16
27t	Adams Mfg.	14
27t	Bayer Aktiengesellschaft	14
29t	Air Products and Chemicals, Inc.	12
29t	Honeywell International, Inc.	12

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.
Notes: For Pittsburgh MSA only.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	1,005	1,065	1,207
Physical Sciences	272	250	270
Geo Sciences	42	53	71
Life Sciences	3,323	2,747	2,866
Other S & E	2,785	2,873	4,002
Total S & E	7,427	6,988	8,416
Arts & Humanities	15,858	17,506	19,809
Total Degrees	23,285	24,494	28,225

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$238,326	$331,195	$613,677
State/Local	$12,963	$6,781	$25,148
Industry	$28,601	$39,052	$21,240
Institutional	$25,696	$33,011	$56,804
Other	$22,529	$44,225	$30,001
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$43,977	$55,913	$84,196
Physical Sciences	$22,144	$22,784	$37,033
Geo Sciences	$3,162	$4,498	$3,448
Life Sciences	$169,906	$276,097	$460,897
Other	$88,926	$94,972	$161,296
Total Expenditures	$328,115	$454,264	$746,870

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	742	699	649	642	671	563	618	565	730	798	716	653	638	684	648

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	43	27	23	23	16	26
VC ($000's)	317,593	140,703	116,415	96,464	77,543	256,177

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.

Raleigh-Durham

Regional Economic Indicators

Metropolitan Population (2005)	1,405,868
Number of Universities (2001)	17
Raleigh-Cary MSA	
Patents per 10,000 Employees (2004)	18.34 (Nat'l:7.29)
Employment Growth (1990-2004)	3.40% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.04% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	6.42% (Nat'l:3.15%)
Durham MSA	
Patents per 10,000 Employees (2004)	8.94 (Nat'l:7.29)
Employment Growth (1990-2004)	2.25% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.54% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	5.85% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	1,673	1,689	2,076
Physical Sciences	475	394	487
Geo Sciences	71	62	54
Life Sciences	3,540	3,582	3,483
Other S & E	1,302	1,474	2,012
Total S & E	7,061	7,201	8,112
Arts & Humanities	12,425	13,014	14,237
Total Degrees	19,486	20,215	22,349

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$305,368	$399,136	$698,994
State/Local	$29,223	$21,330	$40,567
Industry	$34,963	$116,626	$141,286
Institutional	$41,605	$69,173	$153,601
Other	$17,068	$19,819	$39,606
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$8,380	$15,249	$34,337
Physical Sciences	$22,348	$30,868	$41,648
Geo Sciences	$13,251	$18,938	$36,079
Life Sciences	$328,131	$502,890	$869,614
Other	$56,117	$58,139	$92,376
Total Expenditures	$428,227	$626,084	$1,074,054

Source: National Science Foundation.
Notes: Amounts based on NSF Survey of R&D expenditures at respondent universities.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	International Business Machines Corporation	1,060
2	Ericsson, Inc.	164
3	North Carolina State University	142
4	Duke University	120
5	Nortel Networks Limited	89
6	Cisco Technology, Inc.	78
7	Lord Corporation	64
8	Cree, Inc.	61
9	University of North Carolina	59
10	SmithKline Beecham Corporation	57
11	Telefonaktiebolaget LM Ericsson	56
12	Glaxo Wellcome, Inc.	52
13	Closure Medical Corporation	45
14	Micell Technologies, Inc.	44
15	Caterpillar, Inc.	33
16t	Becton, Dickinson & Company	31
16t	Research Triangle Institute	31
18	ABB Power T&D Company, Inc.	30
19	Alcatel	29
20	Infineon Technologies AG	25
21	BOPS, Inc.	21
22t	MCNC	18
22t	Medi-Physics, Inc.	18
24t	ABB Technology AG	17
24t	Square D Company	17
24t	Intel Corporation	17
27t	Tyco Electronics Corporation	16
27t	Nobex Corporation	16
29t	Bell & Howell Mail & Messaging Technologies Co.	15
29t	MTS Systems Corporation	15

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	252	317	322	363	458	429	550	588	881	984	1,042	1,126	949	1,018	951

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	75	64	57	44	46	50
VC ($000's)	486,407	458,645	279,530	197,775	378,053	327,549

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.
Notes: Venture capital data for Raleigh-Durham is based on Research Triangle data, which includes all of North Carolina.

San Diego

Regional Economic Indicators

Metropolitan Population (2005)	2,933,462
Number of Universities (2001)	31
Patents per 10,000 Employees (2004)	17.16 (Nat'l:7.29)
Employment Growth (1990-2004)	2.04% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.16% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	3.95% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	Qualcomm, Inc.	757
2	Isis Pharmaceuticals, Inc.	391
3	Hewlett-Packard Company	365
4	Hewlett-Packard Development Company, L.P.	217
5	University of California, The Regents of	205
6	Sony Corporation	202
7	Callaway Golf Company	187
8	The Scripps Research Institute	137
9	United States of America, Navy	128
10	Cymer, Inc.	127
11	Salk Institute For Biological Studies	76
12	Applied Micro Circuits Corporation	74
13	NCR Corporation	68
14	Conexant Systems, Inc.	59
15	General Instrument Corporation	55
16	Innercool Therapies, Inc.	54
17	Diversa Corporation	53
18	Denso Corporation	49
19	Agouron Pharmaceuticals, Inc.	48
20	Nanogen, Inc.	47
21t	Acushnet Company	43
21t	Gen-Probe Incorporated	43
21t	Nokia Mobile Phone Ltd.	43
24	Mycogen Corporation	42
25	Advanced Cardiovascular Systems, Inc.	41
26	Archimedes Technology Group, Inc.	40
27	General Atomic Company	39
28	Stmicroelectronics, Inc.	38
29	TRW, Inc.	37
30	Intel Corporation	35

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	851	832	1,202
Physical Sciences	344	354	388
Geo Sciences	75	65	60
Life Sciences	2,209	2,549	2,436
Other S & E	1,623	2,109	2,121
Total S & E	5,102	5,909	6,207
Arts & Humanities	19,460	26,737	31,616
Total Degrees	24,562	32,646	37,823

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$301,939	$349,861	$776,507
State/Local	$17,503	$31,138	$26,479
Industry	$12,478	$36,425	$51,638
Institutional	$33,269	$105,508	$174,100
Other	$28,804	$52,359	$111,244
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$28,205	$53,463	$88,431
Physical Sciences	$36,937	$36,668	$27,456
Geo Sciences	$110,035	$118,371	$130,935
Life Sciences	$185,449	$276,480	$752,689
Other	$24,635	$107,104	$201,432
Total Expenditures	$393,993	$575,291	$1,139,968

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	728	842	845	857	910	899	1,091	1,230	1,639	1,741	1,724	1,915	1,926	2,041	1,975

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	150	107	120	127	129	125
VC ($000's)	1,537,337	933,725	799,411	1,247,957	1,055,377	1,229,886

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.

San Francisco

Regional Economic Indicators

Metropolitan Population (2005)	7,039,362
Number of Universities (2001)	102
Patents per 10,000 Employees (2004)	16.05 (Nat'l:7.29)
Employment Growth (1990-2004)	0.87% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.66% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	2.70% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.
Notes: Metropolitan population and number of universities refer to the U.S. Census estimate of the region's CMSA; all other indicators based on San Francisco-Oakland-Fremont MSA.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	3,510	3,670	3,995
Physical Sciences	734	650	816
Geo Sciences	222	207	205
Life Sciences	7,180	6,344	6,615
Other S & E	6,099	7,165	8,702
Total S & E	17,745	18,036	20,333
Arts & Humanities	47,139	48,615	57,043
Total Degrees	64,884	66,651	77,376

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	698,260	$869,174	$1,405,285
State/Local	$54,832	$97,929	$78,517
Industry	$50,962	$110,844	$96,516
Institutional	$124,679	$285,687	$333,659
Other	$84,914	$143,916	$278,696
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$161,615	$240,941	$340,339
Physical Sciences	$136,898	$183,306	$285,320
Geo Sciences	$33,055	$39,422	$74,050
Life Sciences	$599,271	$919,479	$1,327,377
Other	$82,808	$124,402	$165,587
Total Expenditures	$1,013,647	$1,507,550	$2,192,673

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	Advanced Micro Devices, Inc.	2,906
2	Sun Microsystems, Inc.	1,885
3	Applied Materials, Inc.	1,824
4	International Business Machines Corporation	1,791
5	Hewlett-Packard Company	1,270
6	Intel Corporation	1,184
7	University of California, The Regents of	933
8	Agilent Technologies, Inc.	830
9	LSI Logic Corporation	775
10	CISCO Technology, Inc.	696
11	National Semiconductor Association	651
12	Xerox Corporation	543
13	Xilinx, Inc.	468
14	Sony Corporation	416
15	Altera Corporation	398
16	Stanford University	396
17	Apple Computer, Inc.	384
18	LAM Research Corporation	354
19	Micron Technology, Inc.	348
20	Seagate Technology LLC	342
21	Genentech, Inc.	312
22	Cypress Semiconductor Corporation	255
23	Advanced Cardiovascular Systems, Inc.	243
24t	Koninklijke Philips Electronics N.V.	190
24t	Rambus, Inc.	190
26	Chiron Corporation	179
27	Chevron Chemical Company LLC	174
28	Sci-Med Life Systems, Inc.	169
29	Tessera, Inc.	167
30	Oracle Corporation	166

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	2,644	2,905	3,134	3,474	3,816	4,255	5,168	5,758	8,522	9,446	10,058	10,809	10,289	10,816	10,843

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	1,075	783	823	929	948	1,087
VC ($000's)	12,599,531	6,974,247	6,372,420	7,948,294	7,971,848	9,054,347

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.

Seattle

Regional Economic Indicators

Metropolitan Population (2005)	3,166,828
Number of Universities (2001)	43
Patents per 10,000 Employees (2004)	11.51 (Nat'l:7.29)
Employment Growth (1990-2004)	1.52% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.38% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	3.74% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	1,114	988	1,044
Physical Sciences	237	216	646
Geo Sciences	123	116	111
Life Sciences	2,857	2,885	3,067
Other S & E	3,647	4,013	6,010
Total S & E	7,978	8,218	10,878
Arts & Humanities	27,014	25,893	30,496
Total Degrees	34,992	34,111	41,374

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$292,139	$390,522	$607,666
State/Local	$10,170	$10,030	$9,860
Industry	$36,987	$57,424	$45,303
Institutional	$44,537	$63,563	$29,822
Other	$6,676	$9,392	$16,598
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$32,061	$25,041	$72,050
Physical Sciences	$23,067	$27,298	$36,744
Geo Sciences	$54,170	64,305	$82,347
Life Sciences	$257,952	$372,725	$485,357
Other	$23,259	$41,562	$32,751
Total Expenditures	$390,509	$530,931	$709,249

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	Microsoft Corporation	2,011
2	Boeing Company	519
3	University of Washington	185
4	Zymogenetics, Inc.	134
5	AT&T Wireless Services, Inc.	118
6	Weyerhaeuser Company	107
7	Koninklijke Philips Electronics N.V.	104
8	Corixa Corporation	99
9	Immunex Corporation	95
10	Intel Corporation	88
11	Cypress Semiconductor Corporation	84
12	Intermec IP Corporation	81
13	Honeywell International, Inc.	79
14	Sci-Med Life Systems, Inc.	54
15	Icos Corporation of America	45
16t	Allied-Signal, Inc.	41
16t	ATL Ultrasound, Inc.	41
18	Physio-Control Manufacturing Corporation	35
19	Siemens Medical Solutions USA, Inc.	33
20t	Mitutoyo Corporation	32
20t	Terabeam Corporation	32
20t	Neorx Corporation	32
23t	Agilent Technologies, Inc.	30
23t	Microvision, Inc.	30
23t	K-2 Corporation	30
23t	Metawave Communications Corporation	30
27	Digital Control Incorporated	28
28	Amazon.com, Inc.	26
29t	Cray, Inc.	24
29t	Flow International Corporation	24

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	605	666	668	623	635	706	837	985	1,289	1,331	1,294	1,375	1,468	1,542	1,618

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	132	98	74	105	115	131
VC ($000's)	981,776	503,596	371,015	735,135	756,946	966,071

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.

Washington, D.C.

Regional Economic Indicators

Metropolitan Population (2005)	5,214,666
Number of Universities (2001)	44
Patents per 10,000 Employees (2004)	4.99 (Nat'l:7.29)
Employment Growth (1990-2004)	1.83% (Nat'l:1.50%)
Average Wage Growth (1990-2004)	4.44% (Nat'l:3.61%)
Traded Establishment Growth (1990-2004)	4.25% (Nat'l:3.15%)

Sources: Population: U.S. Census Bureau; Universities: Economy League Research; All other data: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Top 30 Patentholders in Region (2000-2004)

	Organization	Patents
1	United States of America, Navy	532
2	United States of America, Health & Human Services	328
3	Human Genome Sciences, Inc.	233
4	United States of America, Army	156
5	Hughes Electronics Corporation	119
6	Applera Corporation	76
7	International Business Machines Corporation	59
8	Bell Atlantic Network Services, Inc.	58
9	University of Maryland	56
10	Lockheed Martin Corporation	51
11t	BAE Sys Information & Electronic Sys Integration, Inc.	46
11t	Samsung Electronics Co., Ltd.	46
13t	Johns Hopkins University	40
13t	United States of America, Department of Commerce	40
15	Georgetown University	36
16t	Invitrogen Corporation	34
16t	Science Applications International Corporation	34
18	Atlantic Research Corporation	32
19t	Genvec, Inc.	31
19t	IGEN International, Inc.	31
21	Microstrategy, Inc.	29
22	Large Scale Proteomics Corporation	27
23t	PE Corporation	26
23t	Wright Manufacturing, Inc.	26
25	Fusion UV Systems, Inc.	24
26t	Anatomic Research, Inc.	22
26t	United States of America, NASA	22
28t	America Online, Inc.	21
28t	Comsat Corporation	21
28t	Verizon Services Corporation	21

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Degrees Conferred by Subject Area

Discipline	1996	2000	2004
Engineering	2,056	1,758	2,239
Physical Sciences	485	352	318
Geo Sciences	46	40	37
Life Sciences	4,277	4,334	4,315
Other S & E	3,709	4,682	6,388
Total S & E	10,573	11,166	13,297
Arts & Humanities	30,038	30,097	35,673
Total Degrees	40,611	41,263	48,970

Source: National Center for Education Statistics.
Notes: Amounts are based on IPEDS Completions Survey; includes both undergraduate and graduate level degrees; Other S&E includes interdisciplinary degrees, mathematics, and computer science.

Financing of Academic R&D Expenditures

Source ($000's)	1995	2000	2005
Federal	$270,252	$353,300	$521,950
State/Local	$56,444	$53,392	$19,754
Industry	$39,411	$17,944	$24,362
Institutional	$72,496	$82,813	$148,740
Other	$17,643	$38,851	$44,231
Discipline ($000's)	**1995**	**2000**	**2005**
Engineering	$80,883	$94,202	$112,178
Physical Sciences	$77,342	$72,664	$87,816
Geo Sciences	$10,505	$11,797	$21,440
Life Sciences	$202,249	$225,963	$333,225
Other	$85,267	$141,674	$204,378
Total Expenditures	$456,246	$546,300	$759,037

Source: National Science Foundation.
Notes: Amounts are based on NSF Survey of R&D expenditures at respondent colleges and universities.

Patents Awarded

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Patents	723	749	784	830	865	892	939	942	1,277	1,260	1,218	1,285	1,236	1,226	1,172

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School.

Venture Capital

	2001	2002	2003	2004	2005	2006
Deals	254	187	169	165	196	204
VC ($000's)	2,118,122	1,072,707	823,664	926,202	998,554	1,125,276

Source: PricewaterhouseCoopers LLP/National Venture Capital Association MoneyTree report based on data from Thomson Financial.
Notes: Venture capital data is presented for the Baltimore-Washington Metroplex and is not separated into individual regions; therefore, this data corresponds with data presented for the Baltimore region.

AUTM Survey Respondent Institutions (2004)

Baltimore

- Johns Hopkins University
- University of Maryland, Baltimore
- University of Maryland, Baltimore County

Boston

- Beth Israel Deaconess Medical Center
- Boston University/Boston Medical Center
- Brandeis University
- Brigham & Women's Hospital
- CBR Institute
- Children's Hospital Boston
- Dana-Farber Cancer Institute
- Harvard University
- Massachusetts Institute of Technology
- New England Medical Center
- Northeastern University
- St. Elizabeth's Medical Center of Boston
- Massachusetts General Hospital
- Tufts University
- University of Massachusetts

New York

- Hospital for Special Surgery
- Mount Sinai School of Medicine of NYU
- New York Blood Center
- New York University
- Sloan Kettering Institute for Cancer Research

Greater Philadelphia

- Fox Chase Cancer Center
- Princeton University
- Temple University
- Thomas Jefferson University
- University of Delaware
- University of Pennsylvania
- Wistar Institute

Pittsburgh

- Allegheny-Singer Research Institute
- Carnegie Mellon University
- Duquesne University
- University of Pittsburgh

Raleigh-Durham

- Duke University
- North Carolina State University
- University of North Carolina, Chapel Hill

San Diego

- Burnham Institute
- The Salk Institute for Biological Studies
- Torrey Pines Institute for Molecular Studies
- University of California-San Diego

San Francisco

- California Pacific Medical Center Research Institute
- Children's Hospital Oakland Research Institute
- Stanford University
- University of California-Berkeley

Seattle

- Fred Hutchinson Cancer Research Center
- University of Washington/ Washington Research Foundation

Washington, D.C.

- George Mason University
- Georgetown University
- Catholic University of America
- University of Maryland, College Park

Note: AUTM data is survey-based, and therefore regional aggregations are dependent on each institution’s willingness to participate

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