

Measuring Up

Enhanced Metrics for a New Economy

> ready > set > innovate



After four years of strategic investments in Pennsylvania's communities, companies and people, the state is now a global leader in many of the rapidly advancing industries that will define the 21st century. The commonwealth has evolved from a coal-producing and industrial-manufacturing state to one encompassing many varied knowledge-intensive industries. We've put our resources to work to help businesses compete in national and international markets and create new employment opportunities for our citizens.

Pennsylvania has a diverse mix of industry giants, world-class academic institutions and innovative state programs. It is poised to capitalize, if not lead the way, in many cutting-edge developments in the biosciences, information technology, advanced manufacturing, advanced energy and conservation technology fields because we now have these assets in place.

Additionally, we've invested new resources to strengthen our presence in these high-growth areas. Bolstered by America's most aggressive economic stimulus packages, we're now leveraging those resources to spark new investments that are fueling more and more developments. All businesses need capital to grow, but companies in these advanced industries often have a greater need for fresh funding to sustain the vast research and development work they've started. We're aggressively working to make those investments possible, because supporting this work will lead to breakthroughs that could create new economic development opportunities in the future.

To be effective, we must thoroughly evaluate and understand the steps we have taken and identify new prospects and challenges. The enhanced metrics outlined in this report will encourage greater accountability for our investment of taxpayer dollars by providing short-term indicators of success earlier in the process. The new indicators will measure the ongoing progress of companies and state activity, as well as the obvious long-term goal of job creation.

Measuring Up: Enhanced Metrics for a New Economy, the 2007 TechFormation Report, is a fresh approach that provides a critical, in-depth look at our performance in growing the commonwealth's knowledge-based economy. TechFormation helps us chart a path to continue our expansion and open the door to exciting opportunities to strengthen Pennsylvania's place as a leader in the global, 21st century economy and to provide new opportunities for our 12 million residents.

— Edward G. Rendell, Governor

TABLE OF CONTENTS

Introduction	1
Methodology	2
What Do We Want to Measure?	3
Research & Technology Commercialization	4
Company Financing	5
Business & Technical Assistance	6
Workforce Development & Education	7
Business Lifecycle Overview	8
Concept Phase	9
Formation Phase	10
Growth Phase	11
Mature Phase	12
Reinvention Phase	13
Participating TBED Organizations	14

INTRODUCTION

Key to the continued growth of Pennsylvania's economy will be its ability to generate new knowledge; translate that knowledge into new products and services; and create successful new firms, industries, and markets. New global realities are reshaping the landscape in which Pennsylvania, and the nation, must compete. The increasing importance of talent, need for strong university-industry research and development (R&D) bases, corporate focus on external sources of R&D for innovation and new product development, and the changing nature of the capital markets are all factors and challenges that must and are being addressed through the commonwealth's technology-based economic development initiatives.

Technology-Based Economic Development (TBED) is a relatively new and different strategy for economic development which is being implemented around the country and acts in parallel to traditional economic development. TBED focuses on cultivating assets already in existence in Pennsylvania – indigenous resources such as talent, research, technology and capital. Specifically, TBED activities are designed to unlock latent economic potential that would otherwise remain dormant.

Changing the Measurement Paradigm

Economic development activities have traditionally been measured by the number of jobs they create. This is a critical metric that will continue to be measured. However, when it comes to TBED, jobs are often a “trailing indicator” (that is, they do not tell us how effective a program is until well after TBED activities are completed), not a “leading indicator” (which can provide a more timely snapshot of TBED progress and success).

The time horizon for TBED impacts is often much longer than that of traditional economic development, because the programs frequently engage with entrepreneurs and businesses at a much earlier stage in their lifecycle; therefore it takes a longer time to realize job creation. In the meantime, there are critical “leading indicators” that Pennsylvania's TBED community believes need to be measured so we can be confident that TBED programs are tracking toward positive economic outcomes.

This report, the fourth in a series of status reports on Pennsylvania's Technology-Based Economic Development activities, has been created to propose and introduce new intermediate and long-term measurements across the spectrum of TBED activity. The first TechFormation Report, published in 2005, detailed how TBED organizations assist companies along the business lifecycle – from the concept phase to maturity and reinvention. The second report specifically addressed the life sciences industry in Pennsylvania, and the third report highlighted the spectrum of services available to Pennsylvania's manufacturers at different points along the business lifecycle.

New Measures for a New Economy

TBED is not only an essential ingredient to the future of Pennsylvania's economy, it provides a framework within which government, universities and business can productively interact to spur growth and innovation. Pennsylvania is operating in a hyper-competitive global economy, and in order to realize the commonwealth's economic potential, the Department of Community and Economic Development (DCED) is seeking to better understand the performance of TBED programs across the state.

The purpose of this report is to introduce new methods for measuring the success of TBED programs. In short, by identifying metrics that can be standardized and applied appropriately across all TBED programs, we can achieve a deeper understanding for how well these programs are working and how they affect and interrelate with one another.

Organization of the Report

- > The first section of the report details the methodology and introduces the enhanced metrics.
- > The second section of the report details the sequence of activities for the four major areas of TBED focus and identifies examples of specific activities to be measured within each program category.
- > The third section details how TBED providers deliver these services across all phases of the business lifecycle – from Concept and Formation, through Growth, to Maturity and Reinvention, and illustrates the applicability of the proposed new metrics within the different stages of the business lifecycle.

[The business lifecycle was detailed in the 2005 TechFormation Report; it is a continuum that illustrates a company's progression from birth towards success.]

METHODOLOGY

The process began with the formation of sub-groups aligned with the four major TBED activity areas described below:

- > **Research and Technology Commercialization:** Turning an idea into a commercial product. Through DCED's Technology Investment Office, the commonwealth invests in activities that enable TBED organizations to work with institutions of higher education, industry and entrepreneurs to commercialize promising technologies. Additionally, the Department provides grants to institutions of higher education to expand or strengthen applied research capacity, hire top research faculty and stimulate technology transfer.
- > **Company Financing:** Investing in technology based companies, typically as a way to attract additional capital. DCED's Technology Investment Office invests in programs that provide seed-capital in the form of debt, equity, grants, or tax incentives to Pennsylvania companies.
- > **Business and Technical Assistance:** Helping companies start, innovate and grow. DCED's Technology Investment Office invests in activities that provide various types of management, business and technical assistance, market research, and a variety of other advisory, training, technical, and information services to companies in the commonwealth.
- > **Workforce Development and Education:** Creating a job-ready workforce that meets the needs of Pennsylvania's businesses. DCED's Technology Investment Office invests in programs designed to strengthen technology curricula at schools in the commonwealth to help prepare students, as well as programs to educate existing or new employees for technology-based careers.

The groups began by creating detailed models of the various activities that take place within the four major TBED program areas. The activity models developed by each group generally followed a similar sequence: funding and support from the commonwealth and other sources are inputs into the program so that TBED providers can conduct their various activities; this TBED activity leads to program specific outputs, which may include making an investment in a company, providing business and technical assistance, or creation of an R&D partnership; these outputs lead to outcomes that directly impact the target population in a wide variety of ways, from the introduction of new products, to the adoption of new production processes, to the placement of graduates in new jobs; these target population outcomes in turn lead to overall economic outcomes such as increased community wealth, a higher Gross State Product, and greater statewide employment.

Each group identified the possible inputs, outputs, and outcomes intrinsic to their respective TBED activity area. Initially, there were scores of different activities identified – all of which had the potential for being measured. Through vigorous discussion, the groups ranked the activities in order of importance and identified which of these activities they deemed critical to measure. And finally, the last step in the decision process was to determine which “critical to measure” activities were both feasible to measure and generally applicable across each of the four main TBED activity areas. Ultimately, ten key measures, and corresponding indicators, were selected by the group as critical to assess in tracking the progress and success of TBED.

There are several important definitions that provide the fundamental basis for understanding these sequences:

- > **Inputs** – funding used to perform activities.
- > **Activities** – tasks performed using resources and methods.
- > **Outputs** – products/services produced as a result of the activities.
- > **Target Population Outcomes** – changes in knowledge, behavior or performance within direct and indirect beneficiaries.
- > **Economic Outcomes** – changes in conditions in the broader economy.

TBED organizations reach many different milestones. Those milestones are signs of positive economic development. Over time, these activities lead to statewide economic benefit.

This report was developed over the course of nine months with the participation of nearly 100 TBED practitioners from every part of Pennsylvania. This group, facilitated by an economics and management consulting firm, Nexus Associates, worked together to develop a common set of measurements.

WHAT DO WE WANT TO MEASURE?

Introduction to Enhanced Metrics

The TBED community has identified several areas of economic development activity it proposes to be measured. In each indicator described here, only the portion of the impact attributable to the TBED program will be measured.

These indicators will be used to measure “TBED attributable” outputs across the four primary areas of TBED activity. These areas of activity, as well as an identification of the applicable metrics, are detailed further in the next section of this report.

1. **Leverage of Additional Funding** - Funding is considered “leveraged” when as a result of a TBED grant and/or investment, another funding source also contributes to the project. Funding is strictly cash, not in-kind contributions, and can come from a broad variety of sources such as the federal government, local government, philanthropic foundations, angel investors, venture capitalists, commercial banks, and/or other financial institutions. For institutions of higher education, funding could also come from contracts for industry sponsored research.
2. **New Company Formation** - A company is considered to be formed if it is legally established and is within three years of having received its Employer Identification Number (Tax Identification).
3. **Research, Development, Testing & Evaluation (RDT&E) Expenditures** - Some TBED activities stimulate a project’s RDT&E activities, which results in increased expenditures. RDT&E expenditures include monies spent on labor, services, materials and equipment used to conduct research, development, testing and evaluation.
4. **Intellectual Property and Licensing** - Intellectual Property is any asset that consists of human knowledge and ideas. Some examples are patents, copyrights, and trademarks. Licensing is the formal contractual granting of certain rights and privileges by the owner of the intellectual property to an individual/company who desires the right to use the intellectual property for commercial purposes. Gross revenues generated by licensing activities include fees, royalty payments and realized capital gains from the sale of technology assets. Quantifying the volume of intellectual property generation and licensing activities will provide a gauge for future entrepreneurial opportunities.
5. **Development and Introduction of New Products** - Developing new products and bringing them to market is a key activity for both start-ups and existing companies. A new product is a good or service that has never before been available in the marketplace, is new to a company’s customers, a product that has been modified, and/or a product line extension.
6. **Revenue** - Increased revenue demonstrates that there is a market demand for the goods or services provided by the company. To measure increased revenues, a company includes revenues recognized at subsidiaries and all the establishments that operate under their ownership or control.
7. **Employment** - The ultimate goal of TBED programs is to create new, high-paying jobs in Pennsylvania and/or to prevent the elimination of existing jobs. A new job is defined as an added number of full-time and part-time employees on a company’s payroll and/or contractors paid directly by the company.
8. **Employee Compensation** - Employee compensation is made up of wages, salaries and benefits. Wages and salaries include total earnings before payroll deductions, including commissions, bonuses, incentives, and premiums for overtime. Benefits include paid leave, insurance benefits, retirement and savings benefits, and legally required benefits such as Social Security, Medicare, federal and state unemployment insurance, and workers’ compensation.
9. **Productivity** - Increased productivity is achieved if a company is able to earn greater revenue per employee.
10. **Graduates and Job Placement** - Workforce development and education is an important component of economic development efforts. Students who graduate as a result of TBED programs are an important factor to measure. Further, if our economic development efforts as a whole are creating new, high-paying jobs, it is likely that these graduates will take positions in Pennsylvania.

RESEARCH & TECHNOLOGY COMMERCIALIZATION

Taking technologies from the lab to the market – commercializing business ideas – doesn't just happen. The obstacles are many, particularly for someone who has not previously navigated this path. The commonwealth supports a multitude of commercialization activities and offers assistance that help take a company from the concept phase to the formation phase of the business lifecycle.

In Pennsylvania, many institutions of higher education and non-profit organizations play a critical role in driving young companies along this continuum. Scientists, researchers, students and entrepreneurs know they can turn to Institutions of Higher Education and non-profit organizations for help in building a business around an emerging or newly developed technology.

The TBED activity sequence begins with state and other funding being directed to institutions of higher education, non-profit organizations, companies and entrepreneurs:

- > **Inputs** – State or other funding goes to TBED practitioners so that they are able to conduct activities that will lead to the commercialization of research and technology.
- > **Activities and Outputs** – These activities and their corresponding outputs occur within institutions of higher education and private sector companies. When research is the focus the goal is often solely to gain new scientific knowledge, but many of these discoveries turn out to have a commercial application. Technologies that may be considered commercially viable may attract funding from either public or private sources. Institutions will also use inputs from the state to form R&D partnerships and create an R&D infrastructure that can continue to generate scientific discovery. To perform this research and development, an institution needs both researchers and students, and state funding is often used to recruit both faculty and students.
- > **Target Population Outcomes** – These outcomes occur both within institutions of higher education and individual companies. They include increased Research, Development, Testing and Evaluation. Through additional efforts, there will be new knowledge and scientific discovery. Labs and companies will then seek to secure patents for this new found intellectual property. Additionally, there will be an increase in technology transfer. With institutions of higher education there are two potential paths towards commercialization – the technology may be spun-off from the university into a newly formed company, or it may be licensed to a new or mature company, and the generating entity receives licensing revenues. Whether the result is a newly formed company or a new product for an existing company, it leads to the product's introduction to the market. The goal is increased sales and increased profitability for the company. As this continues, the company will likely increase investment in its labor force, equipment and facilities.
- > **Economic Outcomes** – Positive outcomes within companies and firms lead to increased employment for citizens, increased community wealth, and an increase in Pennsylvania's Gross State Product. Collectively, these outcomes lead to the creation of an enhanced entrepreneurial culture, which increases the potential for the development of the economy.

Research & Technology Commercialization: Associated Metrics

- > Research, Development, Testing & Evaluation (RDT&E) Expenditures
- > Leverage of Additional Funding
- > Sales Revenue
- > Intellectual Property and Licensing
- > New Company Formation
- > Graduates and Job Placement
- > Development and Introduction of New Products

COMPANY FINANCING

Without investment, great ideas will never come to market. Once a company or individual has that moment of inspiration, finding the funding to make it happen is their next step. Pennsylvania is world-renowned for its non-profit network of technology investment programs.

This network offers a wide range of financing options designed to meet different needs at different stages of development.

One of the primary goals of Pennsylvania's company financing programs is to build viability and credibility in start-up firms or in new products and processes of existing businesses. An early stage investment in a business can attract additional funding in the form of venture capital and/or private equity from a variety of sources, including large corporations. Leveraging this state-provided funding strengthens the position of the company, and ultimately can have a broad economic benefit to the commonwealth as the company progresses along the business lifecycle.

Companies use funding provided by the state and non-profit organizations for a variety of business activities. These can include building a management team, RDT&E, manufacturing, marketing, sales, customer service, etc. As a result of the investments made through the TBED network, companies are better positioned to move products and services into the marketplace, generate revenue, increase employment, and increase productivity.

Pennsylvania's TBED activity sequence for company financing is as follows:

- > **Inputs** – State or other funding goes to TBED practitioners so that they are able to conduct activities that will lead to financing for technology based companies.
- > **Activities and Outputs** – These activities and their corresponding outputs happen within the individual TBED providers. When it comes to company financing, TBED organizations develop mechanisms to provide a wide array of financial assistance programs for entrepreneurs and companies. TBED providers spur “angel” and venture fund investment, foster the creation of regional investment funds, and provide loans, grants, equity, guarantees, as well as R&D investment tax credits. However, adequate mechanisms and procedures must be established within the TBED organization before this financing can be made available to firms.
- > **Target Population Outcomes** – The funding that flows into individual companies from these TBED organizations is utilized by entrepreneurs to obtain labor, materials, equipment and facilities. For more established companies, this funding will often attract later stage capital which will often lead to increased RDT&E, and, ultimately, new products in the marketplace. When market demand is strong, sales and profitability will increase. If this trend continues, the company will likely increase its investment in labor, equipment and facilities.
- > **Economic Outcomes** – Positive outcomes within companies and firms lead to increased employment for citizens, increased community wealth, and an increase in Pennsylvania's Gross State Product. Collectively, these outcomes lead to the creation of an enhanced entrepreneurial culture, which increases the potential for the development of the economy.

Company Financing: Associated Metrics

- > Leverage of Additional Funding
- > Development and Introduction of New Products
- > Sales Revenue
- > Employment
- > New Company Formation
- > Compensation
- > Productivity

BUSINESS & TECHNICAL ASSISTANCE

Even great business ideas can fail if the business built around the idea is not effectively managed.

The commonwealth funds numerous partners and programs that offer entrepreneurs and companies the business and technical assistance they need to succeed. By providing this structure and support, these services fill various technical and managerial gaps that enable the company's executives to pay closer attention to their core business.

Delivering this expertise is a key component of the commonwealth's technology-based economic development activities. Assistance in every aspect of business – from market research to new product development to regulatory approval to manufacturing – is paramount for participating companies.

The TBED activity sequence for business and technical assistance follows this progression:

- > **Inputs** – State or other funding goes to TBED practitioners so they are able to develop the capability to provide technical expertise and business assistance to technology-based companies.
- > **Activities and Outputs** – These activities and their corresponding outputs occur within the individual TBED providers. These providers develop programs, from business assistance and marketing help, to assistance in streamlining production. These programs are utilized to provide participating companies or entrepreneurs with expertise to move their business forward.
- > **Target Population Outcomes** – Business and technical assistance enables companies or entrepreneurs to develop business plans, build out their management teams, run their business more productively or develop new products and bring them to market. Companies will often adjust their business strategy appropriately as a result of such assistance. These changes can be seen as a validation that encourages potential investors and leads to more funding. Companies receiving assistance typically improve business practices and productivity, and bring new products to market, increasing sales and profitability. As the company grows, it invests more in equipment and facilities and hires more employees. The company's market value also grows.
- > **Economic Outcomes** – Positive outcomes within companies and firms lead to increased employment for citizens, increased community wealth, and an increase in Pennsylvania's Gross State Product. Collectively, these outcomes lead to the creation of an enhanced entrepreneurial culture, which increases the potential for the development of the economy.

Technical Assistance: Associated Metrics

- > Development and Introduction of New Products
- > Sales Revenue
- > Employee Compensation
- > Productivity
- > Employment

WORKFORCE DEVELOPMENT & EDUCATION

A highly prepared and educated workforce is a very important resource for any company. In today's "free agent nation," having a smart, well-educated and available workforce is a critical component of any region's, state's or country's economic development efforts.

More than any other time in history, people are driving the economic prosperity of Pennsylvania. The commonwealth funds programs and initiatives created to prepare students and workers for the demands of today's economy. These programs prepare students to graduate with advanced skills and degrees and land high-paying jobs in Pennsylvania, laying the foundation for a strong and prosperous economy.

The TBED activity sequence for workforce development and education is as follows:

- > **Inputs** – State or other funding goes to TBED practitioners to conduct activities to provide workforce development and education programs.
- > **Activities and Outputs** – These activities and their corresponding outputs happen within the individual educational institutions. Activities and outputs include the recruitment of potential students and the development of curricula. Education and training organizations also train instructors so they are fully prepared to train and educate their students. Training facilities may need to be retrofitted and equipped. All of this enables the institutions to provide education and training.
- > **Target Population Outcomes** – There are two unique target populations of workforce development and education activities – the citizens who receive the training and the businesses who are the beneficiaries of their increased competency. Citizens who enroll in and complete these programs, whether they are in the labor force or not, receive new skills and increased employability. This increases the individual's prospects for higher wages. For business, these activities lead to a greater supply of skilled labor. This potentially enables companies to improve productivity and bring new products to market in a timely fashion, thereby increasing sales and profitability. As the company grows, it may invest in equipment and facilities and hire more employees. All of this plays a role in decreasing "brain drain" in Pennsylvania.
- > **Economic Outcomes** – Positive outcomes within companies and firms lead to increased employment for citizens, increased community wealth, and an increase in Pennsylvania's Gross State Product. Collectively, these outcomes lead to the creation "of an enhanced entrepreneurial culture, which increases the potential for the development of the economy.

Workforce Development: Associated Metric

- > Graduates and Job Placement
- > Employment
- > Employee Compensation
- > Productivity

BUSINESS LIFECYCLE OVERVIEW

The 2005 TechFormation Report detailed the impact of Pennsylvania’s Technology-Based Economic Development activities across the “business lifecycle” – the path an entrepreneur or enterprise takes over several years as it grows into maturity.

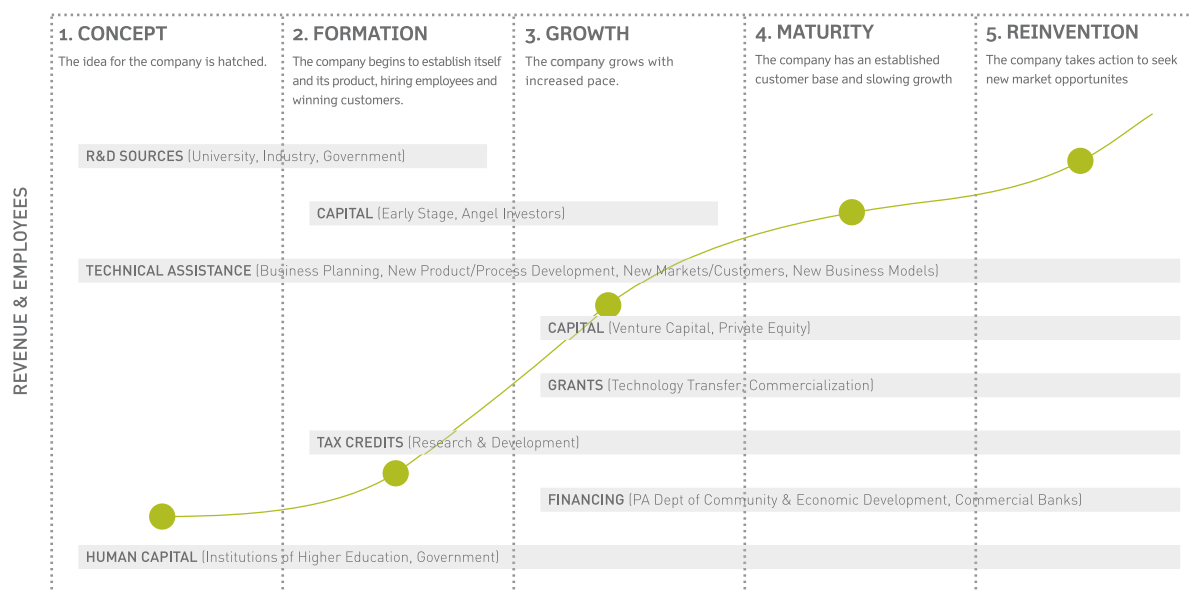
This approach has resonated with businesspeople, academics, legislators and others because it provides the clearest way to view and understand the commonwealth’s many TBED activities. Consequently, to provide a better understanding of the applicability of the proposed alternative metrics, the following section provides an overview of the business lifecycle, examples of the TBED services provided during each phase of the lifecycle, and an indication of which of the proposed metrics may be pertinent in that particular scenario.

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 and ideally – rejuvenation as the company reinvents itself and/or its products.

The time that a business spends in each of these phases can vary widely. However, most successful businesses will move through these phases on their way to becoming “established” and achieving longevity. The types of Technology-Based Economic Development services that companies receive in each phase can also differ, but they are all intended to help the company grow.

Each of these phases, along with a case study illustrating how TBED programs make a difference in each phase and the applicability of the proposed metrics, is detailed on the pages ahead.

Five Phases of a Company’s Lifecycle



Innovation sustains individual companies and manufacturing industries at all stages of the business lifecycle, and the Commonwealth’s economic development partners provide assistance at every phase

Chart courtesy of the 2005 Pennsylvania TechFormation Report

1. Concept Phase

The idea for a new product or service is sparked in the Concept Phase. During this phase the idea is explored, the value proposition for customers is determined, and potential markets, customers, and delivery portals are identified. In short, this is when a business goes from a mere notion to practical possibility.

Most of us are unaware of business activity occurring in the Concept Phase. There is no building, no advertisements, no signs or banners, yet, this phase is paramount. Engendering entrepreneurship and supporting entrepreneurs are key factors in igniting strong economic growth and TBED organizations play a major role in this phase of the business lifecycle.

> > > Case Study: Infrascan

Pennsylvania's network of Technology-Based Economic Development providers has played a major role in the success of InfraScan, a Philadelphia-based technology company.

The idea for a hand held tool for screening brain injuries was born in the labs of the University of Pennsylvania. It was observed that there are different levels of light absorption between blood outside of a vessel and blood traveling within the vessel. If a device could be developed to detect this difference, fast, accurate, and affordable traumatic brain injury detection might be a real possibility.

The School of Biomedical Engineering at Drexel University was asked to engineer and design a prototype for the hand-held tool for screening brain injuries, Infrascanner™.

In February of 2005, entrepreneurs licensed (1) the technology from the inventor and formed InfraScan, a Philadelphia-based technology company. They effectively moved what started out as a lab project from the Concept Phase of the business lifecycle into the Formation Phase.

After formation (2), InfraScan continued to receive assistance through various Penn and Drexel TBED programs. They were also able to expand their research, development, testing and evaluation (RDT&E) (3) by securing Small Business Innovation Research (SBIR) grants from the United States Army and Navy. This additional research played a key role in securing seed funding from BioAdvance – a Life Sciences Greenhouse – and the Ben Franklin Technology Partners (4).

Thirty-four patents – 12 in the United States and 22 in international markets – have been issued related to this device and the technology on which it is built (1).

To date, the company has received more than \$2 million in total investment (4) and is now in the clinical trial stage of product development. Sales of the Infrascanner™ are just beginning in international markets.

This case study exemplifies several of the proposed constructs for alternative metrics.

1. **Intellectual Property and Licensing** – As of December 31, 2006, the company has licensed the use of 34 patents – 12 in the United States and 22 internationally.
2. **New Company Formation** – The company was established in February, 2005.
3. **Research, Development, Testing, and Evaluation Expenditures** – A SBIR award from the U.S. Navy's Office of Naval Research (ONR) was secured in the amount of \$1 million; these funds were then utilized for RDT&E.
4. **Leverage of Additional Funding** – The company leveraged initial funding from TBED sources into more than \$2 million.

2. Formation Phase

The company becomes real during the Formation Phase and moves away from the realm of ideas and possibilities into a results oriented mode. Specifically, this phase focuses on applied research and development, and includes ramping up the business and commercializing the product. Employees are hired and customers are won.

Entrepreneurs are energized by what they see as a world-changing business idea, and weighed down by the extra demands of running the business. Outside guidance and support is important during the Formation Phase. Getting over the hump is where TBED organizations can lend the biggest hand to companies in the Formation Phase.

> > > Case Study: BitArmor

When Pittsburgh-based BitArmor was founded in 2003 (1), it began with nothing more than a revolutionary idea and a PowerPoint presentation. This fledgling computer security company had raised some angel funding, but its data protection technology was in an early stage of development. Other than the founders, there were no employees in the company.

All that changed when founders J. Patrick McGregor, Ph.D. and Matthew White connected with three Technology-Based Economic Development organizations funded by the commonwealth –The Technology Collaborative, Idea Foundry and Ben Franklin Technology Partners (BFTP). All three Pittsburgh-based organizations provide funding to companies through programs created with support from DCED's Technology Investment Office.

In early 2004, Idea Foundry injected a pre-seed investment in BitArmor. This funding was used primarily for business development and helped the company further develop its technology. Idea Foundry also provided the company with guidance and counsel to help leverage its' funding to the fullest extent, gaining additional capital (2).

The Technology Collaborative (TTC) followed by awarding BitArmor a technology commercialization grant (2). This funding was used to hire and train employees for advanced software development and to further initial product development. TTC assisted with recruiting and networking with large potential partners, and also supported the company by housing them in office space for no charge in the Oakland section of the city.

BFTP provided seed capital in 2005 (2), which helped the company expand its Research, Development, Testing and Evaluation (RDT&E). That year, BitArmor's technology entered into beta testing with numerous publicly-traded companies – relationships that thrived with the assistance of the three economic development organizations that supported it. Venture capital funding followed in 2006 (2), led by the VC firm of Draper Triangle (a recipient of a state venture capital investment). In all, the funding from TBED organizations was leveraged to raise over \$3 million in angel funding and venture capital. This funding has enabled BitArmor to complete product development and launch its data protection software – BitArmor Security Suite (3). As of December 31, 2006, the company had four patents pending (4).

Thanks to these investments made by technology-based economic development organizations, BitArmor now has 30 employees (5). It publicly launched BitArmor Security Suite in late 2006 and is generating significant revenue in 2007.

This case study exemplifies several of the proposed constructs for alternative metrics.

1. **New Company Formation** – The company was incorporated in May, 2003.
2. **Leverage of Additional Funding** – The company leveraged initial funding from TBED sources into over \$3 million.
3. **Development and Introduction of New Products** – In 2006, the company introduced its product BitArmor Security Suite to the market.
4. **Intellectual Property and Licensing** – As of December 31, 2006, the company has four patents pending.
5. **Employment** – The company has grown from two employees to 30.

3. Growth Phase

The Growth Phase is an exhilarating time in the life of a company. The company has a clearly defined value proposition that is embraced by the market. It is growing very rapidly in customer base, revenues, and opportunities for employment all within a very short span of time.

A Growth Phase company becomes profit and cash flow-focused for the first time. It is critical to show revenue and positive cash flow as the company moves through this phase. The company needs increased access to capital and is now attractive to follow-on financing opportunities, whether in the form of traditional bank loans, angel investment, or venture capital. TBED organizations often assist growing companies by directly infusing capital as well as introducing them to other funding sources.

> > > Case Study: SalvageDirect

SalvageDirect, a Titusville, Crawford County company, began operations in 1998 with two employees.

The company was originally housed in an old steel mill located in a state designated, tax-free Keystone Opportunity Zone. It moved to a larger space in 2004. The company transformed the labor-intensive auto salvage business by developing and introducing a web-based automobile salvage service (1). This service allows the insurance companies to increase their profits on a vehicle transaction by ten to forty percent.

Beginning in 1999, the Ben Franklin Technology Partners made three investments in SalvageDirect totaling \$535,000. The funding was intended to help support the company's growth and position in the marketplace. In the first year, gross vehicle sales reached \$800,000. The company continued to grow and broadened its market to include not only Pennsylvania but other states such as Florida, Texas, and New York.

In 2000, a Series A round raised \$1 million (2). In September 2002, the Sustainable Jobs Fund, along with Schoffstall Ventures, Vale Investments and several individual investors, closed on a \$575,000 investment in SalvageDirect as part of a \$1,000,000 Series B financing round (2). The Pennsylvania Ben Franklin Technology Investment Authority also invested \$500,000 (2), bringing the total of outside investment to over \$2.5 million. Debt financing was also secured from a local bank.

From 2005 – 2006, gross vehicle sales totaled \$67 million which generated over \$17 million (3) in revenue for the company. SalvageDirect employs 95 people (4) with gross annual payroll at nearly \$3 million.

This case study exemplifies several of the proposed constructs for alternative metrics.

1. **Development and Introduction of New Products** – The company revolutionized the junk car business by launching a web-based salvage service.
2. **Leverage of Additional Funding** – In 2000 – Series A round – Schoffstall and Vale invested \$1 million. In 2002, investors closed on a Series B financing round for \$1.1 million.
3. **Sales Revenue** – As of 2006, sales revenue had grown in excess of \$17 million.
4. **Employment** – The company started with two employees and today has 95 people on the payroll.

4. Mature Phase

Mature companies typically have found their niche in the marketplace, have a steady stream of business, have modest upward revenue, and generally play a key role in their region's economy. The biggest challenge for companies in the Mature Phase is to continue to innovate. Their executives and employees must avoid becoming too comfortable. In other words, growth must continue.

Companies in the Mature Phase must shift their focus to growing their market share, improving productivity and efficiency, and recruiting and maintaining a quality workforce. TBED organizations provide assistance with all of these activities.

> > Case Study: Garland Commercial Industries

As a competitor in the global economy, there is a one-word lesson you will be well-advised to learn: streamline. Garland Commercial Industries, a Freeland, Luzerne County-based manufacturer of commercial ovens and food service equipment, recognized that it had to improve productivity to sustain growth. The company, established in 1974, needed to find a new level of efficiency to help it compete with industry giants internationally. Specifically, the company needed to improve processes so that it could increase sales of convection ovens.

Customers were demanding an oven that was easier to use, more reliable, and durable. The company turned to Ben Franklin Technology Partners for both financing and business and technical assistance. Ben Franklin invested just over \$200,000 in the company over the period of 1998 through 2001.

Ben Franklin Technology Partners also connected Garland with the Lehigh University Enterprise Systems Center. The company and the experts from Lehigh went to work on designing an improved oven. Together, they created a product that the market was asking for (1) – with a stronger structure and better thermal characteristics. Sales revenue increased 16 percent as a result of the design improvements (2). The product redesign also enabled Garland to reduce the number of parts that were built into the oven, thereby decreasing the cost to manufacture and assemble the new oven. These savings complemented manufacturing cost reductions that added more than \$200,000 annually to the company's bottom line.

In addition, manufacturing layout and process improvements allowed Garland to increase production without expanding its manufacturing facility. Ben Franklin and Lehigh also helped Garland create greater efficiency on the manufacturing line, devising innovative ways to combine tasks and adopt more current practices, such as just-in-time inventory. As a result, Garland's market position was improved, enabling the retention of 138 jobs and creation of 30 new jobs (3).

Thanks in part to the new oven and more efficient manufacturing Garland is now one of the leading brands of ovens in the food service industry.

This case study exemplifies several of the proposed constructs for alternative metrics.

1. **Development of New Products** – The company brought its new Master Convection oven to market in 2000.
2. **Sales Revenue** – Revenues grew by 16 percent.
3. **Employment** – The company added 30 new employees and retained 138 employees.

5. Reinvention Phase

This is a critical stage when the company's technology, mindset and focus are updated to meet new realities and seek market opportunities. Companies that do not embrace reinvention can become static in terms of revenue growth and are susceptible to losing market share.

Reinventing a company from the inside is a daunting proposition. Spurring renewed growth by kick-starting a company past the Maturity Phase into Reinvention is difficult and often involves outside assistance. TBED activities and programs can play a significant role in this phase.

> > > Case Study: FesslerUSA

FesslerUSA has a long, rich history of manufacturing garments in Schuylkill Haven, Schuylkill County. Walter Meck, grandfather of the current CEO, founded what is now FesslerUSA in 1900. The family sold the business in 1957, and then bought it back in 1994 knowing they needed to reinvent the business to continue to be a viable, successful company.

Fessler turned to the Manufacturers Resource Center (MRC) for guidance and expertise in marketing, lean manufacturing and training. With guidance from MRC, they changed the market strategy of the company from selling bulk orders of cut-rate clothes to discount stores at low prices to competing as a quality, fast-paced, design-oriented apparel specialist marketing to the high-end garment markets.

To meet their high-end customers' quality needs, FesslerUSA initiated a quality improvement system, designed with input from major customers and the assistance of MRC. This allowed them to maintain continuous quality at each step of the production process. Computerized, automated cutting equipment was installed as part of the production infrastructure transformation, and, from 2005 to 2006, productivity increased by 23 percent (1).

The company invested heavily in training to develop a highly skilled management team, a first-class design support services department, and incorporated lean marketing concepts geared to the 21st century garment industry. FesslerUSA has increased employment from 240 employees at the end of 2005 to 277 in April 2007 (2) – a 13.1 percent increase. The company forecasts the number of employees will rise another 10 percent by the end of 2008. Employee compensation (wages, salaries, and benefits) has increased 12 percent (3).

FesslerUSA is recognized as an industry leader for private label production and design services in the fashion tee-shirt market. The company serves a wide array of designers, labels and specialty stores. The ability to help customers effectively bring design to a very short time frame, before the item is out of style, is the hallmark of FesslerUSA's market strategy for the 21st Century.

This case study exemplifies several of the proposed constructs for alternative metrics.

1. **Productivity** – Revenue per employee increased by 23 percent from 2005 to 2006.
2. **Employment** – FesslerUSA grew its workforce by 13.1 percent from the end of 2005 to April 2007. They forecast the number of employees to rise another 10 percent by the end of 2008.
3. **Employee Compensation** – FesslerUSA has increased the average employee compensation by 12 percent in one year.

PARTICIPATING TBED ORGANIZATIONS

Pennsylvania Technology-Based Economic Development Providers Who Participate in the Alternate Metrics Project:

Pennsylvania Department of Community and Economic Development (DCED)

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. www.newPA.com

2+2+2 Workforce Leadership Grant

The 2+2+2 Workforce Leadership Grant program is funded by the PA Department of Community and Economic Development. The 25 projects currently funded must develop an unified and seamless curricula from high school to 2-year and 4-year post-secondary institutions in one of three new economy clusters: advanced manufacturing/advanced materials, biotechnology/life sciences, or information technology/optoelectronics. The 222WLG program strengthens the link between business and the educational system to assure the supply of new workers meet the needs of the technology-based sectors of the commonwealth. www.222wlg.org

Altoona Blair County Development Corporation

The Altoona Blair County Development Corporation serves businesses in Altoona and Blair County. Services include corporate financing programs; research and development initiatives, access to venture capital; workforce service coordination; management of business innovation programs; business retention and expansion programs for existing firms. www.abcdcorp.org

Association of Independent Colleges and Universities of Pennsylvania

The Association of Independent Colleges and Universities of Pennsylvania (AICUP) is a statewide organization that serves the interests of private higher education. Established in October 1994, AICUP seeks to inform the broader public about the 85 colleges and universities that make up its membership and serve as a single point of contact for the private higher education sector. www.aicup.org

Ben Franklin Technology Partners

For nearly 25 years, Ben Franklin Technology Partners (BFTP) has served as an international model for innovation in technology-based economic development. The organization has worked to diversify and strengthen Pennsylvania's economy by focusing on entrepreneurial development and technological innovation. With a focus on the entrepreneur as the ultimate engine of growth, BFTP delivers crucial resources for technology-driven enterprises. www.benfranklin.org

Ben Franklin Technology Partners of Central and Northern Pennsylvania

Ben Franklin Technology Partners of Central and Northern Pennsylvania works with representatives from industry, higher education, and economic development to stimulate employment in the state. The program provides funding and operational assistance to emerging technology-based companies as well as small, existing manufacturers for the purpose of creating and retaining jobs in Pennsylvania. www.cnp.benfranklin.org

Ben Franklin Technology Partners of Northeastern Pennsylvania (BFTP/NEP)

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. www.nep.benfranklin.org

Ben Franklin Technology Partners of Southeastern Pennsylvania (BFTP/SEP)

BFTP/SEP stimulates entrepreneurial potential by providing the capital, knowledge, and networks entrepreneurs and established enterprises need to compete in the global marketplace, and accelerates the transition of scientific discovery and technology development to commercialization through partnerships and strategic alliances. 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. www.bioadvance.com

PARTICIPATING TBED ORGANIZATIONS

Capital Region Economic Development Corporation (CREDC)

Capital Region Economic Development Corporation (CREDC) is the economic development arm of the Harrisburg Regional Chamber, and is the leading organization for promoting and performing economic development activities in Cumberland, Dauphin and Perry counties. CREDC offers a variety of programs and resources to help attract, retain and expand business and to encourage innovation and technology transfer in the region. www.harrisburgregionalchamber.org

Catalyst Connection

Catalyst Connection is a private non-profit economic development organization operating in southwestern Pennsylvania under contract with the National Institute of Standards and Technology's Manufacturing Extension Partnership, as well as with the Pennsylvania Industrial Resource Centers. The organization's mission is to advance the competitive performance of the 13 county region's small- and medium-sized manufacturing companies. www.catalystconnection.org

Center for Optical Technologies

The Center for Optical Technologies is a multi-institutional initiative based at Lehigh University with a charter to advance research, applications, and regional economic development opportunities for optical and optoelectronic technologies. Lehigh partners with Pennsylvania State University, Northampton Community College, and Lehigh Carbon Community College in research, education and outreach programs, and Ben Franklin Technology Partners of Northeastern Pennsylvania in business development. www.lehigh.edu/optics

eBizITPA

eBizITPA is helping Pennsylvania learn about, develop and deploy Information Technologies. Through a combination of educational programs, grants, client case management and counseling, eBizITPA serves small and medium sized businesses in Northwest PA and is expanding services throughout the commonwealth. www.ebizitpa.org

Enterprise Systems Center

The Enterprise Systems Center (ESC) at Lehigh University coordinates students, faculty, and experienced engineering professionals in assisting early stage as well as established businesses. Our National Science Foundation Research Center, Manufacturing Agility Program and Entrepreneurial Leadership Collaboratory are utilized to help companies compete in a global economy. www.lehigh.edu/~inesc

Greater Oakland Keystone Innovation Zone (GO KIZ)

The Greater Oakland Keystone Innovation Zone (GO KIZ) is focused on increasing technology company formation, location and growth in the region by leveraging the assets of the University of Pittsburgh, University of Pittsburgh Medical Center (UPMC) and Carnegie Mellon. www.universitypartnership.com

Idea Foundry

Idea Foundry, a collective of private foundations, government, universities and industry, supplies the critical ingredients to transform an entrepreneur's technology business idea into a fundable start-up company. Idea Foundry provides, through its in-depth programs, the intellectual and financial capital necessary to bring the business to the stage where formal external funding can be secured or operational stability achieved. www.ideafoundry.org

Innovation Works

As the Ben Franklin Technology Partner of Southwestern PA, Innovation Works increases the success rate of new enterprises in Southwestern Pennsylvania by providing high potential technology companies with access to risk capital, business assistance, and third party resources. Innovation Works provides a continuum of hands-on support, guidance, and investment for these companies. www.innovationworks.org

Innovation Transfer Network (ITN)

The ITN is committed to increasing the transfer of innovative ideas and technology from South Central PA's institutions of higher education to the private sector. The ITN provides companies with a gateway to partner with colleges and universities to address their innovation needs while assisting educational institutions with developing policies to facilitate such interactions. www.innovationtransfernetnetwork.org

Lehigh Valley Economic Development Corporation (LVEDC)

LVEDC is a not-for-profit, full-service, accredited business and economic development agency. Membership-based, LVEDC assists businesses by providing them with regional economic and demographic information, finance and business incentives, site/facility availability and workforce services. Through coordination of services at the local, regional and state level, LVEDC streamlines the relocation and expansion process for businesses. www.lehighvalley.org

PARTICIPATING TBED ORGANIZATIONS

Life Sciences Greenhouse of Central Pennsylvania (LSGPA)

The LSGPA enhances and translate 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 start-up firms, enhancement of existing regional industry, and relocation of biotechnology firms to the region. www.lsgpa.com

Pennsylvania Angel Network (PAN)

PAN is a statewide network of 18 angel investment groups across Pennsylvania, comprising over 650 angel investors. Its mission is to provide resources and support to existing angel groups and encourage the growth of angel investing in the commonwealth. PAN believes that providing support to angels will improve their overall investment environment, as well as the number of investors and new investment dollars in Pennsylvania. www.paangelnetwork.com

Pennsylvania Bio

Pennsylvania Bio is a catalyst to ensure Pennsylvania is a global leader in the biosciences by developing a cohesive community that unites the region's biotechnology, pharmaceutical, research, and financial strengths.

www.pennsylvaniabio.org

Pennsylvania Industrial Resource Center (IRC)

Network The Pennsylvania Industrial Resource Center (IRC) Network represents the seven private, non-profit Industrial Resource Centers located strategically throughout the commonwealth. These Centers were established to help small- and medium-sized manufacturing enterprises respond to changing markets, new technology and the competitive pressures of today's global economy. Representing the IRC Network for the Alternative Metrics project were IMC and DVIRC.

www.pairc.net

Pennsylvania Infrastructure Technology Alliance (PITA)

PITA is a collaboration of Lehigh and Carnegie Mellon Universities whose goals include conducting technology development and educational outreach projects, creating an environment linking emerging and established PA companies, agencies and students, leading to new technologies and companies, increasing the creation and retention of high paying jobs, and attracting funding from other sources. www.ices.cmu.edu/PITA/

Pennsylvania Nanofabrication Manufacturing Technology (NMT) Partnership

The Pennsylvania Nanofabrication Manufacturing Technology (NMT) Partnership is a higher education collaborative dedicated to creating and updating a workforce in Pennsylvania trained in the exciting field of nanotechnology. The NMT academic programs are offered by partner institutions and include associate degree, baccalaureate degree, and certificate pathways to an education in nanotechnology. www.cneu.psu.edu/abHomeOf.html

Pennsylvania NanoMaterials Commercialization Center

The Pennsylvania NanoMaterials Commercialization Center focuses on commercializing nanomaterials technologies and building upon Pennsylvania's advanced materials research and manufacturing. The Center's mission is closely aligned with Pennsylvania's Initiative in Nanotechnology and was founded through the efforts of Alcoa, Bayer Material Science, PPG Industries, U.S. Steel, Carnegie Mellon University and the Pittsburgh Technology Council. www.pananocenter.org

Pennsylvania State System of Higher Education

With more than 109,000 students, the Pennsylvania State System of Higher Education, PASSHE, is the largest provider of higher education in the commonwealth. The 14 PASSHE universities offer more than 250 degree and certificate programs in more than 120 areas of study. More than 405,000 PASSHE alumni live and work in Pennsylvania. www.passhe.edu

Pennsylvania Technical Assistance Program (PennTAP)

PennTAP supports technology-based economic development by engaging, guiding, and empowering companies throughout the commonwealth by advocating objective and experience-based technical and workforce solutions that enable clients to succeed and thrive, stimulating economic growth for Pennsylvania. Technical solution areas include: Environmental; Energy; Health and Safety; Food Industry; Forest Products; Information Technology/e-Business; New Product Development; Technology Transfer; Technology Commercialization; Information Technology for Healthcare; Workforce Development; Statistical Data Analysis; Operation and Production Process Improvement; and General Technology Solutions. www.penntap.psu.edu

PARTICIPATING TBED ORGANIZATIONS

Penn State University Office of Economic and Workforce Development

The Penn State University Office of Economic and Workforce Development helps to advance the economic well being of Pennsylvania by serving as a catalyst, facilitator and collaborator for using the resources, expertise and intellectual assets of Penn State University to help create and retain jobs and enhance the skills of the workforce in the commonwealth.

www.oewd.psu.edu

Penn Venture Partners

Penn Venture Partners, LP is a venture capital fund headquartered in Harrisburg. The Fund invests primarily in mid-stage companies and has a multi-sector focus. Target companies are located within Central and Northwestern Pennsylvania.

Investments are in equity securities and typically held from two to five years. www.pennventures.com

Pittsburgh Life Sciences Greenhouse (PLSG)

PLSG invests in and supports the growth of biosciences companies in Southwestern Pennsylvania. PLSG has investment and business growth programs to increase the linkage between research, technology and commercialization; nurture and develop entrepreneurial biosciences enterprises; grow the region's talent pool in the life sciences; and help biosciences firms locate, expand or start-up in the Greater Pittsburgh region. www.plsg.com

Pittsburgh SuperComputing Center (PSC)

Operated by Carnegie Mellon University with the University of Pittsburgh and Westinghouse Electric Company, PSC facilitates scientific and engineering research requiring high-performance computing. PSC serves both academic researchers and companies who use the facilities to enhance their competitiveness. PSC, as a national resource, benefits Pennsylvania citizens in the areas of education, research and economic competitiveness. www.psc.edu

Pittsburgh Technology Council

The Pittsburgh Technology Council is the first and the largest regional technology trade association in the United States with nearly 1,350 member companies within 13 counties in southwestern Pennsylvania. Its mission is to contribute to the success of the region's technology businesses by focusing on three main industry clusters: information technology, life sciences and advanced manufacturing. www.pghtech.org

Southside Bethlehem KIZ

The Southside Bethlehem KIZ cultivates entrepreneurial opportunities, by aligning the combined resources of Lehigh University, Northampton Community College with the existing business community, economic development organizations and the community at large. Our student Internship and Technology Transfer Mini-grant Programs and various sponsorships are the mainstays of our programming. www.lehighvalley.org

Technology Collaborative (TTC)

The Technology Collaborative (TTC) is an economic development organization whose mission is to help increase Pennsylvania's technology-based economy by developing collaborating industry clusters that leverage the region's world-class assets in Advanced Electronics, Cyber Security, and Robotics. TTC delivers high-value-add programs and services that start-up and expanding businesses need, including: collaborative research, education and training, extensive business support, networking opportunities, and employee recruiting services. www.techcollaborative.org

University City Keystone Innovation Zone

This KIZ is a partnership of Drexel University, Thomas Jefferson University, University of Pennsylvania, University of the Sciences in Philadelphia, Wistar Institute and the early-stage business support community, Philadelphia's UC KIZ connects life science entrepreneurs to resources and success. To start, re-locate or partner with a growing life sciences company in an exciting urban environment. www.uckiz.com

Vehicle Systems and Safety Program (VS&S)

The Vehicle Systems and Safety Program (VS&S) of the Pennsylvania Transportation Institute (PTI) studies the elements of passenger/operator/vehicle/surface interaction and the safety of vehicles traveling over pavement surfaces. Facilities maintained by the program permit research and testing on buses, trucks, and automobiles, including hybrid, electric, and other alternative-fuel vehicles. Research excellence is achieved by assembling multidisciplinary teams of faculty, staff, and students dedicated to analytical, collaborative research. www.vss.psu.edu