

[Pennsylvania TechFormation]

A Status Report and Growth Strategies for
 Technology-Based Economic Development

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【 Letter from Governor Rendell 】

Pennsylvania has embarked on a new direction with the Plan for a New Pennsylvania looking to bring growth and opportunity from border to border. As Governor I am proud of the entrepreneurial spirit of Pennsylvania's business, economic development and university communities.

The creativity and inventiveness of our citizens is Pennsylvania's greatest asset. For centuries, Pennsylvania's economy has been built on a grand tradition of developing and commercializing new ideas. For several decades, the state's economy has been undergoing a transformation from a legacy economy to a 21st century technology-based economy.

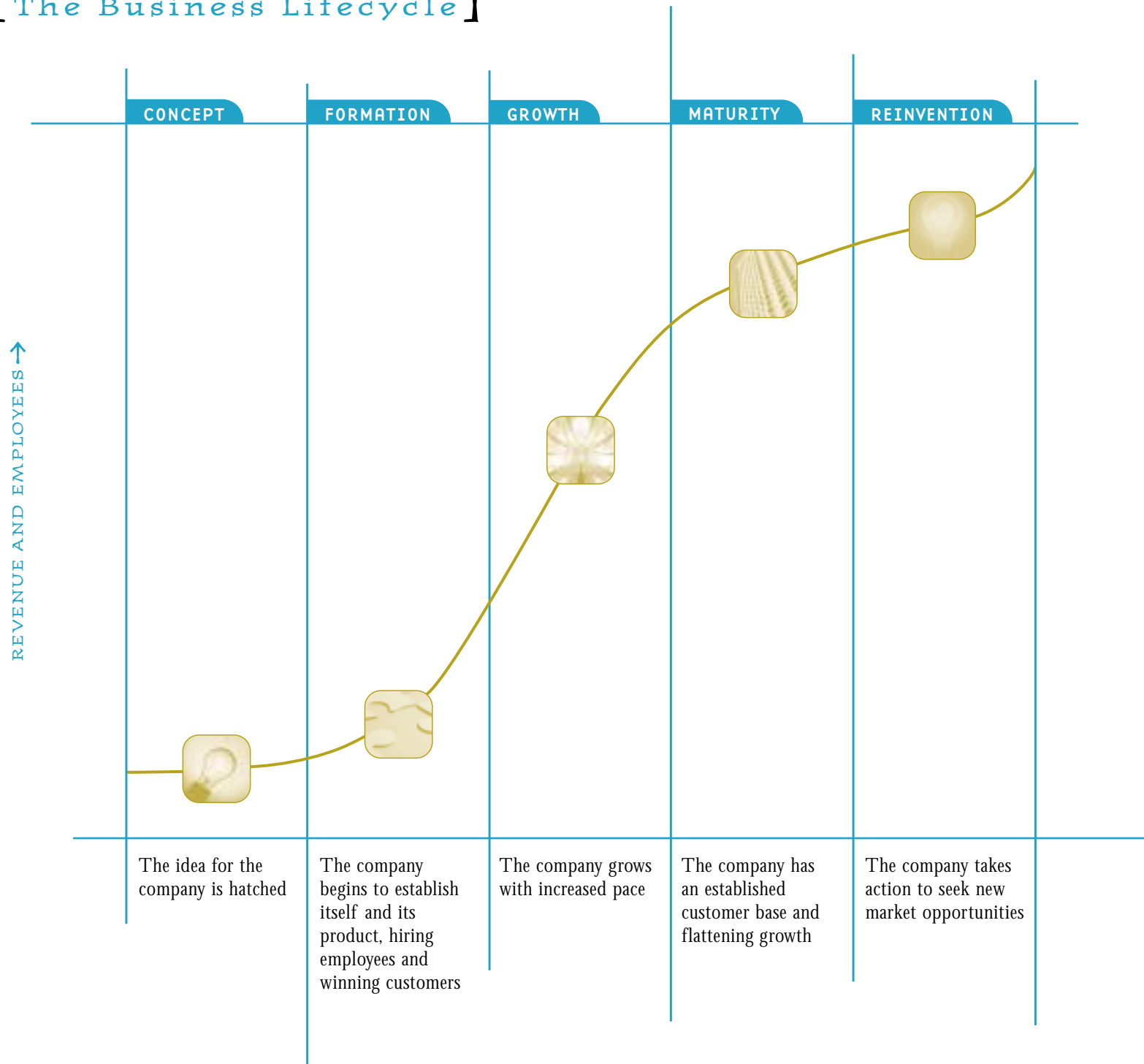
This document reports on the dynamic way in which the Commonwealth's public agencies, academic institutions and technology-focused economic development organizations are serving as stewards through this critical transition period in our economic history. We must create the conditions where all businesses in Pennsylvania put innovation at the heart of their future growth strategies. It is critical that we uncover what works best in the Commonwealth, and to support, sharpen and replicate these practices.

By taking inventory of our assets and pinpointing the challenges we face, this document can serve as a guide to invigorating our technology-based economic development efforts. In the coming years, we will continually reevaluate the Commonwealth's efforts to support technology-based economic development activities to determine if we are effectively utilizing scarce state resources. This will enable us to capture best practices and ensure that Pennsylvania continues to be a global leader in innovation.

The Commonwealth of Pennsylvania is creating an atmosphere that attracts and retains talented entrepreneurs and spurs innovation in our legacy companies, in our universities and in the minds of entrepreneurs across the state. Only through these strategic collaborative efforts will we continue to move ever closer to our goal of empowering our citizens to live, work and do business in a prosperous Pennsylvania.

Edward G. Rendell
Governor

[The Business Lifecycle]



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The purpose of this report is to gauge Pennsylvania’s innovation and entrepreneurial position and to provide the basis for continued improvement strategies. To do this, we compare the Commonwealth to states with legacy economies similar to our own—economies built on traditional manufacturing which are now transitioning to meet the realities of today’s economy. Those states we have used as a benchmark are New York, Michigan, Massachusetts, New Jersey, Ohio and Maryland.

This report illustrates how the Commonwealth’s technology-based economic development organizations assist companies as they move through “The Business Lifecycle.”

THE BUSINESS LIFECYCLE

The business lifecycle is the path an organization takes over several years as it grows into maturity and reinvention. This lifecycle is typically illustrated with an S-shaped curve—modest beginnings, an explosive growth phase, a flattening of growth once the company is established, and ultimately, a rejuvenation as the company reinvents itself and/or its products.

There are five phases of a company’s lifecycle:

- ▶ **CONCEPT**—the idea for the company is hatched. During this phase, the idea is explored, potential markets and delivery portals are identified, and the value proposition for customers is determined.
- ▶ **FORMATION**—the company becomes real. Employees are hired and customers are won. This phase focuses on applied research and development, and includes ramping up the business and commercializing the product.
- ▶ **GROWTH**—the company grows with increased pace. This is typically a time of both tremendous opportunity and risk.
- ▶ **MATURITY**—many well-known companies are in the maturity phase. An established customer base, slowing growth and flattening revenues are hallmarks of this phase.
- ▶ **REINVENTION**—the critical stage when the company’s technology, mindset and focus are updated to meet new realities and seek new market opportunities. Companies that do not embrace reinvention can become static in terms of revenue growth and are susceptible to losing market share.

The time that a business spends in each of these phases can vary widely. However, overall, businesses experience this type of cycle as they grow.

The Commonwealth of Pennsylvania must continue to aggressively pursue the reinvention of its economy. New inventions, an entrepreneurial mindset and the efforts of the state’s technology-based economic development partners are all driving this reinvention. Pennsylvania will reinvigorate its statewide economy by unlocking new market opportunities.

Fortunately Pennsylvania’s innovation-focused economic development organizations are collaborating to create a better future for Pennsylvanians by establishing one of the most supportive business infrastructures in the nation that will create seamless strategies that enable companies to flourish.

[The Business Case for Technology- Based Economic Development]

Pennsylvania is a state in transformation.

We are in the midst of the critical process of transforming our legacy economy—one that made Pennsylvania an agricultural and industrial leader in the 19th century—into a new economy that fits with 21st century realities.

AT AN ECONOMIC CROSSROADS

While some states are building new economies from scratch, Pennsylvania is actively working to leverage a century's worth of agricultural and industrial infrastructure to build an agile economic engine with the capacity to renew these existing industries and create new markets.

The tactics and tools that help businesses grow have changed dramatically over the past 40 years in response to a constantly changing global marketplace. What has remained constant is the need for assets that will drive economic growth. Today, entrepreneurs are to the new Pennsylvania what plentiful land and bountiful rivers were to 19th century Pennsylvania—our most valuable asset.

Site Selection Magazine ranked Pennsylvania 3rd in the
country for new and expanded corporate facilities in 2003.

A WINNING GAME PLAN FOR SUCCESS

Pennsylvania's community of innovation-focused economic development organizations is helping to bring about this important transition.

This type of economic renewal is as much art as it is science. However, it is very clear that governmental bodies and organizations can have a measurable impact on the economy, particularly when leveraged by the private sector.

Across the nation, Pennsylvania is emerging as a leader in driving technology-based economic development. As other states seek to copy our practices we must continue to push the envelope in order to remain competitive.

Small Times magazine ranked Pennsylvania as the country's
seventh best state for nanotechnology in 2004.

TODAY'S RAW MATERIALS

Today, our economic raw materials are an entrepreneurial spirit, smart labor, creative people, available capital and critical support services. More than ever before, our ability to encourage start-up companies and to support reinvention within established businesses will mean long-term prosperity for the Commonwealth.

State government has been visionary in the creation and continued support of critical programs. Technology-based economic development organizations across the state are pushing for this new prosperity. And it's working.

Business 2.0 magazine named Philadelphia one

of the country's 20 biggest "boom towns" in 2004.

TECHNOLOGY-BASED ECONOMIC DEVELOPMENT = HIGH VALUE, SUSTAINABLE JOBS

We are committed to creating jobs for Pennsylvanians—good, high-paying, sustainable jobs for the citizens of the Commonwealth. More jobs in a technology-driven economy fueled by innovation mean a healthier statewide economy. They also mean greater wealth for our citizens, a more robust tax base that allows for more services and amenities, and ultimately, a higher standard of living for all Pennsylvanians.

The Commonwealth has always been a center of innovation. Dating to the days of Benjamin Franklin, Pennsylvania has consistently set new standards, created new economic opportunities and been at the forefront of many ground breaking technological discoveries.

Innovative approaches drove Pennsylvania to be an industrial leader in the first half of the 20th century. Now, in the early years of the 21st century, we must continue on the path of innovation begun over the last two decades in order to invigorate Pennsylvania's economic prosperity.

The connection between stimulating and supporting entrepreneurship and job creation is clear—the youngest and smallest companies are among the country's biggest producers of new jobs. Similarly, technological innovation propels productivity improvements and reinvention, which lead to job retention and growth.

This report will take you through the business life cycle shared by companies in the Commonwealth; the report describes their needs at each stage and how technology-based economic development organizations help meet those needs. In addition, this report will begin to benchmark where Pennsylvania ranks compared to states that have traditionally shared similar industry heritage.

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Concept Phase

[Concept Phase]

All business ideas begin with a “eureka moment”—that point in time when an entrepreneur, factory foreman or research scientist realizes, “there’s a better way to do this.” Once that spark of inspiration has struck, the concept must be evaluated and acted upon in order to turn it into a real product and business.

The process of moving from a concept to a real business is a daunting one, filled with challenges that can make even the truest believer call it quits. Few business ideas ever progress beyond this concept phase. Support at this stage is critical because it can help limit failures and accelerate progress.

Concept Phase entrepreneurs are typically invisible to most of us. Their fledgling business ideas are hatched far below most people’s radar. However, these entrepreneurs hold the keys to potentially spectacular economic growth. The state’s economic development community focuses intensely on unleashing this power to benefit all Pennsylvanians.

PROFILE OF A CONCEPT PHASE INNOVATOR

Characteristics:

- ▶ Creative thinker
- ▶ Serial optimist
- ▶ Willing to take risks
- ▶ Energetic

Where you find them:

- ▶ “Invisible” to most of the public
- ▶ University labs
- ▶ Corporate R&D labs
- ▶ Garages and basements
- ▶ Factory floors
- ▶ In the wake of corporate layoffs

What they need most:

- ▶ Angel, seed stage and family and friends funding
- ▶ Proof of concept
- ▶ Intellectual property strategy
- ▶ Outside business perspective
- ▶ Mentors



Pennsylvania’s technology-based economic development organizations provide a myriad of services and support systems to help entrepreneurs meet the challenges faced during the Concept Phase:

CATEGORY	CHALLENGES	SERVICES & RESOURCES
Innovation	<ul style="list-style-type: none">▶ Idea infrastructure—an environment that allows their idea to be fully developed▶ Intellectual property strategy—the need to secure patent, copyright and/or trademark rights for the concept▶ Prototype development—building the first edition of the product▶ Outside perspective—an experienced, reality-based viewpoint	<ul style="list-style-type: none">▶ University resource connections—providing access to existing university-based resources and expertise▶ Tech transfer expertise and assistance—knowledge of how to extract university and industry-based ideas and ultimately bring them to market▶ Technical review—analysis of technical feasibility▶ Mentors/coaching—access to a network of experienced, knowledgeable professionals who can provide feedback and advice
Workforce	<ul style="list-style-type: none">▶ Employee identification/development—finding professionals with skills complementary to the inventor to build the prospective business	<ul style="list-style-type: none">▶ Executive recruitment—assistance in locating dedicated, experienced executives
Capital	<ul style="list-style-type: none">▶ Business plan drafting—creating a business plan that will attract potential investors▶ Early/high-risk funding—locating the capital required to fully test the concept	<ul style="list-style-type: none">▶ Business plan assistance—help writing a business plan that will appeal to potential investors▶ State and federal funding programs—formalized approach to securing existing government funds such as Small Business Innovation Research grants (SBIR), Small Business Technology Transfer (STTR) and Advanced Technology Program (ATP) grants▶ Pre-seed capital—grants and direct investment from economic development organizations
Business Climate	<ul style="list-style-type: none">▶ Entrepreneurial environment—an atmosphere that supports and encourages risk-taking▶ Market viability—identification of which markets are receptive to the concept	<ul style="list-style-type: none">▶ Incubator space—infrastructure that provides physical space and business advice from experienced professionals▶ Market research—in-depth analysis of the concept’s key markets



CASE STUDY

HOW ECONOMIC DEVELOPMENT ORGANIZATIONS ARE MAKING A DIFFERENCE

MOBILE ASPECTS

In 2000, Mobile Aspects was working with the University of Pittsburgh Small Business Development Center (SBDC) on developing a business model utilizing Radio-Frequency Identification (RFID) technology.

In 2001, the company was interested in developing RFID technology to track videotapes in video stores—a low-margin, intensely competitive business. Working to develop a solid business plan with industry and university support, the SBDC introduced Mobile Aspects to a Ben Franklin Technology Partner for possible investment. Given the strengths of the technology and the possibilities for high-value applications, the Ben Franklin Technology Partner invested a total of \$600,000 in the company over a three-year period. Working closely with the University of Pittsburgh SBDC and Innovation Works, Mobile Aspects researched potential markets that were more suited and could afford this type of supply chain solution and decided to pursue opportunities in the health care market.

As a result of the hands-on market research assistance and business strategy development from the SBDC and Innovation Works, Mobile Aspects developed its supply chain management solution, the SecureCabinet™, which reduces labor and supply costs in operating rooms and interventional areas of large hospitals.

Mobile Aspects' system helped the Massachusetts General Hospital lower inventory management costs by thirty three percent. Other critical customers include the University of Pittsburgh Medical Center, Johns Hopkins, the Cleveland Clinic and the Hospital at the University of Pennsylvania.

The University of Pittsburgh SBDC and the Ben Franklin Technology Partner have played a critical role in fundraising, including federal proposal development, to help the company attract more than \$3 million in federal R&D grants, public and private financing. The University of Pittsburgh SBDC provides ongoing assistance relating to capital raised, product development and market introduction. The Pittsburgh Life Sciences Greenhouse has also collaborated with Mobile Aspects, assisting in the recruitment of a VP of Sales.

HOW IS PENNSYLVANIA DOING?

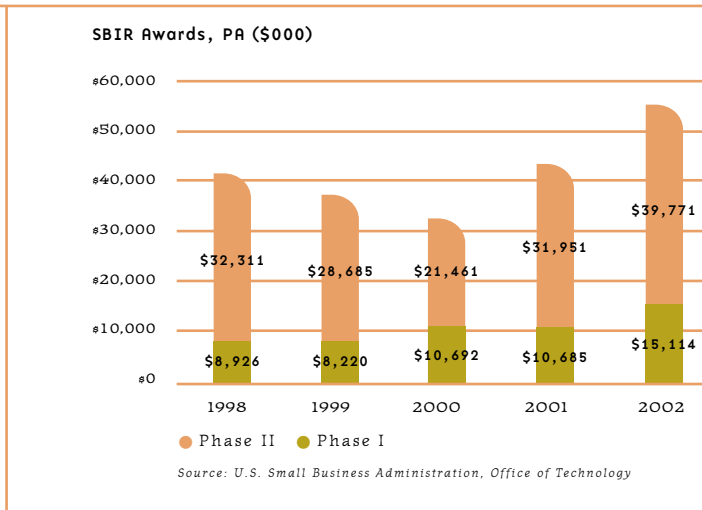
By many performance measures, Pennsylvania is doing well in its competition with peer states in driving Concept Phase entrepreneurship. A sample of critical success factors shows Pennsylvania to be vigorously competing with other states. At the same time, we are playing catch-up on other key indicators as we work to create a better business environment for entrepreneurs.

In order to understand Pennsylvania's level of activity and success in the Concept Phase, we have collected data on the following key measures:

- ▶ Small Business Innovation Research (SBIR) Phase I awards
- ▶ Small Business Technology Transfer (STTR) Phase I awards
- ▶ Patent Productivity

The trends for SBIR awards in Pennsylvania have been improving, with almost \$55 million in 2002 being awarded by this program to small businesses throughout the Commonwealth. This chart shows how Pennsylvania has increased the amount of SBIR awards it receives:

- ▶ Overall, between 1998 and 2002, the Commonwealth ranked 9th in the nation for SBIR awards (number and dollar value, all phases).
- ▶ The Phase I award value per 10,000 citizens was \$55,852 for the nation and \$43,665 for Pennsylvania. This ratio will improve as groups work to bring in more SBIR awards.
- ▶ The average Phase I award between 1998 and 2002 was \$94,396 for the nation and \$94,931 for Pennsylvania.

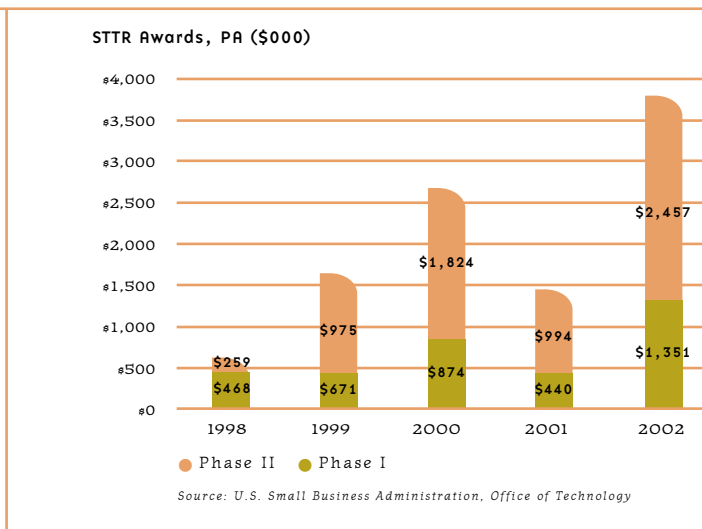


The STTR program also provides competitive grants in two phases.

- ▶ Phase I awards provide up to \$100,000 for proof-of-concept research to show technical merit and feasibility.
- ▶ Phase II awards provide up to \$500,000 for R&D. Only Phase I award winners are considered for Phase II. (More on Phase II awards can be found in the Formation Stage section of this report.)

The trends for STTR awards in Pennsylvania have been generally increasing. This chart illustrates that growth between 1998 and 2002:

- ▶ Overall, between 1998 and 2002, the Commonwealth ranked 10th in the nation for total number of STTR awards (all phases) and 11th for total dollars awarded (all phases).
- ▶ The Phase I value per 10,000 citizens was \$4,445 for the nation and \$3,097 for Pennsylvania. This ratio will improve as groups work to bring in more STTR awards.
- ▶ The average Phase I award between 1998 and 2002 was \$99,656 for the nation and \$100,105 for Pennsylvania.



2003 Patent Activity

- ▶ In 2003, Pennsylvania accounted for 2.5 percent of U.S. patent applications filed and 3.6 percent of U.S. patents issues.
- ▶ In 2003, Pennsylvania saw 40 patent applications filed and 29 patents issues per 100,000 citizens.
- ▶ Comparable figures for the United States are 68 filings and 34 patents issued per 100,000 citizens.

States Issued the Most Patents in 2003

RANK	STATE	NUMBER OF PATENTS
1.	California	22,351
3.	Texas	6,509
2.	New York	6,973
4.	Michigan	4,266
5.	Massachusetts	4,199
6.	New Jersey	4,068
7.	Illinois	3,979
8.	Ohio	3,972
9.	Pennsylvania	3,592
10.	Minnesota	3,243
21.	Maryland	1,623

Source: United States Patent and Trademark Office; annual reports, 1999–2003

[Formation Phase]

Taking a business from concept to a commercialized product is an exciting, frustrating, exhilarating and time-consuming process. The Formation Phase of a company is filled with challenges. Often, the main goal of this phase is simply to survive and stay in business. Inevitably, this is a time of trial and error.

During the Formation Phase, a company shifts its attention from ideas and possibilities to results. A forming company needs to establish a client base, begin to gain traction in its sales efforts and forge alliances and partnerships that will enable it to grow.

A company in formation is bringing on new people and often quickly depletes its resources. This can complicate the funding picture; frequently, there is some sort of cash crunch during this phase. Founders and staff work around the clock to accomplish goals and create momentum for the company.

The formation of a company is the time at which it needs the most guidance and support. A company in this phase is very fragile due to its lack of internal resources, and consequently dependent on outside assistance and support.



PROFILE OF A FORMATION PHASE INNOVATOR:

- Characteristics:**
- ▶ Overwhelmed with start-up logistics
 - ▶ Sleep-deprived
 - ▶ Evangelistic
- Where you find them:**
- ▶ At work at all hours
 - ▶ Incubators
 - ▶ Laboratories
 - ▶ Technology Parks
- What they need most:**
- ▶ Business support/guidance
 - ▶ Mentors
 - ▶ Strategic partners
 - ▶ Team of true believers
 - ▶ Funding
 - ▶ More hours in the day

HOW IS PENNSYLVANIA DOING?

By several key measures of evaluating Formation Phase entrepreneurial growth, Pennsylvania is doing well, although the Commonwealth does trail several competitor states.

Pennsylvania is a top 15 state across these indicators. The technology-based economic development organizations in the state are working to raise the Commonwealth's status within this upper echelon.

To understand Pennsylvania's level of activity and success in the Formation Phase, we have collected data on the following key measures:

- ▶ Small Business Innovation Research (SBIR) Phase II awards
- ▶ Small Business Technology Transfer (STTR) Phase II awards
- ▶ Early Stage Venture Capital investment
- ▶ Technical and professional degrees

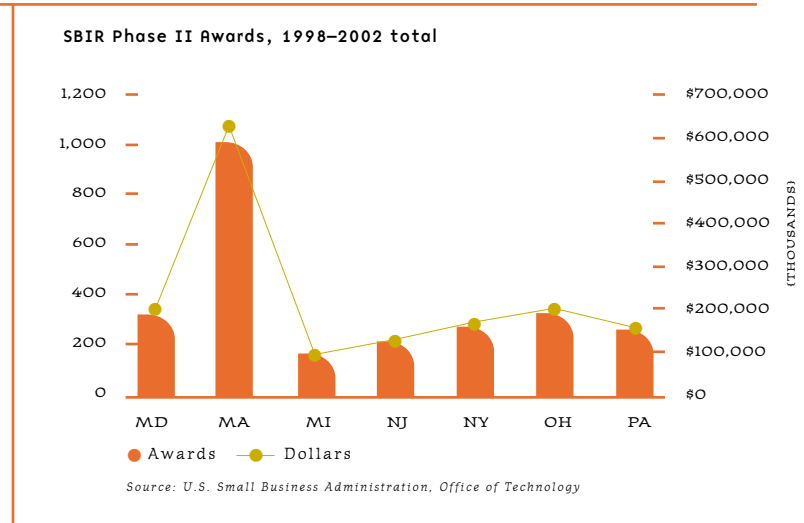
SBIR PHASE II AWARDS

As in the Concept Phase, the federal government's Small Business Innovation Research Program (SBIR) is a valuable source of financing for Formation Phase entrepreneurs.

The SBIR program provides competitive grants in two phases. The first phase is detailed in the Concept Phase section of this report. Phase II awards provide up to \$750,000 for prototype development. Only Phase I award winners may be considered for Phase II.

This chart shows how Pennsylvania compares to other key states in SBIR Phase II awards:

- ▶ Overall, between 1998 and 2002, the Commonwealth ranked 9th in the nation for SBIR awards (number and dollar value, all phases).
- ▶ The Phase II award value per 10,000 citizens was \$150,401 for the nation and \$125,517 for Pennsylvania. This ratio will improve as groups work to bring in more SBIR awards.
- ▶ The average Phase II award between 1998 and 2002 was \$609,203 for the nation and \$611,825 for Pennsylvania.



STTR PHASE II AWARDS

The federal government's Small Business Technology Transfer Program (STTR) is an important source of financing for entrepreneurs. The STTR program provides competitive grants in two phases. Phase I awards provide up to \$100,000 for proof-of-concept research to show technical merit and feasibility. Phase II awards provide up to \$500,000 for R&D.

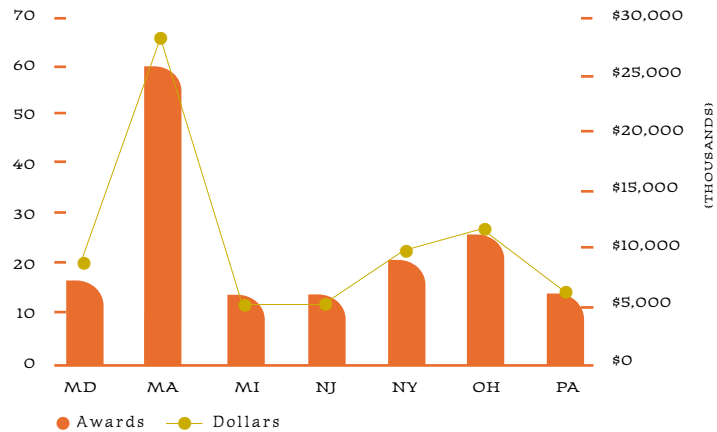
The trends show that Pennsylvania is doing increasingly well in winning STTR awards. This chart details how Pennsylvania ranks with other key competitor states for Phase II STTR grants:

► Overall, between 1998 and 2002, the Commonwealth ranked 10th in the nation for total number of STTR awards (all phases) and 11th for total dollars awarded (all phases).

► The Phase II award value per 10,000 citizens was \$7,811 for the nation and \$5,299 for Pennsylvania. This ratio will improve as groups work to bring in more STTR awards.

► The average Phase II award between 1998 and 2002 was \$458,677 for the nation and \$433,932 for Pennsylvania.

STTR Phase II Awards, 1998–2002 total



Source: U.S. Small Business Administration, Office of Technology



TECHNICAL AND PROFESSIONAL DEGREES AWARDED

A technically competent workforce is a requirement for productivity and economic well-being. Many factors contribute to the workforce skill level. Graduates with technical degrees (those in science and technology disciplines) are an important component of the mix.

Companies frequently cite access to skilled labor as a consideration for location decisions. Not all jobs require doctoral or other advanced or professional degrees, although a strong pipeline of graduates with a diverse mix of credentials is important. Therefore, a greater number of technology degrees in a state can make that region more attractive to technology-based businesses.

This chart shows technical (science and engineering) and professional (including human and veterinary life sciences and law) degrees awarded:

- Between 1996 and 2001, Pennsylvania accounted for 5 percent of all technical and professional degrees awarded nationwide.
- Pennsylvania ranked 5th in the U.S. in technical degrees awarded for that period.
- In 2001, Pennsylvania awarded 108 technical degrees and the United States awarded 97 degrees per 10,000 citizens.

	U.S.	MD	MA	MI	NJ	NY	OH	PA
Share, U.S. ('96 - '01)	100%	1.7%	3.3%	3.5%	2.0%	8.2%	3.7%	4.9%
Rank, All Degrees ('96 - '01)	-	21	9	8	19	2	7	5
Degrees per 10k pop. (2001)	96.7	86.5	138.6	92.2	62.6	114.9	87.7	107.9
Rank, degrees/10k pop. (2001)	-	38	2	24	48	11	35	15

Source: National Science Foundation WebCASPAR Database



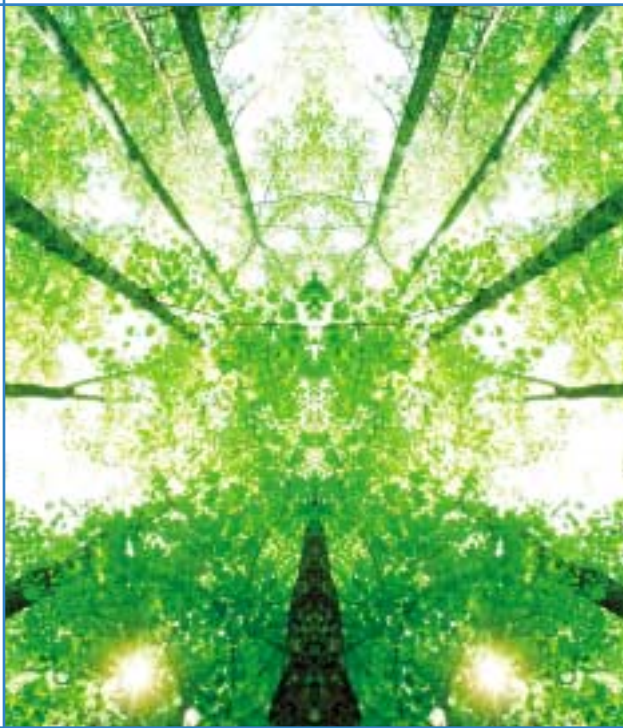
[Growth Phase]

Once the foundation has been set, companies that are going to succeed typically experience very rapid growth, with sales growing exponentially over a relatively short time span—five to ten years.

This is an exciting time in the life of a company—one in which the executive team must drive the organization. Things are happening quickly—sales are up, staff is growing, resources are churned and new markets are increasingly accessible.

A company entering the rapid growth stage is similar to a growing teenager—it devours everything in sight. Growth Phase companies must have increasing access to sophisticated business expertise and additional capital.

This is also a time when an organization may make significant investments in staff and assets, which can exacerbate already existing cash flow problems. Opportunity and risk are most visible, as companies have already consumed a lot of their resources. It becomes critical as a company moves through this phase to begin to show revenue and generate positive cash flow.



PROFILE OF A GROWTH PHASE INNOVATOR:

Characteristics:

- ▶ Re-energized by soaring success
- ▶ Profit and cash flow-focused for first time
- ▶ Inundated with internal issues

Where you find them:

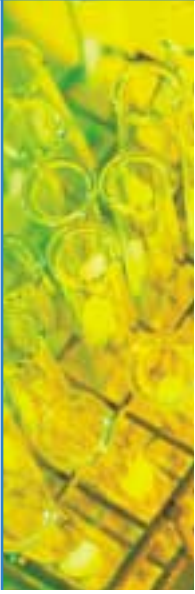
- ▶ The office
- ▶ The boardroom
- ▶ Networking events
- ▶ Industry functions and seminars

What they need most:

- ▶ Physical facilities
- ▶ Increasing customer base
- ▶ Institutional funding
- ▶ Larger workforce

This chart details some of the challenges companies face during the Growth Phase, and how Pennsylvania's technology-based economic development organizations help entrepreneurs meet those challenges:

CATEGORY	CHALLENGES	SERVICES & RESOURCES
<p>Innovation</p>	<ul style="list-style-type: none"> ▶ Ongoing intellectual property support—as awareness of the company increases, it needs increased vigilance to protect patent, copyright and/or trademark rights 	<ul style="list-style-type: none"> ▶ Legal services as needed—economic development organizations provide access to a network of intellectual property attorneys
<p>Workforce</p>	<ul style="list-style-type: none"> ▶ Management team build out—identifying and adding complementary members of upper management ▶ Core team training—assistance for the core team in coping with the growing scope of the business 	<ul style="list-style-type: none"> ▶ Talent recruitment—identification and hiring assistance for needed workforce ▶ In-house training and education—professional development of existing workforce
<p>Capital</p>	<ul style="list-style-type: none"> ▶ Additional rounds of venture capital—having burned through the majority of its early stage funding, the company now needs a cash infusion to capitalize on its growing opportunities ▶ Increased market share—the company must add significant market share to grow ▶ Increased revenue—in order to fuel growth, revenues must rise rapidly ▶ Bank debt—the company begins to become a candidate for initial and enhanced bank debt 	<ul style="list-style-type: none"> ▶ Syndicated venture capital networks—a wide array of potential investors ▶ Economic Stimulus Packages—state funds available to fuel business growth ▶ Domestic market development—identification of potential domestic customers ▶ Export assistance—identification of overseas customers and order fulfillment assistance
<p>Business Climate</p>	<ul style="list-style-type: none"> ▶ Expanding customer base—the critical need of increasing revenues ▶ Physical facility expansion—as the business grows, added workspace is needed to fulfill customer demand 	<ul style="list-style-type: none"> ▶ Trade missions—formal, organized visits to potential new markets ▶ Trade fairs—industry-specific opportunities ▶ Federal procurement programs—knowledgeable access and guidance through existing federal opportunities ▶ Location assistance—site selection guidance ▶ Low interest loans—for capital improvements ▶ Tax incentives—identifying incentives for which the company may be eligible



CASE STUDY

HOW ECONOMIC DEVELOPMENT ORGANIZATIONS ARE MAKING A DIFFERENCE

ORASURE TECHNOLOGIES

In 1987, three friends selected Bethlehem as their location to launch what would become OraSure Technologies, Inc. OraSure's story is a classic success, leveraging community and university partnerships, funding and a network of experts and business contacts to create jobs, develop a niche market and improve the region's image.

The company's first product was a sunscreen towelette. The Ben Franklin Technology Partners invested \$235,000 in the young company and provided incubator space, business counseling and technical service assistance. The company secured a deal with Kmart in 1988 to carry the towelette chain-wide, and in 1990 the product was licensed to Schering-Plough for marketing under the Coppertone® label.

With Ben Franklin funding, the company also developed a new enzyme immunoassay-based diagnostic product line targeted at the insurance industry. They raised \$450,000 in equity financing and \$500,000 in debt from a group of angel investors to support that effort. Through a series of acquisitions and mergers, the company moved into the business of oral fluid testing and excelled; it is now the global leader in this market. Along the way they raised \$4.6 million in a private placement, \$6.5 million from venture capital firms and another \$2.8 million from existing investors. In recent years, OraSure has worked with the Manufacturers Resource Center on projects involving information systems, ISO 9000 and various employee training efforts.

Now publicly traded on NASDAQ under (OSUR), OraSure revenues have grown from \$77,000 in 1989 to \$32 million in 2003, representing an explosive 24% annual growth. OraSure currently has 200 employees. The company has three facilities, two of which are located at the John M. Cook Technology Center, a technology campus located adjacent to Lehigh University on restored Bethlehem Steel Brownfield sites, initially conceived and developed by DCED partner organizations Ben Franklin, Bethlehem Economic Development Corporation, Lehigh Valley Industrial Park, Inc. and Northampton County New Jobs Corporation.

HOW'S PENNSYLVANIA DOING?

Thanks in part to technology-based economic development organizations in Pennsylvania, Growth Phase companies are doing well.

The Commonwealth is solidly in the top 10 in later stage venture capital investment. Among competitor states, only Massachusetts and New Jersey are currently outperforming the Commonwealth.

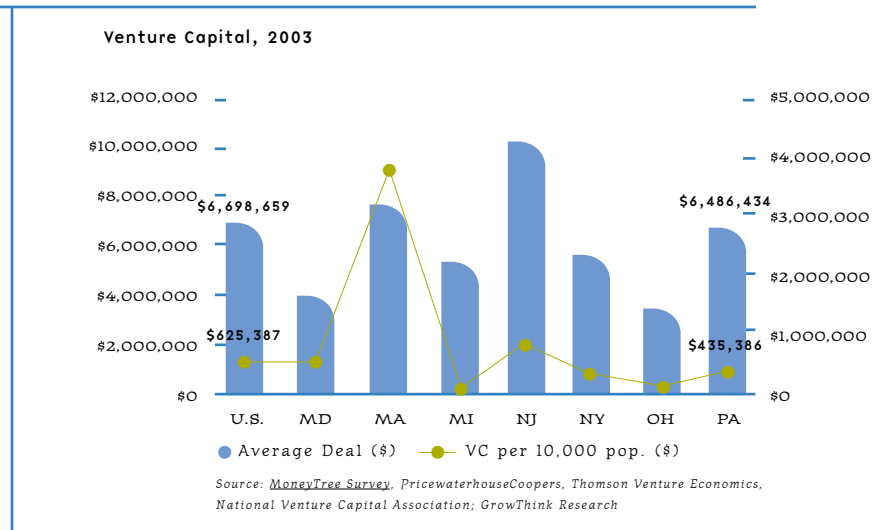
In order to understand Pennsylvania's level of activity and success in the Growth Phase, we have collected data on the following key measures:

- ▶ Total venture capital investment
- ▶ Venture capital investment by industry sector

VENTURE CAPITAL

Venture capital is an important source of funding for many companies. In the Growth Phase of the Business Lifecycle companies need venture capital to move to the next level. Capital in this stage generally goes directly toward operations, including a larger workforce.

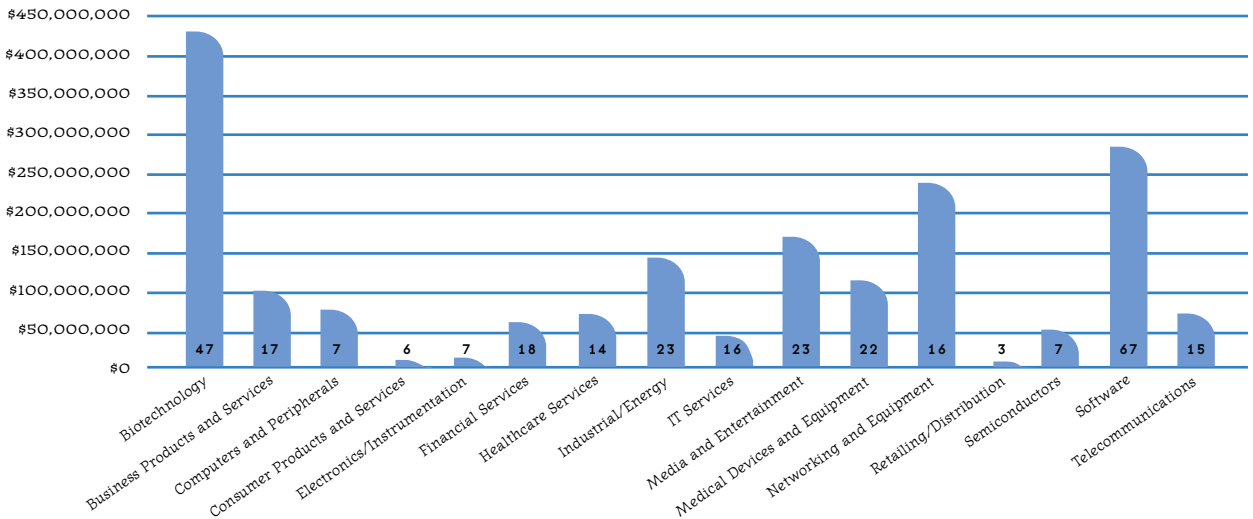
- ▶ In 2003, there were 83 investments in Pennsylvania, totaling \$538.4 million.
- ▶ Nationwide, Pennsylvania ranked 5th in the number of deals and 7th in total venture capital invested during the year.
- ▶ The Commonwealth accounted for about 3 percent of all deals and venture capital invested during 2003.



Pennsylvania has attracted investments into a diverse set of industry segments. This chart of venture investments by industry sector demonstrates that most are receiving a share of the overall investment totals:

PA Venture Capital investment by sector, 2001-03

[Note: no. of deals listed inside column]



Source: MoneyTree Survey, PricewaterhouseCoopers, Thomson Venture Economics, National Venture Capital Association; GrowThink Research



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[Maturity Phase]

This chart details some of those challenges faced by a Maturity Phase entrepreneur, and how Pennsylvania’s technology-based economic development organizations help entrepreneurs meet those challenges faced by a Maturity Phase entrepreneur:

CATEGORY	CHALLENGES	SERVICES & RESOURCES
Innovation	<ul style="list-style-type: none"> ▶ Process enhancements—making the production process more efficient ▶ Product line extensions—identifying and creating new versions of the company’s core offering 	<ul style="list-style-type: none"> ▶ Diagnostics—identification of changing business goals and development of an action plan to achieve those goals ▶ Product development—access to university and industry-based R&D to enhance existing product lines
Workforce	<ul style="list-style-type: none"> ▶ Supply chain management—manage supply chains for non-core services 	<ul style="list-style-type: none"> ▶ Workforce training—professional development and introduction of more sophisticated company-wide training strategies
Capital	<ul style="list-style-type: none"> ▶ Recapitalization—solidifying the company’s financial structure 	<ul style="list-style-type: none"> ▶ Commonwealth-based capital—access to funding programs administered by the state
Business Climate	<ul style="list-style-type: none"> ▶ New market developments—changing conditions within the market ▶ Corporate spin-outs—employees and ideas leave the company to become new businesses ▶ Global economic trends—the state of the worldwide economy and its impact on sales ▶ Strategic alliances—the need to partner with complementary organizations in order to maintain and grow the company 	<ul style="list-style-type: none"> ▶ Networking—industry-specific events and groups ▶ Market research—identification of external trends and opportunities ▶ Market development—implementation of new sales initiatives ▶ University partnerships—affiliations with university-based R&D ▶ Industry partnerships—affiliations with industry-based R&D ▶ Fighting commoditization—assistance in creating value-added products and services



CASE STUDY

HOW ECONOMIC DEVELOPMENT ORGANIZATIONS ARE MAKING A DIFFERENCE

ARROW INTERNATIONAL

In the mid-1970s, Reading-based Arrow International transitioned from its historical business of manufacturing knitting needles into the production of high-tech surgical needles and other medical devices. With the assistance of the Commonwealth's technology-based economic development organizations, the company continues to show an entrepreneurial approach to business.

From 1988 to 1990, Arrow partnered with Ben Franklin Technology Partners and Lehigh University to update production methods and implement computer-aided design capabilities. As a result of increased efficiency, Arrow succeeded in dramatically cutting product cycle time. Ben Franklin invested \$130,550 in these efforts, an investment matched by Arrow. Arrow added 72 new jobs as a result of this work. They also developed a computerized optical inspection system that boosted quality levels.

In 2004, the LifeSciences Greenhouse of Central PA assisted Arrow in arranging collaborative research with State College-based NanoHorizons, an emerging leader in nano-scale material an device technologies.

Arrow went public on NASDAQ in 1992 and has grown rapidly since then, recording \$430 million in sales in 2004. They have been named to the Forbes list of the 200 Best Small Companies in the U.S. in 2003 for the second consecutive year. They now employ more than 3,000 people. Arrow and NanoHorizons are developing opportunities to apply state-of-the-art nanotechnology to numerous emerging cost and performance issues in medical device technology.

HOW IS PENNSYLVANIA DOING?

By several key measures, Pennsylvania is holding steady in supporting Maturity Phase companies.

The following indicators show that Pennsylvania narrowly trails key competitor states in Merchandise Exports and Manufacturing Value Added.

- ▶ Merchandise Exports
- ▶ Manufacturing Value Added

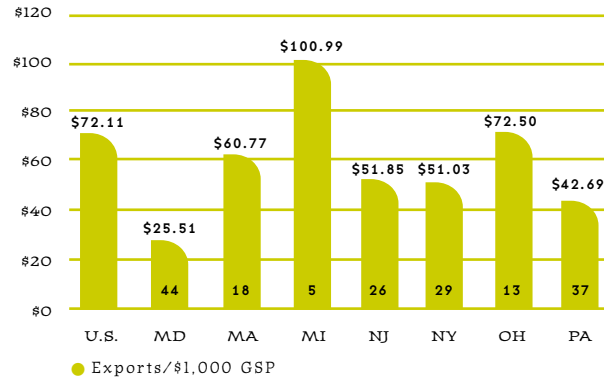
MERCHANDISE EXPORTS

International trade is important for generating income and increasing a state's economic competitiveness. Export income represents an inflow of funds to a region, and carries with it the benefits associated with increased spending activity and the related multiplier effects. Merchandise exports are further associated with extensive distribution networks, which add to regional capacity and competitiveness.

- ▶ Pennsylvania accounts for about 2.6 of U.S. merchandise exports (2001) for the 50 states. That is below the Commonwealth's share of Gross State Product (GSP), which is 4 percent.
- ▶ Pennsylvania's under-representation with respect to merchandise exports accounts for its relatively low "export intensity"—or merchandise exports per \$1,000 of GSP.
- ▶ If the Pennsylvania economy continues its transition away from manufacturing employment and toward increased employment in services, it is possible that the share of merchandise exports will continue to fall, even as export activity from non-traditional "knowledge" sectors continues to grow.

Merchandise Exports per \$1,000 GSP

[Note: state rank in column]



Source: Massachusetts Institute for Social and Economic Research (MISER)
(data from Census Bureau, Foreign Trade Division)



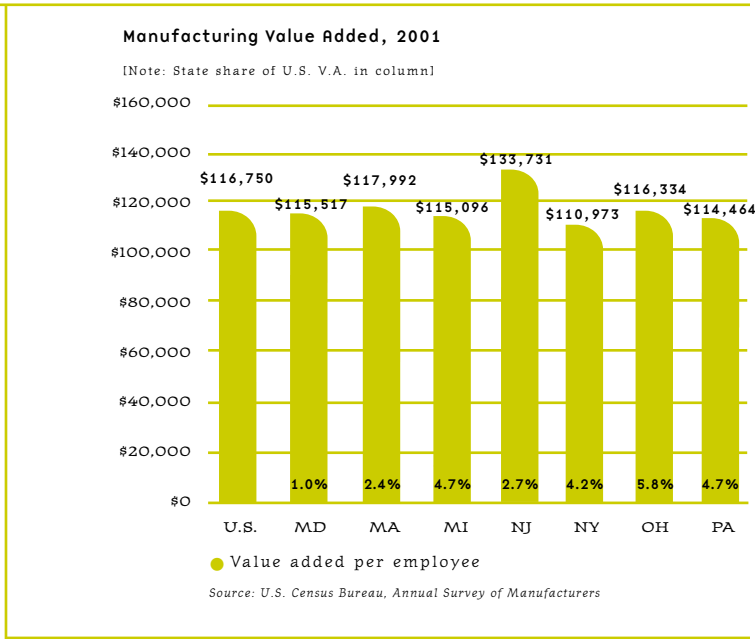
MANUFACTURING VALUE ADDED

Mature companies that are thriving typically have a high level of productivity. Manufacturing Value Added is one way to measure the productivity of labor and capital. High values suggest the presence of a highly skilled workforce, firms with higher productivity or capital intensive manufacturing firms. For manufacturing as for all sectors, higher productivity is associated with above-average wages.

Value added in manufacturing is the dollar value of manufacturing output minus the value of materials and other intermediate inputs. Value added is considered to be the best value measure available for comparing the relative economic importance of manufacturing among industries and geographic areas.

Value added per manufacturing employee is a ratio of total “value added” in manufacturing and the total number of manufacturing employees. Value added per manufacturing employee is calculated by dividing the total amount of value added by manufacturers by all employees.

- ▶ Pennsylvania accounts for 4.7 percent of all U.S. manufacturing value added.
- ▶ Pennsylvania value added per employee is slightly below the national average.



[Reinvention Phase]

Pennsylvania must steer its Maturity Phase companies towards Reinvention. Mature companies that fail to reinvent themselves—that do not innovate and pursue new opportunities—may face decline and ultimately, extinction. Currently, the technology-focused economic development organizations are working with companies across Pennsylvania to help them reinvent and respond to global competition and emerging opportunities, thereby enhancing the state's economy.

Particularly in Pennsylvania's legacy sector of the economy, it is critical that companies reinvent their market strategies and, oftentimes, their production infrastructures and product offerings. Century-old businesses that embrace new methods for competing in their evolving marketplace are the ones that will continue to succeed.

A significant challenge of this phase is changing the corporate mindset. It is far easier for a company to continue to do what brought it initial success, rather than to update that once-successful formula. However, reinvention is the key for successfully maintaining a viable business by enabling companies to move forward within an ever-changing market landscape.

The need for reinvention is dictated by four major factors influencing a business—the market, the customers, the competition and the company itself. Three of these factors are outside the company's control. Shifts in any of the factors impact a business' bottom line.

PROFILE OF A REINVENTION PHASE INNOVATOR:

Characteristics:

- ▶ Proven risk-taker
- ▶ Restless, ready for something new
- ▶ Recommitted
- ▶ Reenergized

Where you find them:

- ▶ Business front lines
- ▶ Working at all hours again
- ▶ Spending time learning related industries

What they need most:

- ▶ A new market vision
- ▶ Committed, flexible workforce
- ▶ New revenue streams
- ▶ Test market wins
- ▶ New products and processes
- ▶ Succession planning



TOTAL RESEARCH & DEVELOPMENT

The investment a state makes in research and development is a significant factor in determining the level of potential regional output. It is an indicator of potential long-term growth, and also plays a role in commercialization and technology spin-out activity. This activity allows a business greater opportunity to reinvent itself.

R&D expenditures come **from** a number of sources—in particular, industry, the federal government and academia—and flow **to** a number of the same sources. Each area where R&D is performed has different attributes.

Nationally, about three-fourths of all R&D expenditures occur in industry. Within industry, just over 60 percent of R&D occurs in manufacturing sectors. The remainder—non-industry R&D—is split between academic research institutions and the federal government (primarily through federal research centers). This chart showing R&D intensity measures investment per \$1,000 of Gross State Product:

- ▶ In 2001, Pennsylvania accounted for 4.1 percent (\$11.2 billion) of all U.S. R&D expenditures (\$274.2 billion), ranking 8th in the nation.
- ▶ The Commonwealth accounted for 4.5 percent (\$9 billion) of all U.S. R&D expenditures (\$198.5 billion) in industry.
- ▶ Total R&D expenditures for Pennsylvania is a bit above the national average.

2001 total R&D expenditures:

STATE	R&D INTENSITY (PERCENTAGE)	NATIONAL RANK
United States	2.71	—
Maryland	5.84	2
Massachusetts	5.10	3
Michigan	4.85	4
New Jersey	3.12	14
Pennsylvania	2.73	15
Ohio	2.35	19
New York	1.75	30

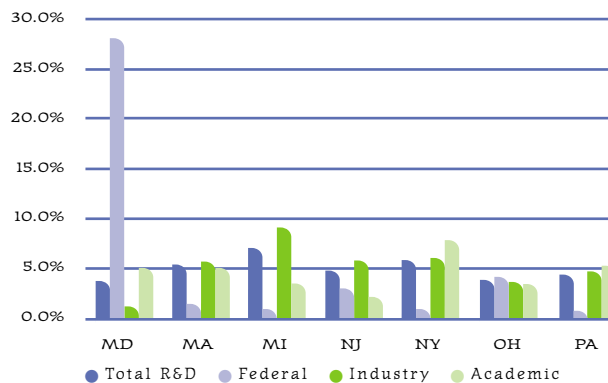
Source: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development

- ▶ In 2001, Pennsylvania accounted for 4.1 percent (\$11.2 billion) of all U.S. R&D expenditures (\$274.2 billion), ranking 8th in the nation.

- ▶ R&D expenditures come from several sources including industry, the federal government and academia. Nationally, about three-fourths of all R&D expenditures occur in industry.

- ▶ The Commonwealth accounted for 4.5 percent (\$9 billion) of all U.S. R&D expenditures (\$198.5 billion) in industry.

Share of U.S. R&D expenditures by destination, 1998–2001

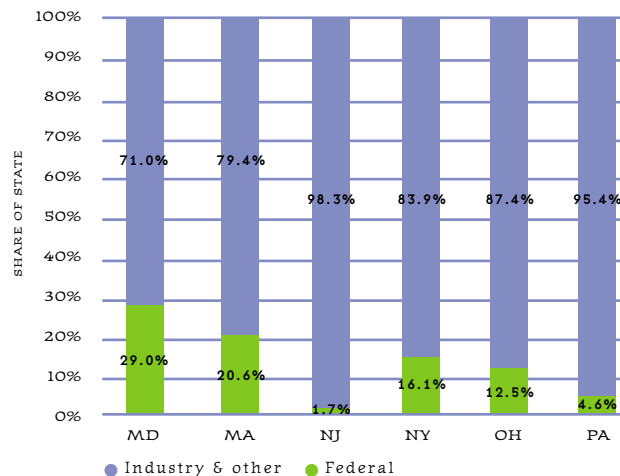


Source: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development

- ▶ Approximately 75% of the nation's R&D expenditures are in industry.

- ▶ In Pennsylvania, 95.4% of R&D expenditure is in industry.

Industry R&D expenditures by source, 1998–2001



Source: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development



Many of the indicators and anecdotal evidence contained in this report demonstrate that Pennsylvania is doing well in building its technology-based economy, but other evidence shows that there is room for improvement. We intend for the Pennsylvania TechFormation Report to be the first in a series of status reports on technology-based economic development in the Commonwealth. The indicators and prose are intended to help the leaders of Pennsylvania’s technology community make informed strategic decisions on how to best fuel technology-based economic development.

Only through the combined efforts of the technology-based economic development organizations, the Legislature, the companies and the Commonwealth will Pennsylvania empower citizens and stimulate business growth to create high-wage, high skilled jobs that strengthen the overall economy.

The Commonwealth, with leadership from the Pennsylvania Department of Community and Economic Development, has many partners in technology-based economic development. The partners played an active role in developing this report, and continue to help shape the Commonwealth's economic present and future. Our partner organizations are:

Department of Community and Economic Development– DCED fosters opportunities for businesses and communities to succeed and thrive in a global economy, thereby enabling Pennsylvanians to achieve a superior quality of life.
 WEBSITE: www.newpa.com

Altoona Blair County Development Corporation–ABCD Corporation serves businesses in Altoona and Blair counties. Services include corporate financing programs; access to venture capital; workforce service coordination; management of business development programs; business retention and expansion programs for existing firms.
 WEBSITE: www.abcdcorp.org

Ben Franklin Technology Development Authority–The BFTDA is a \$53 million state-based technology development program, one of the largest in the nation. BFTDA programs offer financial and technical assistance to businesses, entrepreneurs, communities, local governments, educators and non-profit organizations.
 WEBSITE: www.inventpa.com

Ben Franklin Technology Partners of Central and Northern PA–BFTP/CNP helps companies strengthen their positions in today's competitive marketplace. Programs include numerous investment vehicles; Centers of Excellence to facilitate technology transfer and commercialization; consulting and financial planning services; incubation and workforce development.
 WEBSITE: www.cnp.benfranklin.org

Ben Franklin Technology Partners–BFTP is an international model for innovation in technology-based economic development. Serving the entire state, BFTP invests risk capital in emerging technology-based enterprises and established businesses; provides hands-on technical and business expertise to spur growth and accelerate commercialization activities; and provides entrepreneurs with access to its extensive network of public and private resources.
 WEBSITE: www.benfranklin.org

Ben Franklin Technology Partners of Northeastern PA– BFTP/NEP links Northeastern Pennsylvania entrepreneurs and companies with people, technology, ideas, funding, and other resources to help them prosper in today's knowledge-based economy. BFTP/NEP develops early-stage, technology-oriented firms; helps established manufacturers creatively apply new technology; and promotes initiatives to foster a favorable business environment for high-growth companies.
 WEBSITE: www.nep.benfranklin.org

Ben Franklin Technology Partners of Southeastern PA–BFTP/SEP provides capital and expertise in technology, finance and business that helps entrepreneurs and established businesses overcome challenges and plan for growth in Southeastern Pennsylvania. Services and programs include critical seed capital for early stage companies; growth capital for product development, process improvement and technology commercialization; financing through mezzanine and guarantee funds; funding for the commercialization of university discoveries; and access to venture capital funds.
 WEBSITE: www.sep.benfranklin.org

BioAdvance–BioAdvance is the Biotechnology Greenhouse of Southeastern Pennsylvania. It invests in emerging life sciences technologies; accelerates technology transfer from research laboratories into start-ups and established companies; builds collaborations between academic, entrepreneurial, corporate, financial and government partners; and works to attract, retain and support life sciences entrepreneurs.
 WEBSITE: www.bioadvance.com

Catalyst Connection–As part of the commonwealth's Industrial Resource Center Network, Catalyst Connection advances the performance of the southwestern Pennsylvania region's small- and medium-sized manufacturing and technology companies by providing services, including commercial loan programs, information technology, lean manufacturing, market development, product development, quality systems, Web marketing and workforce development.
 WEBSITE: www.catalystconnection.org

The Center for eBusiness and Advanced Information Technology–eBizITPA assists companies in Northwestern Pennsylvania all along the business lifecycle. Specific services include education and training programs in e-business and advanced information technology; access to online supply-chain management solutions; and programs to attract and establish viable businesses.
 WEBSITE: www.eBizITPA.org

The Delaware Valley Industrial Resource Center–The DVIRC serves manufacturers in the Greater Philadelphia region through services such as education and training programs, consulting services, government affairs, workforce development, economic development partnerships and world-class best practices. DVIRC is part of Pennsylvania's Industrial Resource Center Network.
 WEBSITE: www.dvirc.org

Eastern Technology Council—The Tech Council serves leaders of technology-oriented companies in Eastern Pennsylvania by providing valuable contacts, capital and information with a broad variety of events, publications and innovative services.
 WEBSITE: www.techcouncil.org

Greater Philadelphia Venture Group—The GPVG is a catalyst organization promoting the Greater Philadelphia region's status as one of North America's top private equity markets.
 WEBSITE: www.gpvv.com

Great Valley Technology Alliance—The GVTA is helping create a self-sustaining technology-based economy in Northeastern Pennsylvania. Services, programs and facilities include venture capital investment, research centers, technical education and the attraction and retention of human capital.
 WEBSITE: www.greatvalleyalliance.com

Idea Foundry—Idea Foundry, a collective of private foundations, government entities, universities, venture capitalists and industry, supplies the critical ingredients to transform an entrepreneur's business idea into a fundable start-up company. In bridging the gap between the idea generation and a fundable start-up, Idea Foundry is providing the intellectual and financial capital necessary to bring innovators' business ideas to the stage where formal external funding can be secured.
 WEBSITE: www.ideafoundry.org

The Industrial Modernization Center—As part of the Commonwealth's Industrial Resource Center Network, the IMC helps Pennsylvania's small and medium-sized manufacturers by building awareness of best manufacturing technologies and management practices, and assisting in their implementation.
 WEBSITE: www.imcpa.org

Innovation Philadelphia—Innovation Philadelphia enhances the global innovation economy of the Greater Philadelphia region by providing the resources to grow, attract and retain entrepreneurs and technology-based companies in the region. Services include investment and commercialization programs, regional economic development and entrepreneurial research and resource publications.
 WEBSITE: www.IPphila.com

Innovation Works (the Ben Franklin Technology Partner of Southwestern PA)—As part of the Commonwealth's Ben Franklin Technology Partners Network, Innovation Works increases the success rate of new enterprises in Southwestern Pennsylvania by providing high potential technology companies with access to risk capital, business expertise, and third party resources. Innovation Works provides a continuum of hands-on support, guidance, and investment for these companies.
 WEBSITE: www.innovationworks.org

Life Sciences Greenhouse Central PA—The LSGPA enhances and translates important discoveries in the life sciences into economic growth and job creation in the Central PA region. Benchmarks for success include direct new job creation, expansion of service-related jobs, development of new startup firms, enhancement of existing regional industry, and relocation of biotechnology firms to the region.
 WEBSITE: www.lsgpa.com

MANTEC—For South Central Pennsylvania manufacturers committed to attaining measurable improvement in productivity, profitability and competitiveness, MANTEC leverages private and public monies for cost-effective solutions delivered by proven providers. MANTEC is a member of the Industrial Resource Center Network.
 WEBSITE: www.mantec.org

Manufacturers Resource Center—The MRC helps small and mid-size manufacturers enhance their ability to compete successfully by providing them with consulting, education and strategic partnering.
 WEBSITE: www.mrcpa.org

Northeastern PA Industrial Resource Center—NEPIRC helps manufacturers by identifying opportunities to make the business more effective; constructing a plan that prioritizes key issues; and ultimately developing solutions to the identified problems.
 WEBSITE: www.nepirc.org

Northwest Pennsylvania Industrial Resource Center—The NWIRC works to strengthen the competitive performance of smaller manufacturing firms in Northwestern Pennsylvania. The NWIRC promotes workforce development and the implementation of best manufacturing technologies and management practices.
 WEBSITE: www.nwirc.org

Pennsylvania Bio—Pennsylvania Bio is a catalyst to ensure Pennsylvania is a global leader in the life sciences by developing a cohesive community that unites the region's biotechnology, pharmaceutical, research and financial strengths.
 WEBSITE: www.pennsylvaniabio.com

Pennsylvania Small Business Development Centers—Pennsylvania Small Business Development Centers—The statewide network of sixteen university-based SBDCs assists high growth and technology firms with sophisticated business management issues, including alternative financing, human resources, intellectual property, and product commercialization. With access to a vast array of resources available through the national SBDC network, the SBDCs help technology-based businesses start, grow and prosper through providing education, and confidential, individual consulting at no cost.
 WEBSITE: www.pasbdc.org

Pennsylvania Technical Assistance Program—PENNTAP supports technology-based economic development by helping Pennsylvania companies improve competitiveness by providing a limited amount of free technology assistance to help resolve specific technology needs. Services provided include: Environmental Assistance; Food Industry Assistance; Forest Products Assistance; Information Technology/e-Business Assistance; NASA Technology Transfer Assistance; Occupational Safety and Health Assistance; Product Development Assistance; and Statistical Data Analyses.
WEBSITE: www.penntap.psu.edu

Pittsburgh Digital Greenhouse—The PDG is a strategic economic development initiative established to foster growth within the networking and multimedia industry in Southwestern PA. Services include collaborative research, education and training, extensive business support, networking opportunities and employee recruiting services.
WEBSITE: www.digitalgreenhouse.com

Pittsburgh LifeSciences Greenhouse—PLSG invests in and supports the growth of regional life sciences companies in the Pittsburgh Region. PLSG has programs to increase the linkage between research, technology and commercialization; nurture and develop entrepreneurial bioscience enterprises; invest in and grow the region's talent pool in the biosciences; help bioscience firms locate, expand or start-up in Southwestern Pennsylvania.
WEBSITE: www.pittsburghlifesciences.com

Pittsburgh Technology Council—The Pittsburgh Technology Council is the largest regional technology trade association in the United States with 1,400 member companies within the 13 counties of Southwestern Pennsylvania. Its mission is to contribute to the success of the region's technology businesses, and it focuses on developing the economic strength of five main industry clusters: advanced manufacturing, advanced materials, biotechnology/life sciences, environmental technology and information technology.
WEBSITE: www.pghtech.org

Pittsburgh Venture Capital Association—The PVCA catalyzes venture investment and entrepreneurialism in Western Pennsylvania. The PVCA facilitates quality deal flow, encourages investor collaboration and fosters important relationships with key service providers. Activities include an annual venture fair, regular networking events, a membership directory and award ceremonies for successful regional entrepreneurs.
WEBSITE: www.thepvca.org

Regional Export Network—The Export Network assists Pennsylvania businesses in navigating the changing world of international trade.
WEBSITE: www.inventpa.com

Southern Alleghenies Planning & Development Commission of Pennsylvania—SAPDC is dedicated to encouraging the creation and retention of jobs, while actively seeking to improve the quality of life for residents of the Southern Alleghenies Region.
WEBSITE: www.sapdc.org

Technology Council of Central PA—The Council works to create, attract, retain and grow technology businesses in Central PA. It accomplishes this by providing valuable contacts, capital and information with a broad variety of events, publications and innovative services.
WEBSITE: www.tccp.org

Team Pennsylvania Foundation—Team PA's goal is to make Pennsylvania the national leader in economic growth by working to keep and attract talent in Pennsylvania; providing business location decision-making information; networking state leaders; and funding important economic development, expansion and retention opportunities.
WEBSITE: www.teampa.com

Technology Council of Northwest PA—The Tech Council promotes the development, growth and recognition of the technology community in the eight-counties of Northwestern Pennsylvania. Services include networking and peer-to-peer mentoring; public policy development; advocacy and government affairs and member services such as special events.
WEBSITE: www.techcouncilnwp.org

University of Pennsylvania—The University of Pennsylvania is a 264-year-old Ivy League institution consistently ranked among the top elite research universities in the world. Penn is committed to facilitating the commercialization of university discoveries for the public good and develops, protects, transfers and commercializes intellectual property resulting from the University's research via its Center for Technology Transfer (CTT).
WEBSITE: www.upenn.edu

