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Pennsylvania's True Commonwealth: The State of Manufacturing – Challenges and Opportunities (Full Report)

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Pennsylvania's True Commonwealth:

The State of Manufacturing – Challenges and Opportunities

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Commissioned by

Pennsylvania's Industrial Resource Centers (IRCs)

Pennsylvania's True Commonwealth:
The State of Manufacturing – Challenges and Opportunities

About the Study Team

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John Brandt is the CEO of the Manufacturing Performance Institute, a research and consulting firm, and a former editor-in-chief of *IndustryWeek*. He has earned more than 20 national, state and regional awards for reporting and writing on economics and finance; management; and sales and marketing. His background also includes a decade of successful management and consulting experience in economics; health care; human resources and management training; public relations; and sales and marketing. A Phi Beta Kappa graduate of Case Western Reserve University, Brandt holds a B.A. in economics and English. He lectures frequently around the globe on topics including leadership and strategy, manufacturing and regional economic development. Brandt and his MPI team are responsible for the Next Generation Manufacturing study released in 2009. Brandt led the development of this study's CEO focus groups and developed the focus group questionnaire.

Iryna V. Lendel

Iryna Lendel was the project manager of the CSU research team. She served as a lead researcher for the quantitative analyses, including descriptive analyses of the state of manufacturing in Pennsylvania and in the IRC regions, as well as driver and cluster industry, innovation and economic impact analyses. Dr. Lendel is an economist with 15 years of experience conducting applied economic research and 10 years experience analyzing regional and industry economic development. Her research portfolio includes projects on manufacturing, high-tech industries, the re-emerging optics industry, and state and regional science and innovation policies. Dr. Lendel has also conducted multiple economic impact analyses. Lendel is the Assistant Director of the Center for Economic Development at the Maxine Goodman Levin College of Urban Affairs at Cleveland State University. She was named a Fulbright New Century Scholar for 2009-2010.

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Charlie Post
Charlie Post has been a Project Manager/Research Associate in the Maxine Goodman Levin College of Urban Affairs at Cleveland State University since 1992. Previously, he was a Policy Analyst at The Center for Regional Economic Issues (REI) at Case Western Reserve University, a Research Analyst at Mathematica Policy Research (MPR) in Washington, D.C., and a Policy Analyst in the Department of Energy (DOE). While at CSU, Post has provided computer programming and data analysis related to the various facets of urban sprawl and has worked on studies related to industrial clusters, economic impacts of the Cleveland Port Authority, and affordable housing.

Jim Samuel
Jim Samuel founded Capitol Integrity Group, Ltd. in 2005 as a strategic policy development and communications consultancy. His clients include public and private corporations, government agencies, institutions of higher education, business associations and nonprofit entities. Samuel was responsible for developing the study's public policy recommendations. He is a Fellow of Cleveland State University's Maxine Goodman Levin College of Urban Affairs and recently served as a co-author of the Levin College's report Driving Ohio's Prosperity, a strategy document for Central Ohio's automotive and advanced manufacturing sector. Samuel served Ohio Governor Bob Taft as Executive Assistant for Business and Industry. Immediately prior to his appointment to the Governor's staff, Samuel served eight years as the Deputy Administrator and Chief of Corporate Affairs at the Ohio Bureau of Workers' Compensation. Samuel's work has been recognized with an award from the Public Relations Society of America and the Bulldog Award for Crisis Communications.

Fran Stewart
Fran Stewart is a Cleveland-area writer, editor and designer. She has spent more than 15 years working for newspapers, including the Cleveland *Plain Dealer.* Stewart was responsible for coordinating the research report, for analyzing the data from the focus groups and for much of the writing of the report.

Much of her writing today is in the areas of economic development, public policy and urban issues. She has worked on projects for Cleveland State University's Levin College of Urban Affairs, PolicyBridge, the Ohio Department of Development, the Ohio Department of Transportation, the Cleveland Leadership Center, North Carolina A&T State University, and the U.S. Department of Housing and Urban Development.

Research & Design Assistants

Jean Marie Hacker contributed to developing the financial impact model.

Songpyo Kim contributed to analyses of the state of manufacturing in Pennsylvania and in the individual IRC regions.

Katherine Kowalczyk contributed to analysis of manufacturing in the individual IRC regions.

Nick Matej provided graphic design assistance.

Sunjoo Park contributed to the innovation analysis.

Chang-Shik Song contributed to the innovation analysis.

Introduction

The Industrial Resource Center Network of Pennsylvania is the state's affiliate of the National Institute of Standards and Technology's Hollings Manufacturing Extension Partnership program. Both the IRC program and the MEP have longstanding traditions of self-assessment and evolution as ways of being accountable to the public and of promoting continuous improvement. The IRC program and the MEP are charged with helping manufacturing in general, and small to midsized manufacturers in particular, improve their competitive position.

The IRC program uses the outcomes from these assessments to think about the challenges their constituents face due to rapid evolution in the globally competitive environment. Additionally, the IRC Program has joined with the MEP to discover best management and production practices, standardize them in terms of educational and training practices, and then disseminate these practices widely. Again, this is with an emphasis on small and midsized establishments and businesses.

This report builds on the 2004 report, *Manufacturing Pennsylvania's Future*, written by Deloitte Consulting and the Maxine Goodman Levin College of Urban Affairs at Cleveland State University. In August 2010, as the negative impact of the Great Recession was beginning to ebb and after a decade of global competitive challenges, the IRC Program embarked on a new round of self-evaluation and assessment. The economic development and nonprofit management research groups at Cleveland State University's Levin College were engaged to examine the state of manufacturing in the Commonwealth, discover the management practices of the "best of the best" manufacturers in the state, and suggest practice innovations that would enhance the competitive position of Pennsylvania's manufacturers. This work was undertaken with the MPI Group.

The project was supported by funding from the Industrial Resource Center program, the Hollings Manufacturing Extension Partnership of the National Institute of Standards and Technology, the John D. and Catherine T. MacArthur Foundation's Network on Building Resilient Regions, and the Pennsylvania Department of Community and Economic Development, with funding provided by the National Telecommunications and Information Administration.

The work benefited from the advice and review of an external advisory board that was facilitated by Ken Voytek, NIST/MEP's chief economist, and Joe Houldin, CEO of the Delaware Valley Industrial Resource Center. They worked with: Emily DeRocco, President, the Manufacturing Institute of the National Association of Manufacturers; Samuel Leiken, Vice President of the Council on Competitiveness; Howard Wial, Ph.D., Fellow of the Metropolitan Policy Program of the Brookings Institution; and Mike Trebing, Senior Economic Analyst, Federal Reserve Bank of Philadelphia. The work was also reviewed and discussed by the IRC's Strategic Advisory Board and the directors of the network's seven centers. The report also benefited from data provided by the Central Pennsylvania Workforce Development Corporation (CPWDC).

The research team acknowledges the many contributions of our advisers and funders. Their participation and support do not mean that each agrees with all we have written. The team alone is responsible for the findings and interpretation of the data.

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EXECUTIVE SUMMARY

Pennsylvania is a Commonwealth, one of only four of the nation's states that has deliberately maintained the traditional English term. This distinction is more than a question for an elementary school social studies test or a trivia contest. In an era of shrinking government budgets and declining revenues, it is more than a trifling pursuit to consider what is sufficient and necessary to support the "common well-being." The question for such difficult economic times is how best to identify, support and nurture activities that are critical to the Commonwealth and the common good of its citizens.

Without a doubt, one of those critical areas is manufacturing. Manufacturing continues to be one of Pennsylvania's important wealth generators. Although popular opinion seems to have dismissed manufacturing as a relic of a different era and a different economic structure, Pennsylvania's manufacturers continue to take seriously their role as wealth generators for the state and nation. The facts support their claim: Manufacturing is Pennsylvania's largest source of Gross State Product (GSP) and its fourth-largest employment sector. In 2009, Pennsylvania was the sixth-largest manufacturing state in the nation in terms of GSP. Manufacturing remains a key part of Pennsylvania's innovation infrastructure and is present in all parts of the state, from city to suburb to rural county. Manufacturing productivity − measured as GSP per employee − was more than $27,000 higher in 2008 than productivity measured among non-manufacturing industries.

An essential measure of importance or centrality to an economy is the size of an industry's multipliers − meaning, the additional jobs, sales, or income generated from sales in the industry. Manufacturing has the highest multipliers of any other Pennsylvania industry. **Every $1 increase in final demand for products manufactured in Pennsylvania leads to a total increase in gross value added by all industries of $2.52.** No other industry in the state comes close to rivaling the impact of manufacturing:

- A $1 million increase in final demand for manufactured products in Pennsylvania results in the creation of 4.2 jobs; 2.9 jobs directly and indirectly in manufacturing and an additional 1.3 jobs through the spending of employees of the manufacturers and the employees in their supply chain;
- Manufacturing's labor income multiplier effect of $3.60 is more than double that of most other Pennsylvania industry sectors. Agriculture is the state's only other industry with a labor income multiplier above $2. Manufacturing's multiplier is so extraordinarily high because of the length of its supply chain, which is reflected in its indirect income multiplier of $1.74.

Yet, there is also no doubt that the past decade has been a challenging time for Pennsylvania's manufacturers. News accounts that chronicle job losses and plant closings have been correct in the details − even if they have failed to convey the industry's ongoing importance. The reality is that the weakness in Pennsylvania's manufacturing sector could have been even worse if not for critical state support in helping companies transition to more advanced manufacturing products and processes.

Pennsylvania's seven Industrial Resource Centers (IRCs) have leveraged this state support and targeted resources toward the specific needs of the regions they serve. The IRCs were created in 1988 as

a response to the declining steel industry and as a conduit for the needed industrial transformation that became apparent in light of the double-dip recession of 1980 to 1982. Since their inception, the IRCs have remained true to their mission of helping small and midsized manufacturing companies adapt and prosper in the face of ever-quickening economic change. The public has received demonstrable benefit from the IRCs' focus on manufacturers: Companies that received IRC services are estimated to have paid an additional $31 million in state and local taxes in 2009 due to increased sales alone.

The Effects of a Bubble and Currency

Pennsylvania is currently in the early stages of a slow recovery from the deepest recession it has experienced since the double dip of the early 1980s. This latest economic crisis has become known as the Great Recession because of its length and depth. For Pennsylvania, there is a key difference between the double dip of the '80s and the recent Great Recession. The recession of the 1980s triggered a major restructuring of the state's traditional economic base. That recession was an economic heart attack for Pennsylvania and the rest of the industrial Northeast and Midwest. The rest of the nation experienced a deep generalized recession as the Federal Reserve acted to break the back of wage-price inflation and, in so doing, triggered a major recession. In contrast, the triggers of the Great Recession did not lie in the immediate structure of Pennsylvania's economy. They were located in other regional economies in the nation and in the global financial markets. This is a critical difference and demands different policy responses and approaches.

An enormous housing price bubble and a combination of fraud and poor regulation in the international securities markets were the immediate triggers of the Great Recession, and major restructuring is being experienced in those parts of the region, and globe, that had overheated housing markets. A second source of macroeconomic tension in the decade leading up to the current recession was the structural deficit of the U.S. federal government and the international trade distortions associated with a grossly undervalued Chinese currency. The tie to Pennsylvania for both triggers is indirect, but important. The housing bubble and consumers' ability to withdraw equity from their houses (or to withdraw their transitory speculative gains) fed a massive boom in domestic consumption. Where were those goods produced?

U.S. and Pennsylvania's manufacturers had to compete against the "China Price." The Chinese currency was massively undervalued and manipulated. Not allowing it to float in response to trade surpluses on the Chinese side and large deficits for the United States resulted in production advantages for China that were not warranted by economic conditions. If China's currency had been allowed to float, U.S. corporations would still have been investing in China − it is a rapidly growing market, after all − but the decline in U.S. manufacturing Gross Product and employment would not have been as deep.

The combined impacts of the 2001 and 2008 recessions on manufacturing in Pennsylvania, and the nation as a whole, are apparent in many of the figures and tables presented in this report. So is the impact of an undervalued Chinese currency. Some economic commentators blithely dismiss the Chinese currency problem as an indirect subsidy to American consumption and, therefore, a beneficial transfer of wealth from China to the United States. There is a problem with this logic in a continent-wide common market, which is what the U.S. economy is. Goods-producing, or manufacturing, states, such as

Pennsylvania, do not have their own currencies. They cannot devalue their currency to lower their production costs. Instead, plants close and production moves to offshore competitors.

Yes, U.S. consumers have enjoyed a boost in their ability to consume, especially those in states and regions that produce services or that experienced the bubble in housing prices and with it phantom wealth. But, in a global economy where one major producer manipulates its currency, there is a long-term cost. The manufacturing base becomes hollowed out over time. This is a threat to overall economic well-being because, when market forces eventually overcome the artificial relative value of China's currency, the U.S. manufacturing base will not be in place to respond. And, contrary to expectations of those who look no further than the smooth, quick operation of the theoretical economists' invisible hand, manufacturing capacity, supply chain, knowledge and products will not be sitting patiently on a shelf somewhere to be rapidly redeployed. The path to prosperity will have been permanently altered, and the manufacturing commons will need to be recreated.

How Pennsylvania's Best Manufacturers Are Competing

While many may agree with this macroeconomic lament over the hollowing out of America's manufacturing core, what does this have to do with public policy in Pennsylvania today? There are two implications. The first is immediate. Our research and conversations with Pennsylvania's manufacturers show a clear ability to compete against the punishing headwinds of currency manipulation when firms engage in enterprise transformation. Such transformation:

- Is built on the foundation of a strong objective strategic plan;
- Is followed by the systematic elimination of waste in the production process, improving quality, and shortening the time it takes to get product to market (these actions are frequently put under the label of what is known as lean manufacturing techniques);
- Measures what is important and establishes a culture of continuous improvement;
- Empowers the core workforce and frees senior management to work on the business;
- Engages in product development in a niche market, coupled with an effective sales and marketing strategy.

This is a recipe that is easy to recite, challenging to implement and hard to stick with unless it is a core part of a company's operations. We have witnessed that the best-of-the-best manufacturers in Pennsylvania can structure their operations to contain cost structures that reside in the middle of their income statements, while allowing company leadership the time and resources to implement strategies to grow the top line. To succeed, manufacturers today cannot just focus on cost containment or on growth; the imperative is to do both. "If you're not doing lean, if you're not doing some sort of continuous improvement, I don't know how you're still around," said an Erie-area manufacturer. It is evident from discussions with the leaders of some of Pennsylvania's best manufacturing firms that lean manufacturing and other production process improvement techniques do not cost jobs; they save companies. With those saved companies come saved jobs.

The words of Pennsylvania's manufacturing leaders speak most eloquently on this point:

- “You have to simplify your business, eliminate stuff that doesn’t make you money,” said one focus group participant. “We make it really easy to decide what business to go after and what we don’t. Lean is part of that. Every employee has gone through lean training."
- **“**We train people that this is the way things are done. Lean is core to the culture,” a Bethlehem focus group participant said. “In order to stay ahead of the competition, this is what we do. We just don’t say ‘no’ unless physically it isn’t possible. That message has to get down right to that employee level about the importance of why we do things.”
- “Operational excellence is something you have to embrace,” said a manufacturer in the Wilkes-Barre area. “We run a lot of continuous improvement programs. We don’t have one silver bullet.”

In our discussions with the best manufacturers in Pennsylvania, this recipe is most effective when the secret sauce is applied: full disclosure of operating financials and performance metrics to the corporate team, which is then reinforced with meaningful gain-sharing on a monthly or quarterly basis with employees. This systematic approach to enterprise transformation among Pennsylvania’s small and midsized manufacturers is not taught in any business school. However, this knowledge resides in affordable form in the state’s IRCs. The IRCs function as applied graduate business schools, engaged not only in enterprise transformation, but also in a slow, grinding battle to remake the state’s manufacturing base. Transferring knowledge of how the largest and most important contributor to Pennsylvania’s wealth and prosperity can transform itself is the IRCs' mission. The IRCs have a stewardship responsibility not only to enhance that manufacturing knowledge base, but also to disseminate that knowledge.

Over the longer term, the competitive position of America's manufacturers will improve when the value of the U.S. currency drops, which is inevitable. The speed of the snap-back will be dictated either by the speed at which widespread enterprise transformation takes place or the speed at which new firms fill gaps created by the death of old ones. **The social and economic cost triggered by firm deaths greatly exceeds the cost of enterprise transformation.** Here again, the IRC program is positioned to accelerate positive and necessary transition.

Despite the pressure of almost a decade of intense global economic competition, many of Pennsylvania's manufacturing companies have adapted, survived and laid the foundation for a robust revival, frequently aided and advised by their regional IRC. "The only sustainable competitive advantage any company today has is the ability to learn faster," a Bethlehem-area manufacturer noted during a focus group. "Eventually you will be copied. So the only sustainable advantage is your ability to learn."

Manufacturing – A Vital Part of Pennsylvania's Economy

The data are clear: Manufacturing is the largest sector of Pennsylvania's economy. Despite the news reports and political comments that declare its demise, manufacturing continues to fuel Pennsylvania's economic engine. As can be seen in the following two tables, manufacturing accounts for the largest contribution and share of Pennsylvania's GSP. It held onto the top spot throughout the decade analyzed. However, the dramatically declining share – falling from 18.8 percent of GSP to 13.6 percent by 2008 – demonstrates the urgent need for reassessing Pennsylvania's manufacturing environment and suggesting

What Counts As Manufacturing?

There is a difference between the way manufacturing is defined in economic statistics and what most of us think of as a manufacturing company. In terms of the North American Industrial Classification System (NAICS), manufacturing covers industry codes 31-33. The economic statistics will count a business establishment as a manufacturing plant as long as more than half of the value added at that location comes from physical manufacturing production. There are multi-establishment firms in which the headquarters is in one location, research and product development in another, and production in a third. In that case, the company's economic impact will appear in three different industry classifications: Management of Companies and Enterprises; Professional, Scientific, and Technical Services; and Manufacturing. Alternatively, a single-establishment company, where all business functions take place at a single address, will be assigned to the NAICS code that accounts for the largest portion of value added. If production accounts for the most value added, then the company will be classified as a manufacturer; if management provides the most value added, then the classification will be Management of Companies or Enterprises. To the statistics keepers, Nike is not a manufacturer; its establishments fall into management, research, and wholesale footwear. Apple is not an electronics manufacturer; its establishments are listed in management, research, information, wholesale electronics, and retail electronics.

strategies for shoring up this vital segment of economic infrastructure. The heavy toll of the 2001 recession manifested in a nearly 3 percentage point contraction in GSP in manufacturing in the five years from 1998 to 2003. Global competition and commoditization continued to erode Pennsylvania's manufacturing base throughout the first decade of the 21st century. Despite this decade of stress, the sector generates more than $60 billion in GSP.

Manufacturing is Pennsylvania's largest industry in terms of percent share of GSP, despite the Great Recession.

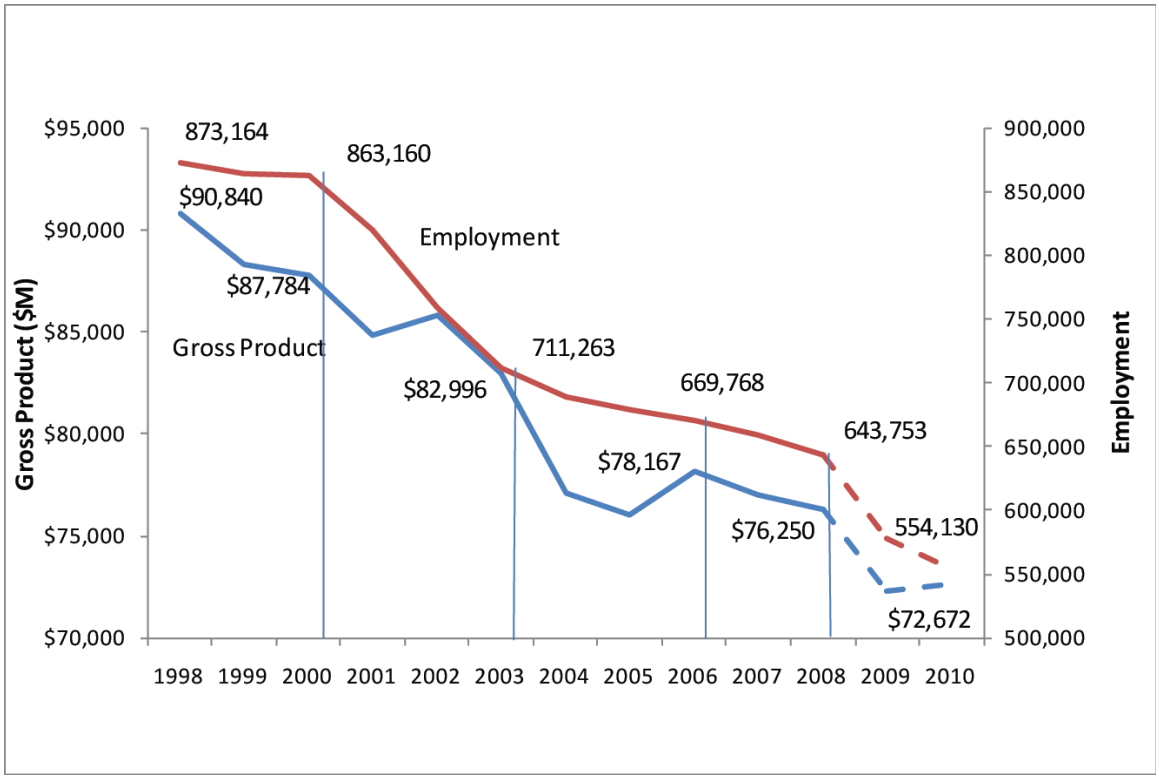
NAICS Industrial Sector	1998	2003	2006	2008
Manufacturing	**18.8%**	**15.9%**	**14.2%**	**13.6%**
Real Estate and Rental and Leasing	11.1%	11.5%	11.4%	11.8%
Health Care and Social Assistance	8.1%	9.1%	9.4%	9.7%
Public Administration	9.9%	9.8%	9.5%	9.4%
Professional, Scientific, and Technical Service	6.2%	6.8%	7.3%	7.8%
Finance and Insurance	7.2%	7.4%	7.7%	7.3%
Retail Trade	6.8%	6.8%	6.4%	6.0%
Wholesale Trade	5.5%	5.7%	6.0%	6.0%
Construction	4.0%	4.4%	4.7%	4.0%
Information	3.6%	3.7%	3.6%	3.6%
Transportation and Warehousing	3.3%	3.2%	3.3%	3.2%
Utilities	2.8%	2.7%	2.8%	2.9%
Management of Companies and Enterprises	1.6%	1.8%	2.3%	2.7%
Administrative and Support Services	2.5%	2.6%	2.6%	2.7%
Other Services (except Public Administration)	2.5%	2.5%	2.4%	2.4%
Accommodation and Food Services	2.2%	2.2%	2.2%	2.2%
Educational Services	1.7%	1.9%	1.9%	1.9%
Arts, Entertainment and Recreation	0.7%	0.8%	0.8%	0.8%
Mining	0.6%	0.6%	0.7%	0.8%
Agriculture, Forestry, Fishing and Hunting	0.6%	0.6%	0.5%	0.6%

Source: Moody's Economy.com

The decline in manufacturing's share of GSP is not surprising, given the paroxysm of job losses that slashed the industry's statewide employment footprint by nearly 37 percent from 1998 to 2010. Gross manufacturing product shrank by 20 percent over the same timeframe. Unlike the continued erosion in employment numbers, a glimmer of good news could be seen in the uptick in gross manufacturing product in 2010, which is connected to the weak recovery in employment that began in the first quarter of the year.

Indeed, given the widespread employment losses throughout the industry over the past decade, the surprising news is that manufacturing has managed to stay on top as Pennsylvania's largest source of GSP. **This illustrates the multiplied impact manufacturing has in the state's economy and points to the potential benefits of working to nurture the nascent rebound seen in gross manufacturing product – in the Commonwealth and around the nation**. Nationwide, gross manufacturing product fell by little more than 10 percent from 1998 to 2010 – a painful contraction, yes, but half the magnitude of severity experienced in Pennsylvania. In terms of manufacturing employment, the distress was more equally shared, with the nation as a whole seeing a 34 percent decrease in jobs.

The real value of manufacturing Gross State Product and Employment has dropped in Pennsylvania. Rebound is forecast with the recovery.



Note: Vertical lines represent significant years for the analysis. National business cycle peaks: March 2001 and December 2007; trough: November 2001. Year 2008 is the last year of real data estimates.

Source: Moody's Economy.com and NBER

Given the ubiquitous reporting on the loss of manufacturing jobs nationwide, it is important to note the continued importance of manufacturing in Pennsylvania as an employer. **Despite losing nearly 230,000 jobs between 1998 and 2008, manufacturing still employs more Pennsylvania workers than**

nearly all other industry sectors. Only three – Health Care and Social Assistance, Public Administration and Retail Trade – put more Pennsylvanians to work.

Manufacturing was Pennsylvania's fourth-largest employer in 2008.

NAICS Industrial Sector	1998	2003	2006	2008	2008 Rank
Health Care and Social Assistance	716,894	777,232	844,496	882,085	1
Public Administration	711,857	745,244	745,267	749,086	2
Retail Trade	652,798	661,145	654,264	648,475	3
Manufacturing	***873,164***	***711,263***	***669,768***	***643,573***	***4***
Accommodation and Food Services	365,157	394,821	409,962	416,021	5
Professional, Scientific and Technical Service	252,015	278,487	307,510	318,202	6
Administrative and Support Services	255,722	257,556	278,261	277,594	7
Finance and Insurance	265,627	270,511	267,869	264,280	8
Construction	221,051	245,652	260,753	254,513	9
Other Services (except Public Administration)	235,757	259,960	258,346	254,255	10
Wholesale Trade	217,378	227,225	237,631	238,516	11
Educational Services	182,080	202,592	209,356	218,601	12
Transportation and Warehousing	174,929	191,289	211,785	216,193	13
Management of Companies and Enterprises	64,414	74,108	99,020	113,486	14
Information	122,949	119,366	108,062	105,867	15
Arts, Entertainment and Recreation	64,721	75,772	81,509	86,930	16
Agriculture, Forestry, Fishing and Hunting	86,502	85,568	85,561	81,904	17
Real Estate and Rental and Leasing	64,830	67,848	67,036	65,434	18
Mining	20,325	22,430	22,632	22,998	19
Utilities	32,775	27,954	21,630	22,558	20
Total	5,635,234	5,751,785	5,887,217	5,920,993	

Source: Moody's Economy.com

The massive job losses have led many political leaders and media pundits to write off manufacturing. Many reportedly in-the-know analysts and policy makers have declared U.S. manufacturing to be dead. Yet, manufacturers who have survived the difficult environment of the past decade by retooling and repositioning say they are poised for growth. That positioning can, and should, be enhanced with selective changes in public policy. These new policy recommendations will be discussed later in this summary.

Manufacturing, Productivity, and Earnings

Understanding productivity is key to understanding how economies develop. Earnings cannot increase without increases in productivity to pay for the higher earnings. Productivity is defined as value added per hour worked. In this report, productivity is measured as gross state product per job. This approach was taken because state-level data on hours worked by industry do not exist and GSP is similar to value added.

Most people associate productivity with how hard or smart people work, which is an important contributing factor. However, productivity is also influenced by the level and types of machinery, the cost of management and supervision, and, most importantly, by the margin the product can earn. An

example may help illustrate this meaning: If you go to a local lunch counter, how much does a cup of coffee cost? Perhaps it costs a dollar. How much does the same cup cost in a nationally branded coffee shop, such as Starbucks or Caribou? If you order a standard cup of coffee, it is nearly double the cost at the local establishment, and the price climbs as you customize the product. Who is the hardest worker? Is it the barista? Or is it the person who takes the order, delivers the food, cleans up and keeps everyone in line? The lesson to be learned is that the real source of productivity lies with the product, the brand, management and the production system. In other words, productivity lies with the margins embedded in the product and in the customer's experience. As margins increase, so does value added. The reason this is relevant is that, as margins erode and products become commodities, productivity gains can only take place if companies work harder, smarter, or with more efficient equipment. If companies don't, then productivity growth slows or reverses.

As products age, both in terms of location along the product cycle and in terms of the chronological age of the product, competitors appear, prices are cut, margins erode, and productivity declines. That is where margins play a key role in measured productivity. Margins are only maintained by having a steady flow of innovation, which prevents the business's product from becoming commoditized, and by having a strong brand.

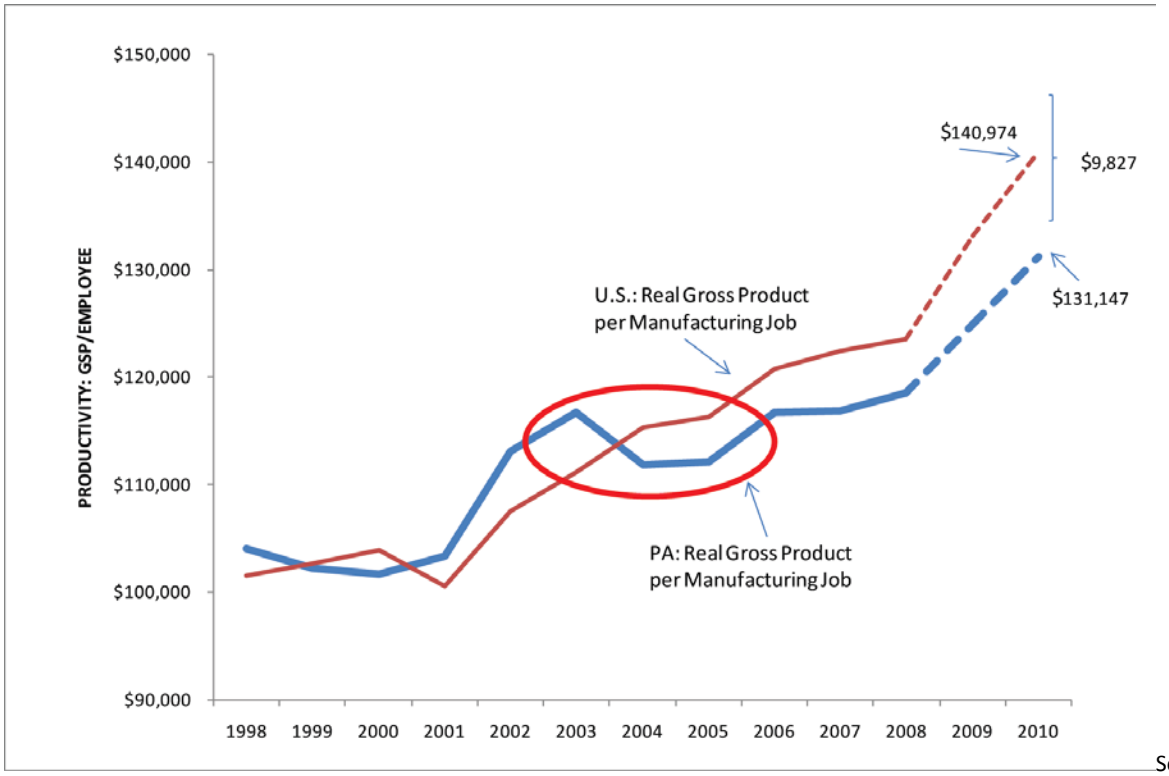
The best of Pennsylvania's manufacturers fight commoditization each and every day and understand that improving productivity is management's job through product innovation. Despite the challenging environment, focus group participants spoke of opportunity. They are developing new products, offering new services and creatively adding new value. Many spoke of the need to focus on a niche market and learn to anticipate the needs of clients.

- "The only way we're going to survive is to come up with new products," said one Philadelphia-area manufacturer.
- "We're pretty versatile," said a counterpart in the York area. "We're not afraid to try things we've never tried before. Our product mix has changed over the past five years. That's probably why we're still around now − product flexibility."
- "Our approach is let's get close and then jump in with both feet and learn as we go," said an Erie-area focus group participant. "We have to leverage our strengths. … We don't have to be perfect; we just have to be good enough to live to fight another day."
- "We have to be much more nimble, provide faster delivery, have lower prices. Quality is a given," said one York-area manufacturer.
- "We look for 'I need this but…' I love the 'but' because that's where we can do something. We're looking for volumes that are large enough that we can have some impact but small enough that China is not going to be interested. … We're not sitting around in a think tank, thinking what's the next best thing. We're looking at what we can make better and make better for your application. We're telling [our sales] representatives [to ask], 'What can we do to solve your problem?' "

- "As we emerge from this, I think we will have a lot bigger piece of the pie. The recession has cleaned out a lot of companies that were teetering on the edge," said a Williamsport-area manufacturer.

Pennsylvania manufacturers, who once were national leaders in productivity, have fallen behind their counterparts in other areas of the country. Pennsylvania manufacturing productivity lagged the national average by $5,098 per job in 2008. The gap for 2010 was projected to nearly double to $9,827 per job. Underperformance has been the case throughout much of the past decade. As the following figure shows, Pennsylvania's manufacturing productivity exceeded the U.S. average in 1998, slipped behind for the next few years, surged ahead between 2001 and 2003, before falling well short of the national mark and remaining there for the rest of the decade. **The data for 2005 and 2006 are circled because a reversal of trend took place in Pennsylvania over those years. Despite facing the beginning of the Great Recession, the trajectory of the manufacturing sector changed.**

Growing Productivity Gap: Pennsylvania Manufacturing vs. U.S. Manufacturing



Source: Moody's Economy.com

Much of Pennsylvania's employment and GSP losses can be attributed to declines in two areas critical to the state's economy: pharmaceuticals and petrochemicals. Pharmaceuticals as an industry experienced consolidation as new drug introductions slowed and global companies bought each other.

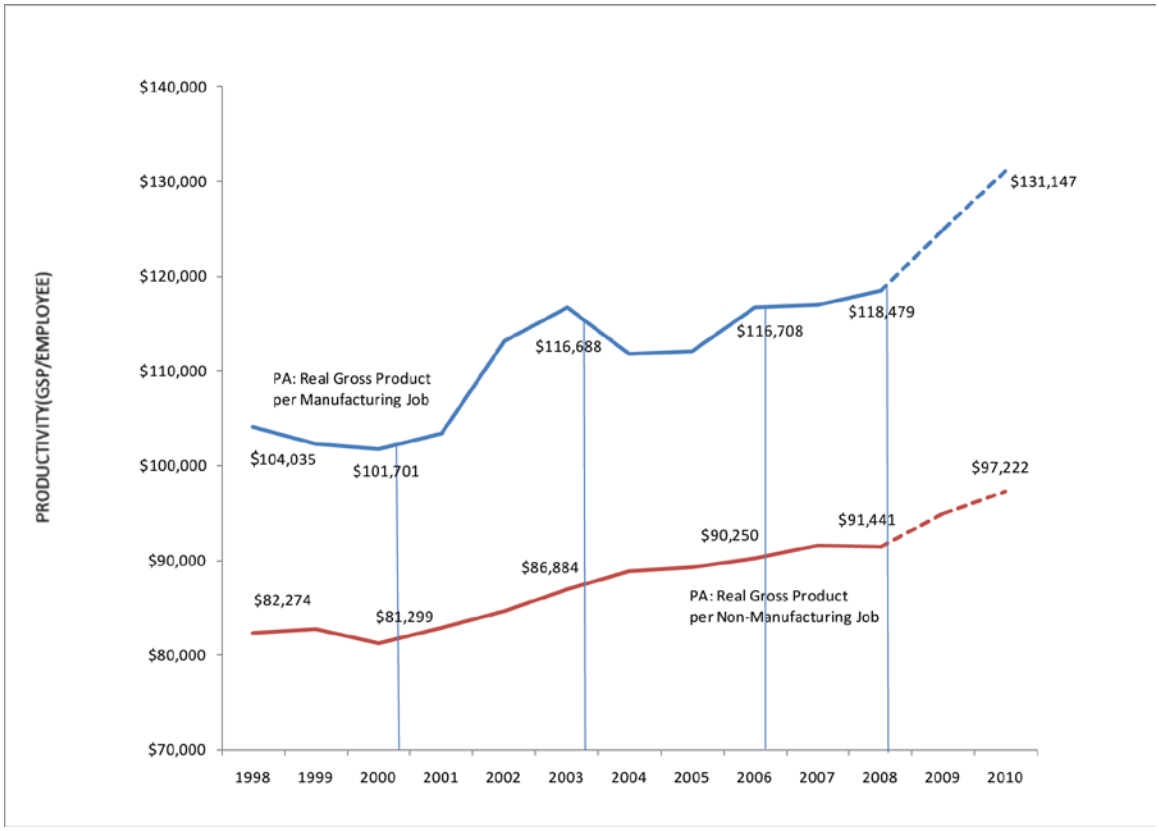
Unfortunately, those located in Pennsylvania lost. Drilling down into Pennsylvania's 2003-2006 losses reveals the industries at the four-digit NAICS level that experienced the greatest loss in GSP:

- NAICS 3254 Pharmaceutical and Medicine Manufacturing: -$3.8 billion
- NAICS 3251 Petrochemical Manufacturing: -$2.4 billion
- NAICS 3252 Resin and Synthetic Rubber Manufacturing: -$948 million
- NAICS 3241 Petroleum and Coal Products Manufacturing: -$868 million
- NAICS 3259 Other Chemical Product & Preparation Manufacturing: -$519 million

The loss in GSP from 2003 to 2006 that is accounted for by just these five manufacturing industries totaled $8.5 billion. That is twice as large as the $4.8 billion total drop in manufacturing GSP over the same time period. In terms of manufacturing employment from 2003 to 2006, Pennsylvania's pharmaceutical and petrochemical industries experienced some of the largest losses, but the textile sector also witnessed sharp cuts.

Despite the challenges displayed in the figures throughout this summary and report, productivity in manufacturing dwarfs that in the non-manufacturing private sector. Manufacturing is key to the level of productivity in the state, as the following figure shows. Gross product per employee in 2008 was more than $27,000 higher for Pennsylvania manufacturers than for non-manufacturers. The gap was projected to widen through 2010 to $33,925. This gap may be explained by improved capital and managerial practices among manufacturers. However, it reinforces the need for strategies to support Pennsylvania's critical manufacturing sector and to fight commoditization.

Pennsylvania Manufacturing vs. Non-manufacturing Productivity



Source: Moody's Economy.com

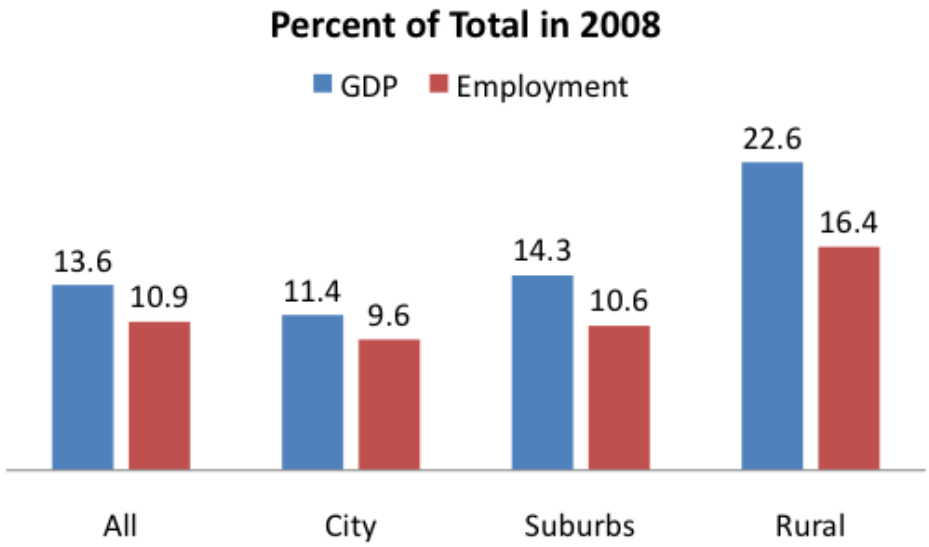
The Geography of Pennsylvania's Manufacturing

As was discussed earlier, manufacturing contributed 13.6 percent to Pennsylvania's GSP and accounted for 10.9 percent of the state's total employment in 2008, putting to work more than a half million people. What may be less appreciated is the effect the manufacturing sector has in all of Pennsylvania's counties. While important to the entire state – manufacturing is of particular importance to rural Pennsylvania.

In Pennsylvania's central counties − those counties where one of the state's central cities is located and where greater population and business densities exist − manufacturing contributed 11.4 percent of GSP and employed 9.6 percent of workers. In Pennsylvania's suburban counties− counties that are part of the metropolitan statistical area and abut a central county − manufacturing accounted for 14.3 percent of GSP and employed 10.6 percent of workers. Manufacturing had the largest impact on the state's more rural counties, where it accounted for 22.6 percent of GSP and 16.4 percent of employment.

Although the actual dollar amount contributed toward GSP and employment totals were far greater in the 14 central counties and the 18 suburban counties, **manufacturing accounted for a much greater share of GSP and employment in the rural areas of Pennsylvania.**

Manufacturing Activity by Type of County



Pennsylvania's Employment by Establishment Size

Between 2006 and 2008, Pennsylvania's largest manufacturing establishments – those with more than 1,000 employees – shed more than 16 percent of their jobs, idling 14,251 workers. As can be seen in the following table, manufacturers that employed 500 to 999 workers cut 6.9 percent of their workforce, and plants employing 100 to 249 workers contracted by 4.9 percent.

Two size groups of manufacturing plants experienced job growth over this three-year period: those with 20 to 99 workers and those with 250 to 499 employees. More than one-quarter of the state's manufacturing jobs are in plants employing 20 to 99 workers. This was an establishment size that did not experience any job losses as the Great Recession began and deepened. Companies with 100 to 249 employees, which account for nearly one-quarter of manufacturing jobs, experienced 32 percent of the overall job loss for the industry. Companies with 250 to 499 workers experienced nearly 3 percent job growth. The next two establishment size categories lost almost 20,000 jobs.

Outsourcing likely explains the steep losses among the state's larger manufacturers. **Manufacturers employing 250-499 workers, which was the only establishment size to experience significant growth between 2006 and 2008, may represent the optimal size for a globally competitive yet flexible manufacturing establishment that can withstand cyclical and structural change.** Such plants would be small enough to be nimble and would be at such a scale to be well-managed without

excessive overhead employment, but they would be large enough to endure, innovate and compete in a global market.

Jobs Gained or Lost in Pennsylvania's Manufacturing Establishments: 2006 to 2008

Manufacturing Establishment Size	Percent Distribution the Number of Jobs in 2006	Change in the Number of Jobs 2006 to 2008	Percent of Job Loss within Size Category	Percent Distribution of Job Loss 2006 to 2008
Less than 20	9.4%	-565	-0.9%	-2.2%
20 to 99	26.0%	139	0.1%	0.6%
100 to 249	24.3%	-7,967	-4.9%	-31.7%
250 to 499	15.2%	2,875	2.9%	11.4%
500 to 999	11.7%	-5,362	-6.9%	-21.3%
1,000 or more	13.3%	-14,251	-16.1%	-56.7%
TOTAL	100.0%	-25,131	-3.8%	100.0%

Source: U.S. Census Bureau, County Business Patterns

Manufacturing: Critical to Pennsylvania's Innovation Infrastructure

Earlier, the connection between innovation and productivity was made. To explore Pennsylvania's innovation infrastructure and to better understand the position that Pennsylvania's manufacturers fill in that infrastructure, the research team undertook an analysis of patents issued and filed. Although a patent analysis does not capture all forms of innovation, it does provide perspective on the inventive and breakthrough activities occurring in Pennsylvania and the role of manufacturing establishments in bringing innovation to the marketplace.

Of the 16,054 patents issued between 2001 and 2010 to Pennsylvania companies and universities, nearly 60 percent, or 9,577, were assigned to manufacturing companies. (Due to data limitations, this is a conservative estimate.) These 9,577 patents came from 20 different four-digit NAICS industries, with the medical, biochemistry, and data processing innovation categories accounting for nearly half of the filings and awards. The remainder of the patents filed or issued was in a broad range of innovation. Pennsylvania's manufacturing companies are patenting in optics and semiconductors, computer and electrical equipment manufacturing, transportation, and new products development.

Manufacturing accounts for 13.6 percent of Pennsylvania's GSP and 10.8 percent of private employment. Yet, the industry also accounts for 21 percent of Pennsylvania's GSP that comes from industries the U.S. Bureau of Labor Statistics considers to be intensive employers of technology workers, and it accounts for 22 percent of technology jobs. These numbers clearly understate the role that Pennsylvania's manufacturers play in technology-based economic development. As we noted earlier, if an establishment's primary value added is not production, then its NAICS code will not designate technology jobs that support production as manufacturing activity. Whether it is through patent activity or through GSP that comes from industries that are intense employers of technology labor, manufacturing is a critical part of Pennsylvania's technology infrastructure.

Skill Development and the Manufacturing Industry

Manufacturing in the United States traditionally provided hard-working people who had not pursued college education with jobs that paid well enough to support a family. The substantial job losses in manufacturing and the transition toward a more service-oriented economy have raised concerns about the fate of good-paying jobs for people who lack advanced education and skills. Some prominent economists have suggested that U.S. employment is taking on the shape of a barbell, with most growth concentrated either among low-skill jobs that are accessible to high school graduates with limited on-the-job training or high-skill positions that require a bachelor's degree, frequently coupled with large amounts of on-the-job training. Others economists have noted this job creation pattern, but they assert that retirements will create many job openings in the middle of the skills distribution. The fate of middle-skill jobs is an important long-term public policy issue in Pennsylvania because nearly 58 percent of the state's adult workers have a high school education or less. Skill development and acquisition are critical to this group's economic security.

Yet, Pennsylvania manufacturers paint a different view of the workplace: They don't see a shortage of middle-skill jobs; they worry about a scarcity of workers with skills critical to manufacturing activities. This is a surprising result coming at the tail end of the Great Recession and in the early stages of an anemic recovery. Among focus group participants surveyed, 94 percent rated "human-capital acquisition, development and retention" as important to their company's success over the next five years; 60 percent described it as highly important. In particular, these top performers fretted over skills, attitude and interest. Workforce issues constrained their ability to grow. "We can't find machinists, welders, hands-on guys who used to be the backbone of this country," said a Philadelphia-area manufacturer. "We have the opportunity to grow. But we can't find the people."

How can the observations from the national data and the focus group observations be reconciled? Pennsylvania occupational data show something different than what is seen in the national reports. Classifying jobs into three categories hides what is happening in the middle. Most of the employment shift in Pennsylvania is from Gateway occupations to low-skill jobs. Gateway positions require a high school diploma and modest amounts of on-the-job training. Middle-skill occupations require some combination of postsecondary schooling that is industry-recognized, substantial amounts of on-the-job training, or, less frequently, a specialized associate's degree. Middle-skill jobs, as a whole, did not shrink in Pennsylvania. However, they did shift into different industries, meaning that a person may hold middle skills applicable for one job but those skills may not transfer to another.

From 2006 to 2008, the number of middle-skill manufacturing jobs did decline by 3.7 percent, but that compares to the nearly 5 percent decline for both Gateway and low-skill positions. Manufacturing jobs that require advanced skills saw a 2.1 percent gain. In 2008, 25.5 percent of all manufacturing jobs were middle-skill; 11.8 percent required advanced skills; 38.9 percent were Gateway occupations, and 23.7 percent were low-skill jobs.

Given manufacturing's shifting employment structure, does the industry continue to be an important source of middle-skill work in Pennsylvania? The data say yes:

- In 2008, middle-skill manufacturing jobs accounted for 10.8 percent of all middle-skill positions in Pennsylvania and 2.9 percent of *all jobs* in the Commonwealth.
- Half of all middle-skill manufacturing jobs are in production. The next-largest occupational grouping for middle-skill manufacturing jobs is in the skilled trades and industrial maintenance.
- Sales positions are the third-largest source of middle-skill occupations within the manufacturing sector.

As productivity continues to increase in the manufacturing sector and production jobs come back slowly, we expect to see increased demand for workers with mid-level skills. Job creation will occur mostly through turnover. Building career ladders for those in Gateway positions by providing access to middle-skill positions, particularly production occupations, will be critical to both the success of the manufacturing sector and to the economic success of workers who do not go on to earn college degrees.

The Impact of Pennsylvania's IRC Program

The research team used two different sets of techniques to measure the impact of the IRC program on Pennsylvania's economy. The impact analysis began with data collected by the federal partner to the IRC Network, the Hollings Manufacturing Extension Partnership program of the National Institute of Standards and Technology. NIST/MEP hires an independent survey firm to collect data from business establishments that use MEP-supported services. The research team used data from the NIST/MEP survey on new and retained sales and new and retained jobs to power two separate analyses. The first was a straightforward examination of the financial impact of the IRC program. The second used an input-output model, a commonly used economic impact analytical technique, to estimate the multiplier effects of the IRC program. Data were examined for fiscal years 2008 and 2009; fiscal year 2010 was not examined because impact data had not been collected.

The first measure of the program's impact was leverage. This measured additional funds raised from federal, client and other sources due to the presence of state funds invested in the IRC program. Each dollar of state funding for the IRC program was associated with $1.50 in additional funds raised and earned in fiscal years 2008 and 2009. The fiscal data reveal the connection between state funding for the IRCs and program activities. **The steep decline in state funding from FY 2009 to FY 2010 was accompanied by a dramatic drop in client revenues.** Client revenues declined 35 percent in the same year although federal funding remained relatively constant. Funding from other grants also declined by 64 percent. Such significant losses in funding would be presumed to affect IRC activities, but the impact in terms of economic outcomes cannot be assessed at this time.

Leverage is not impact, however; what is important is how these leveraged funds affect the economy of the state. The impact of Pennsylvania's Department of Community and Economic Development funding of the IRC program was measured through sales of client companies as reported in the NIST/MEP survey. Every $1 of DCED funding for the network of regional centers in fiscal year 2008 returned $51 in new and retained sales. In fiscal year 2009, the yield dropped to $46. The IRCs' client companies reported that services delivered to them by the network centers were responsible for an

increase in sales in fiscal year 2008 of more than a quarter-billion dollars and retained sales of another half-billion dollars. Sales impact associated with DCED funding of the IRC program in fiscal year 2009 dropped. Although retained sales remained about the same ($531 million), reported new sales fell by more than half, dropping from $273 million to $102 million. Given that the economy began its recovery in 2009, it is difficult to associate this drop with the lingering effects of the recession. It is highly likely that the drop is related to the $1.3 million decline in DCED funding from FY 2008 to FY2009.

An important measure of the effectiveness of any economic development program is the cost per job created and retained. IRC activity affected more than 6,331 jobs in fiscal year 2009; clients reported 4,833 jobs retained and 1,498 new jobs created. **The cost per job to the state of Pennsylvania was $2,187 in fiscal year 2009.** This calculation is justified based on the assumption that DCED funding leverages the federal funds from NIST/MEP. However, combining federal and state funds in the calculation would bring the public cost per job to $3,027. The cost per job created or retained due to IRC support for manufacturing services is substantially lower than the cost per job created by other economic development programs reviewed. The cost per job created or retained due to IRC support for manufacturing was also much lower than the allowable cost per job stated in guidelines for other state and federal economic development programs.

In addition to examining the direct financial impact of the IRC program on Pennsylvania's economy, the study team sought to quantify the economic impact of both the manufacturing sector and the IRC program. The economic impact was measured in terms of the **value added, employment multipliers, labor (household) income, and state and local taxes paid** that were triggered by the performance improvements of client manufacturing companies.

Without a doubt, investment in the IRC program has sparked dynamic returns. The impact has rippled throughout the Pennsylvania economy:

- The economic impact model estimated that more than 4,200 jobs were created in the state by the direct, indirect or induced result of increased sales in companies that used IRC services.
- As a result of increased sales, labor income in the state increased by more than $235 million.
- The increased sales generated an increased demand in output (sales) for Pennsylvania products and services valued at almost $1.1 billion.
- Companies that received IRC services are estimated to have paid an additional $31 million in state and local taxes in 2009 due to increased sales alone.
- State and local governments collected nearly $17 million in business sales and property taxes and nearly $5 million in personal income tax. This by itself was $8 million more than the state's FY 2009 support for the IRC program.
- Total GSP, or total value added, grew by nearly $411 million as a result of increased sales at companies that used IRC services.

Opportunities for Policy and Programming

Understanding manufacturing's economic contribution and competitive performance in Pennsylvania is important. Knowing context beyond banner headlines of job losses and plant closings is critical. But manufacturers struggling to survive and retool in such a challenging environment need more than understanding; they need support as they transform their enterprises to compete and succeed. The months-long analysis of economic data and discussions with dozens of Pennsylvania's successful manufacturers has generated recommendations for wide-ranging policy and programmatic changes for supporting this crucial contributor to the Commonwealth and the common well-being.

Taxes

Tax reform was not a lengthy topic of conversation during the focus groups, but the little said spoke volumes about what manufacturers consider an over burdensome tax climate in Pennsylvania. The limited discussion of the state's tax structure had the effect of conveying the obvious: Tax reform has been talked about repeatedly among political and business leaders. Reforming the tax structure is important to help Pennsylvania compete, but there are other factors, as well. Among surveyed manufacturers who represented the "best" of their region, taxes were a recurring concern. Survey results and comments were more succinct. They focused on the state's high tax rates (its corporate rate, especially) and the complexity of the tax code (compliance and navigation). Of 57 written survey responses outside of the prepared survey questions, 24 comments were made about the tax rate or the tax code. When asked what kept them up at night, many respondents answered taxes. Of those who wrote simply one word or one phrase, taxes in Pennsylvania was the dominant response.

The manufacturers know that they have a duty to pay taxes. However, they are looking for a system that is flatter and easier to comply with. If they were given a choice between a corporate tax system that was flatter and broader and was easier to comply with versus one that had a number of carve-outs and incentives tailored for manufacturing, they would go with flatter, fairer, and easier. Their highest concern is in **reducing the corporate net income tax.** At a flat rate of 9.99 percent, it is currently the second-highest rate in the country.

Most of the companies that participated in the focus groups were small to midsized manufacturers, which is the group that has been the state's strongest performers. They wanted a tax system that provided incentives to reinvest in their businesses, especially in capital equipment, new product development, and workforce training. They typically pay for their research and development and invest in their workforce through cash flow. Their comments indicated that they would like to see the state's research and development tax credit work for their firms and apply to product development. Comments were made that there is a limited pool of funds and they go quickly.

A lesson learned by small and midsized businesses during the Great Recession is the importance of internal finance and investing in their businesses through retained earnings. Public policy should encourage the use of retained earnings as an investment vehicle for small to midsized businesses. Granted, this is mainly a federal issue, but long-term economic benefit could come from promoting less leveraged financial structures, especially among small and midsized firms.

Firm-based Economic Development

Public policy analysts and economists love to think about their ability to influence the world through the manipulation of a few big public policy levers. In the case of Pennsylvania, the thought may be that it is enough to fix the business tax code and let the market work to return the state to prosperity. Unfortunately, pulling on that one big lever will not be enough. Contrary to expectations of those who look no further than at the smooth, quick operation of the theoretical economists' invisible hand, manufacturing capacity, supply chain, knowledge, and products will not be sitting patiently on a shelf somewhere to be rapidly redeployed. The path to prosperity will be permanently altered and the manufacturing commons will have to be recreated.

Many of Pennsylvania's manufacturers have cut so much to survive this recession that they no longer have the capability to manage their business properly. Many have divested their product development capacity. Others have abandoned their practices of lean manufacturing and continuous improvement. As production comes back, they will have to rethink their production processes and sourcing. Yes, over a decade, the market will work toward a solution. But the cost of such a laissez faire approach will be a slower-than-need-be pace of recovery and an unnecessary loss of firms. The speed of the rebound among Pennsylvania's manufacturers will be dictated by the speed at which widespread enterprise transformation takes place or the speed at which firms transition to fill gaps created by the death of companies that could not adapt. Here, the IRCs are positioned to accelerate positive and necessary transition, and it is here where the practice of economic development takes place.

There are areas of managerial weakness that represent opportunities for transformation through strategic state support. Focus group interviews with manufacturers that are succeeding despite the challenges of market realignment and economic environment pointed to two key areas: improved management practices and new product development.

Many focus group participants talked of their lean journey and of the need to "change their culture." Lean is one of several business management strategies that focus group participants have embraced. Although lean focuses on eliminating waste, which some have interpreted simply to mean cutting jobs, focus group participants spoke of lean as a necessary component of growth. It has given them the tools to determine where opportunities lie. But it works best when it is part of a sustained strategic effort to transform the manufacturing enterprise and is a tool to implement a corporate culture of continuous improvement.

Many focus group participants indicated that they have been so concerned about surviving the Great Recession that they have not focused on new product development. Much of new product development, they said, is being driven by customer requests. Several also have moved to integrate their suppliers into the development process. **This suggests that state-supported efforts to stimulate niche-based new product development in small to midsized manufacturing establishments can yield important returns. The prospect is all the brighter when product development pulls new technologies into their products or production processes.**

There is no silver bullet when it comes to helping a private company become more competitive. Many things have to be done right, and this rests on the company's commitment to engage in enterprise transformation. There is no single place to start the journey. The most successful small and midsized manufacturers have found ways to provide service offerings that shelter their physical products from pure price-based competition. Most of the firms we talked to engaged in product development, but it is very different from the formal processes used by large companies. Most follow their customers to understand need, use suppliers as research and development and technology resources, finance internally, and use their current product sets as platforms for product improvements and extensions. This is a world of sustaining innovation, not disruptive innovation.

Workforce Development

There is always a tension in an organization that has two customers; and this is universally true when it comes to workforce development. The current system is expected to treat both potential employers and workers as clients. The workforce system is expected to be a competitive source of workers, yet also take on social service responsibilities for the underprivileged and under-skilled. This can be thought of as a tension between the demand-side of a market (employers) and the supply side (potential employees), with the workforce system being a "market maker." An ever-present challenge is how effectively to organize demand − the employers. Many employers are using temporary staffing agencies, especially for low-skill and Gateway occupations. The difficulty lies in organizing and articulating the demand for workers with middle skills.

The seven regional IRCs are part of the state's economic development capacity and are its "feet on the street," working on a daily basis with employers. In a future where middle-skill manufacturing jobs will be at the top of the job ladders many workers climb, the IRC program can bridge the gap between the supply and demand sides of the labor market. Middle-skill jobs that can support families require substantial amounts of on-the-job training accompanied by industry-standard and certified skills training. This is a recipe for a modern version of an apprenticeship program, one that is responsive to employers, combines formal training attached to a certificate, and is cemented by structured on-the-job training. Such comprehensive workforce development will require an intermediary that has experience in structuring programs, that is responsive to employers, especially manufacturers, and that understands how to work in both the private and public realms.

Conclusion

Pennsylvania's manufacturing sector is central to the state's economy. It is the largest sector in terms of the generation of Gross State Product; it is the state's fourth-largest source of jobs; it has the highest productivity of any sector; and it has the highest employment, income, and value added multipliers of any economic sector in the state. The sector is in transition and will need management support and education as it regains its footing after emerging from the Great Recession and a decade in which the value of the U.S. currency worked against it.

Of particular note is the performance of the small to midsized segment of the industry during the Great Recession and the disproportionate role the industry plays in the economic development of rural Pennsylvania.

Manufacturing is a sector that deserves continued public support and investment in the form of state tax and regulatory reform, employer-responsive workforce development programs, and a resource that can transfer knowledge about business growth strategies and management practices that fit the demands of small and midsized firms. The Industrial Resource Center program is a tested tool in the state's economic development toolbox. It works with small to midsized manufacturing companies to improve their competitiveness by providing management education, training and implementation strategies that are experientially based and respond to the needs of a sector and size of firm that is frequently overlooked.

The data demonstrate that the IRC program creates and retains jobs in a cost-effective manner, that the tax return from new sales alone pays for the state's program cost, and that program services pass a market test through the fees charged. Although the fees clients paid for services are a sign of value, state and federal support is justified to allow the IRC Network to engage in its own product development to better serve the emerging needs of small and midsized manufacturers and to allow the IRCs to provide services to companies that cannot afford the fees of major management consulting organizations.

True economic development takes place by helping leaders improve the income statements of their businesses through their location in Pennsylvania. This is the mission of the IRCs. They help businesses improve their operations by moving the numbers on the middle lines of the statement. They help to grow the top line by helping companies develop new products and provide new services based on strategic thinking and action. The seven manufacturing centers supported by the IRC program are true stewards of Pennsylvania's commonwealth.

PENNSYLVANIA MACROECONOMIC ANALYSIS

Why Focus on Manufacturing?

The data are clear: Manufacturing is the largest sector of Pennsylvania's economy. Despite the news reports and political comments that declare its demise, manufacturing continues to fuel Pennsylvania's economic engine. Manufacturing accounts for the largest share of Pennsylvania's gross state product, as is shown below. It held onto the top spot throughout the decade analyzed despite taking some hard knocks. However, the dramatically declining share – falling from 18.8 percent of GSP to 13.6 percent by 2008 – demonstrates the urgent need for reassessing Pennsylvania's manufacturing environment and suggesting strategies for shoring up this vital segment of its economic infrastructure. The heavy toll of the 2001 recession manifested in a nearly 3 percentage point contraction in manufacturing in the five years from 1998 to 2003. Global competition and commoditization continued to erode Pennsylvania's manufacturing base throughout the first decade of the 21st century. As manufacturing declined, other industry sectors gained ground: Real Estate; Health Care & Social Assistance; and Professional, Scientific, & Technical Services are the largest of Pennsylvania's industry sectors to show consistent growth in share of GSP for the period examined. This striking realignment of Pennsylvania's economic portfolio can be seen in the narrowing gap between Manufacturing and Real Estate, which stood at 7.7 percentage points in 1998, compared to only 1.8 percentage points by 2008.

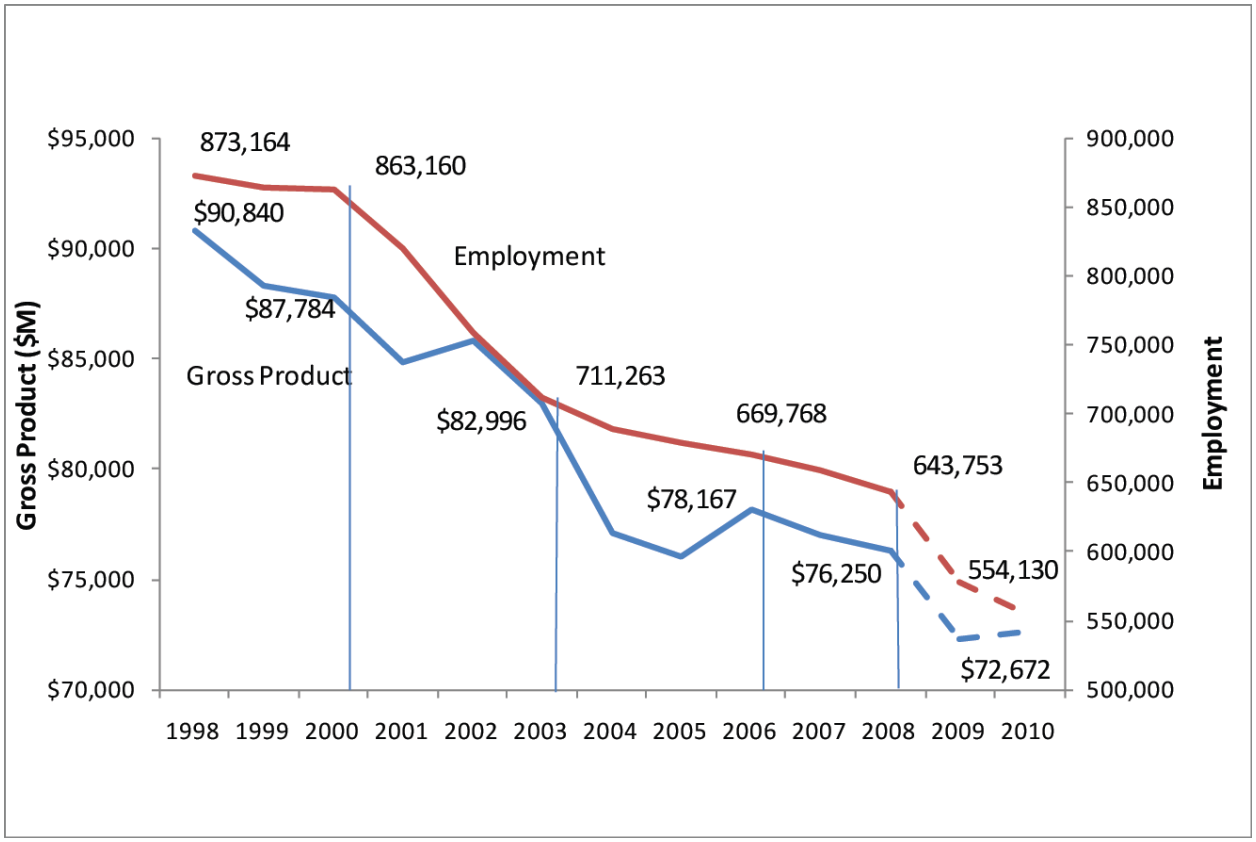
Percent of Gross State Product by Industry, 1998-2008

NAICS Industrial Sector	1998	2003	2006	2008
Manufacturing	**18.8%**	**15.9%**	**14.2%**	**13.6%**
Real Estate and Rental and Leasing	11.1%	11.5%	11.4%	11.8%
Health Care and Social Assistance	8.1%	9.1%	9.4%	9.7%
Public Administration	9.9%	9.8%	9.5%	9.4%
Professional, Scientific, and Technical Service	6.2%	6.8%	7.3%	7.8%
Finance and Insurance	7.2%	7.4%	7.7%	7.3%
Retail Trade	6.8%	6.8%	6.4%	6.0%
Wholesale Trade	5.5%	5.7%	6.0%	6.0%
Construction	4.0%	4.4%	4.7%	4.0%
Information	3.6%	3.7%	3.6%	3.6%
Transportation and Warehousing	3.3%	3.2%	3.3%	3.2%
Utilities	2.8%	2.7%	2.8%	2.9%
Management of Companies and Enterprises	1.6%	1.8%	2.3%	2.7%
Administrative and Support Services	2.5%	2.6%	2.6%	2.7%
Other Services (except Public Administration)	2.5%	2.5%	2.4%	2.4%
Accommodation and Food Services	2.2%	2.2%	2.2%	2.2%
Educational Services	1.7%	1.9%	1.9%	1.9%
Arts, Entertainment and Recreation	0.7%	0.8%	0.8%	0.8%
Mining	0.6%	0.6%	0.7%	0.8%
Agriculture, Forestry, Fishing and Hunting	0.6%	0.6%	0.5%	0.6%

Source: Moody's Economy.com

The decline in manufacturing's share of GSP is not surprising, given the pronounced job losses that slashed the industry's employment footprint by nearly 37 percent from 1998 to 2010. Gross manufacturing product shrank by 20 percent over the same timeframe. Unlike the continued erosion in employment numbers, a glimmer of good news could be seen in the slight uptick in gross manufacturing product in 2010, which is connected to the weak recovery in employment that began in the first quarter of the year.

Pennsylvania's Gross Manufacturing Product and Employment

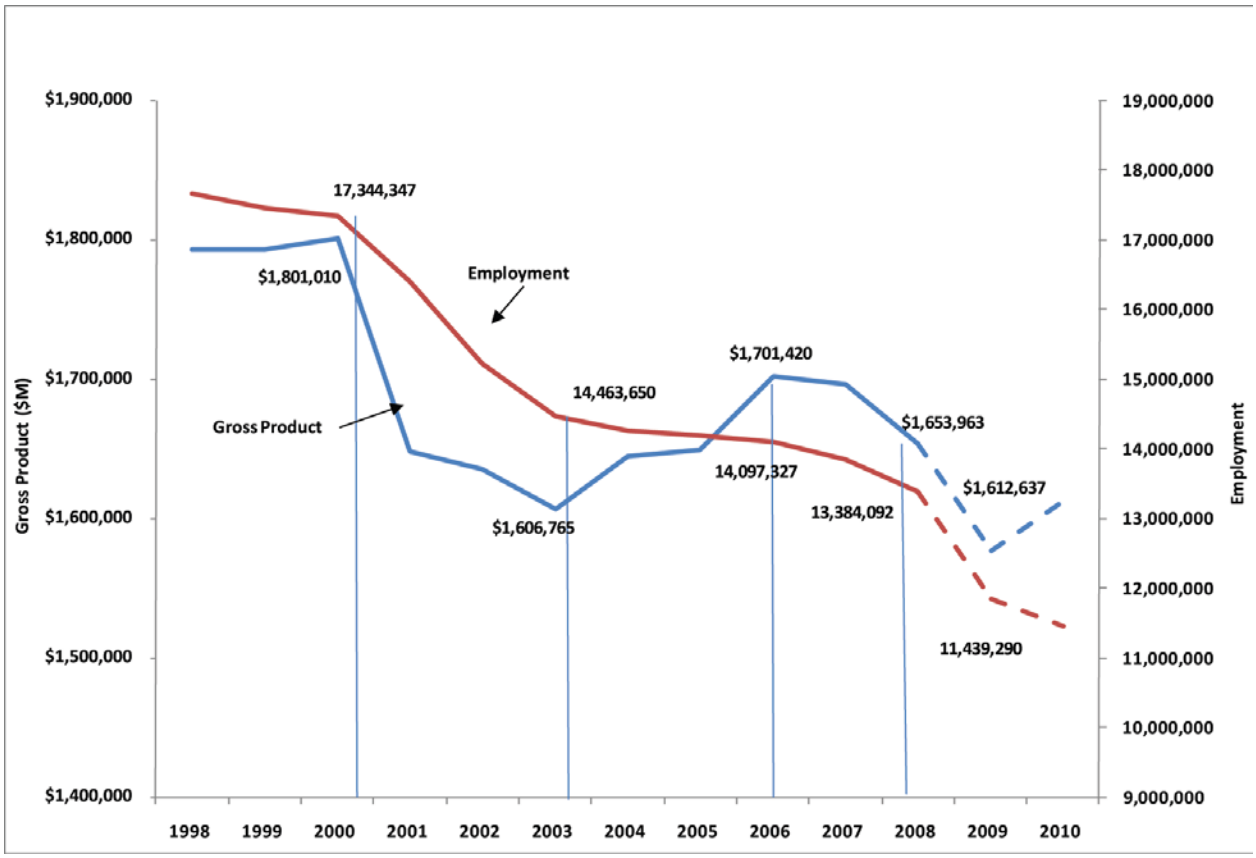


Source: Moody's Economy.com
Note: Vertical lines represent significant years for the analysis. National business cycle peaks: March 2001 and December 2007; trough: November 2001. Year 2008 is the last year of real data estimates.

Indeed, given the widespread hemorrhaging of both jobs and output in the industry over the past decade, the surprising news is that manufacturing has managed to stay on top as Pennsylvania's largest source of GSP. This illustrates the multiplied impact manufacturing has in the state's economy and points to the potential benefits of working to nurture the nascent rebound seen in gross manufacturing product. As the following figure shows, U.S. manufacturing GSP also propagated green shoots of recovery in 2010. Nationwide, gross manufacturing product fell by little more than 10 percent

from 1998 to 2010 – a painful contraction, yes, but half the magnitude of severity experienced in Pennsylvania. In terms of manufacturing employment, the distress was more equally shared, with the nation as a whole seeing a 34 percent decrease in jobs.

U.S. Gross Manufacturing Product and Employment



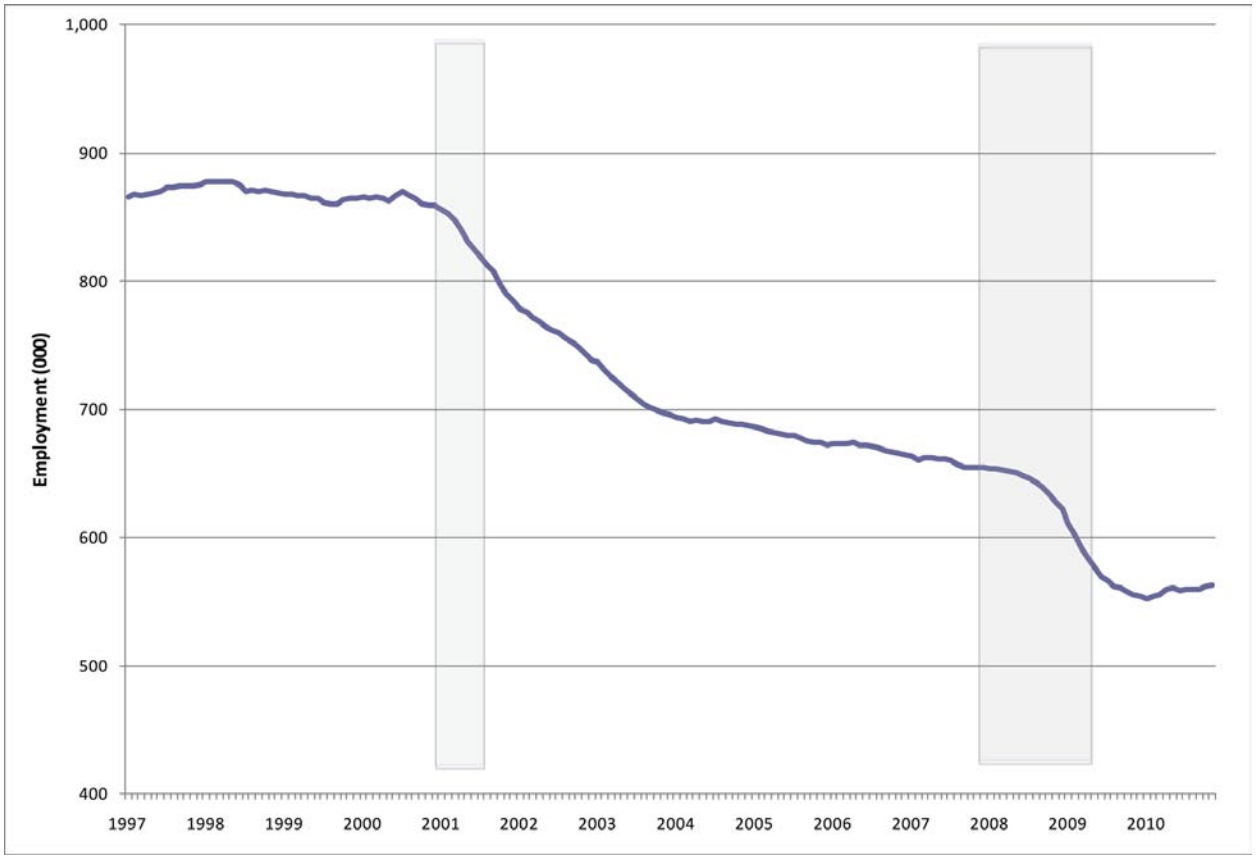
Note: Vertical lines represent significant years for the analysis. National business cycle peaks: March 2001 and December 2007; trough: November 2001. Year 2008 is the last year of real data estimates.
Source: Moody's Economy.com and NBER

The more precipitous decline in Pennsylvania's gross manufacturing product, compared to the nation as a whole, is a troubling sign and poses a threat to the Commonwealth's entire economic structure. As the following figure shows, Pennsylvania's economy is more dependent on manufacturing than is the U.S. economy overall. In 1998, manufacturing accounted for 15.5 percent of U.S. GDP, compared to 18.8 percent of Pennsylvania's GSP. By 2008, the manufacturing sector's share of U.S. GDP had fallen to 11.6 percent, compared to 13.6 percent of Pennsylvania's GSP. Beyond accounting for a smaller share of the U.S. economic pie, manufacturing nationwide experienced a smaller decline (3.9 percentage points) over the decade, compared to the 5.2 percentage point reduction in Pennsylvania.

Given the ubiquitous reporting on the loss of manufacturing jobs nationwide, it is important to note the continued – albeit shrinking – importance of manufacturing in Pennsylvania as an employer. **Despite losing nearly 230,000 jobs between 1998 and 2008, manufacturing still employs more**

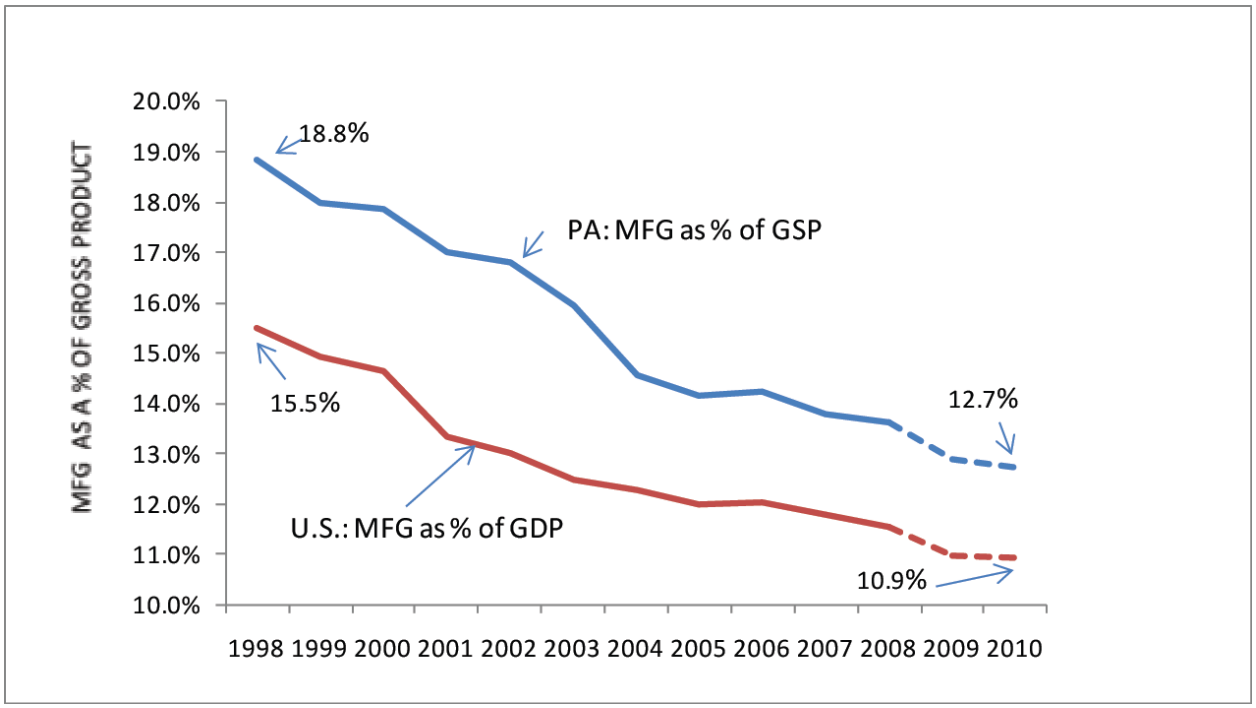
Pennsylvania workers than nearly all other industry sectors. Only three – Health Care and Social Assistance, Public Administration and Retail Trade – put more Pennsylvanians to work. Back in 1998, manufacturing was the Commonwealth's dominant industry, employing more than 870,000 workers. As the following table shows, manufacturing's broad employment reach dwarfed the second-largest industry by nearly 22 percent. By 2003, manufacturing had shed 160,000 jobs and had fallen to No. 3 in statewide employment. The job losses in manufacturing were relentless throughout the decade due to global competition, changing technology and product commoditization. The recent "Great Recession" and subsequent tepid recovery have accelerated this trend. According to Economy.com projections, manufacturing employment fell by nearly 14 percent – 89,623 jobs – between 2008 and 2010.The following figure shows a decade of steep declines in Pennsylvania's monthly manufacturing employment. As can be seen, the downhill slide began in earnest with the 2001 recession (shaded in gray), but, instead of seeing improvement after the recession ended, manufacturing job losses intensified in the early years of the decade. Manufacturing employment in the state continued to decline, but more gradually, throughout in the middle years before essentially "dropping off a cliff" during the Great Recession. But those losses have leveled off, and modest growth has reappeared in the industry.

Pennsylvania Manufacturing Employment, January 1997 to November 2010



These massive job losses – in Pennsylvania and throughout the nation – have led many political leaders and media pundits to write off job opportunities in manufacturing. Many reportedly in-the-know analysts and policy makers have declared U.S. manufacturing to be dead. Yet, manufacturers who have survived the difficult environment of the past decade by retooling and repositioning say they are poised for growth.

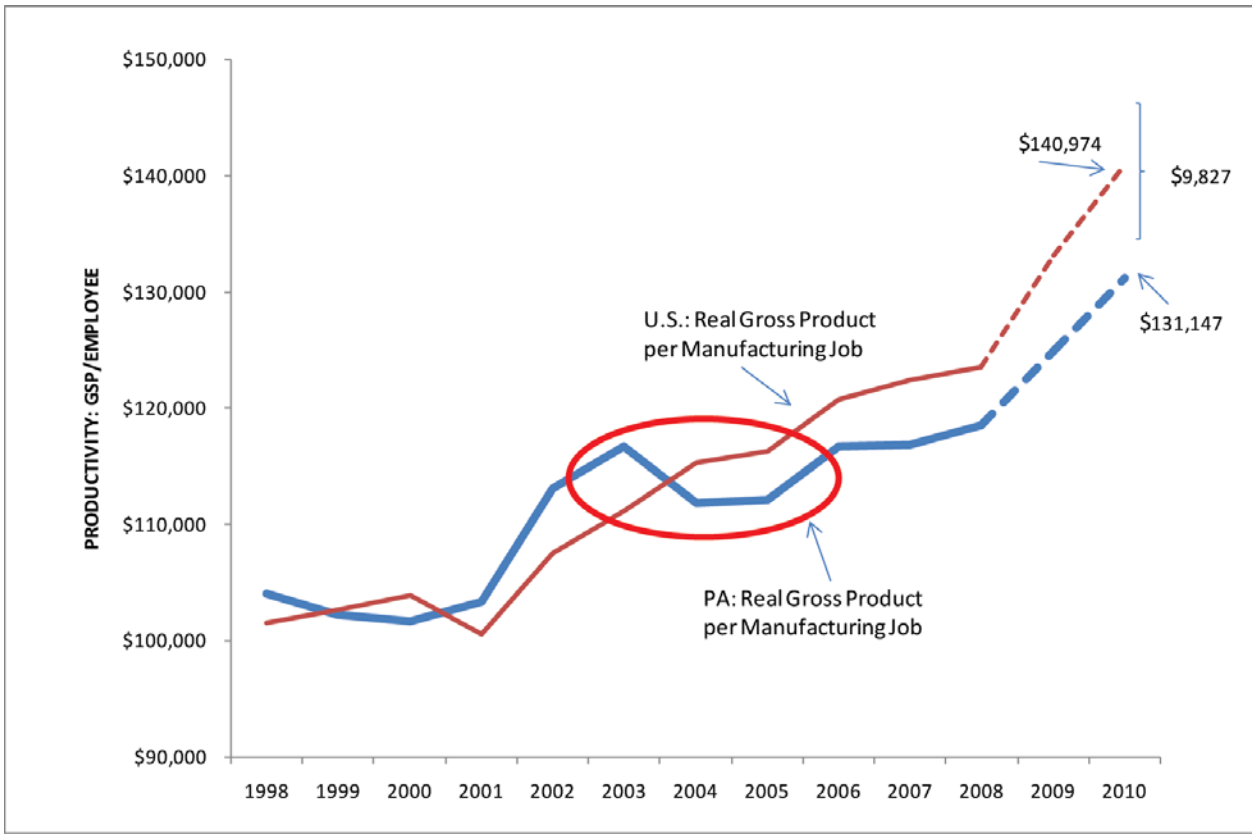
Manufacturing As a Percent of Total Gross Product, Pennsylvania vs. the U.S.



Source: Moody's Economy.com

Pennsylvania manufacturers, who once were national leaders in productivity, have fallen behind their counterparts in other areas of the country. Pennsylvania manufacturing productivity lagged the national average by $5,098 per job in 2008. The gap for 2010 was projected to nearly double to $9,827per job. Underperformance has been the case throughout much of the past decade. As the following figure shows, Pennsylvania's manufacturing productivity exceeded the U.S. average in 1998, slipped behind for the next few years, surged ahead between 2001 and 2003, before falling well short of the national mark and remaining there for the rest of the decade. The 2004 "Manufacturing Pennsylvania's Future" study had projected that the Commonwealth's manufacturing productivity would stay above the national average, but those projections were seemingly optimistic. Between 2007 and 2008, Pennsylvania's manufacturing productivity grew at a rate faster than the nation as a whole (1.34% vs. 0.89%, respectively), but the gain was not enough to return the Commonwealth merely to "average." Even more troubling, the projections that Moody's Economy.com has made through 2010 show Pennsylvania's manufacturing productivity growth falling even further off the national pace.

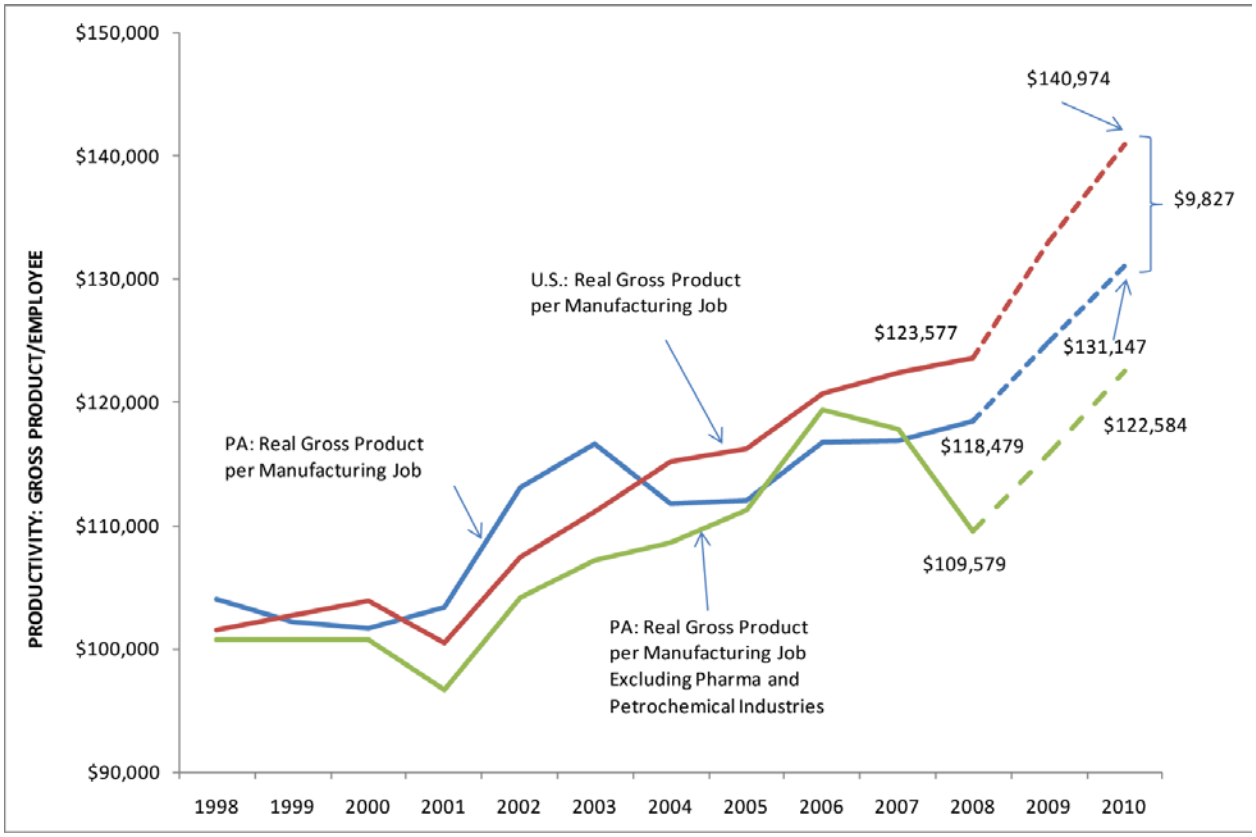
Growing Productivity Gap: Pennsylvania Manufacturing vs. U.S. Manufacturing



Source: Moody's Economy.com

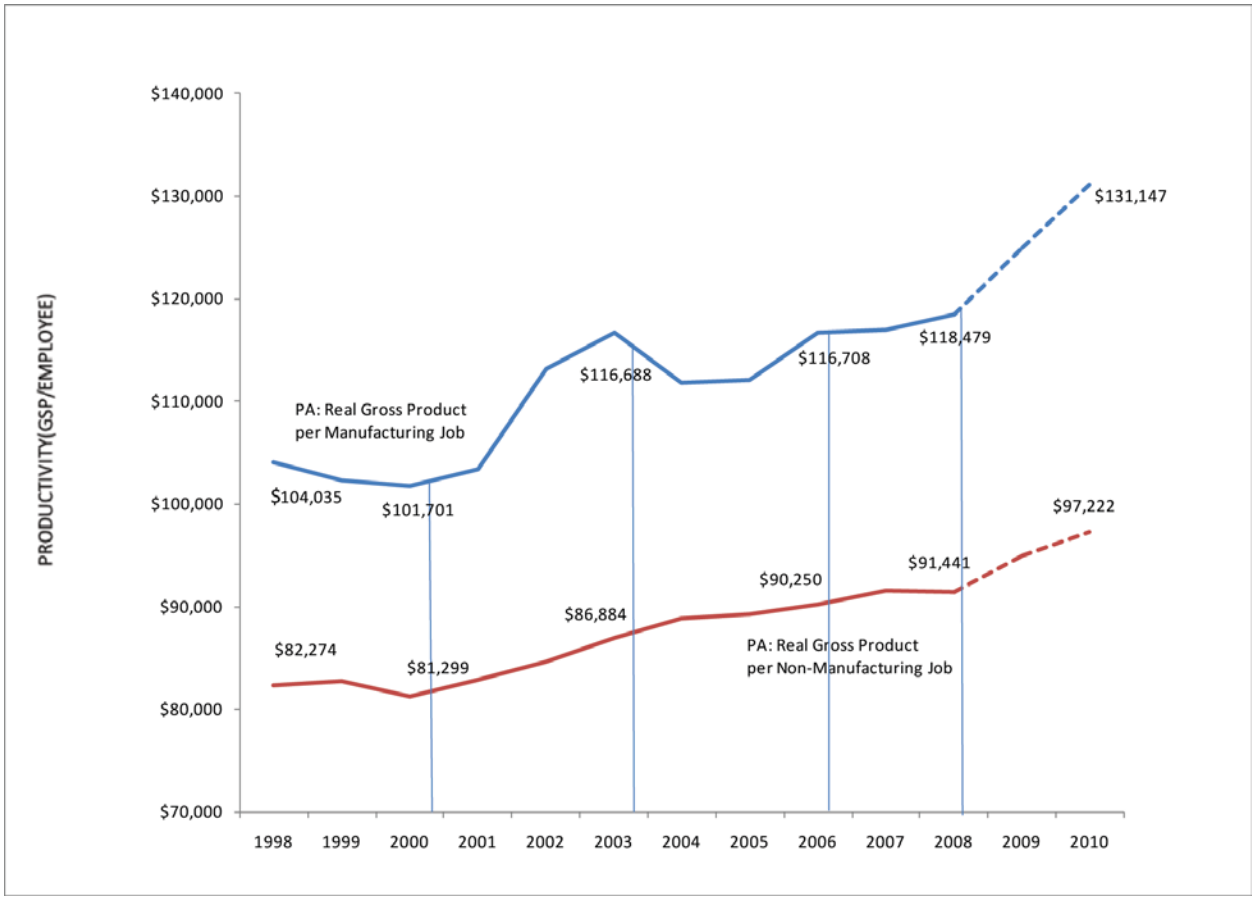
As will be discussed later, much of Pennsylvania's employment and GSP losses can be attributed to declines in two areas critical to the state's economy: pharmaceuticals and petrochemicals. The following figure shows that pharmaceuticals and petrochemicals are important contributors to Pennsylvania's manufacturing productivity. Between 2000 and 2003, these industries drove the state's productivity level above the national average. From 2003 to 2005, a change in the industries' fortunes was manifested in a dramatic decline in state manufacturing productivity. From 2005 to 2007, sluggish performance in the state's pharmaceuticals and petrochemicals industries served as a drag on Pennsylvania's overall manufacturing productivity.

The Impact of Pharmaceuticals and Petrochemicals on Pennsylvania's Productivity



Lagging manufacturing productivity points to a sluggish economic recovery in Pennsylvania, especially given the fact that manufacturing productivity in the Commonwealth far exceeds productivity in the non-manufacturing sector. As the following figure shows, gross product per employee in 2008 was more than $27,000 higher for Pennsylvania manufacturers than for non-manufacturers. That gap was projected to widen through 2010 to $33,925. Although this gap may be explained by improved capital and managerial practices among manufacturers, coupled with higher margins on products when compared to service production, it reinforces the need for strategies to support Pennsylvania's critical manufacturing sector, especially around new product development.

Pennsylvania Manufacturing vs. Non-manufacturing Productivity



Source: Moody's Economy.com

A Matter of Currency

The combined impacts of the 2001 and 2008 recessions on manufacturing in Pennsylvania, and the nation as a whole, are apparent in many of the figures and tables presented in this section (and in subsequent ones). So is the impact of an undervalued Chinese currency.[1] Some economic commentators blithely dismiss the Chinese currency problem as an indirect subsidy to American consumption and, therefore, a beneficial transfer of wealth of subsidized consumption from China to the United States. There is a problem with this logic in a continent-wide common market, which is what the U.S. economy is. Goods- producing, or manufacturing, states, such as Pennsylvania, do not have their own currencies. They cannot devalue their currency to lower their production costs. Instead, plants close and production moves to offshore competitors. Yes, U.S. consumers will enjoy a boost in their ability to consume, especially those in states and regions that produce services or are populated

[1] Bloom, N., Draca, M., & Van Reenen, J. (2011, January). "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT, and Productivity." National Bureau of Economic Research Working Paper 16717. Available: http://www.nber.org/papers/w16717.

with consumers or those in states and regions that experienced the bubble in housing prices and with it phantom wealth. But, in a global economy where one major producer manipulates its currency, there is a long-term cost. The manufacturing base becomes hollowed out over time.[2] When market forces eventually overcome the artificial relative value of China's currency, the manufacturing base will not be in place to respond, especially among the network of small and midsized manufacturers. And, contrary to expectations of those who look no further than at the smooth, quick operation of the theoretical economists' invisible hand, manufacturing capacity, supply chain, knowledge, and products will not be sitting patiently on a shelf somewhere to be rapidly redeployed.[3] The path to prosperity will be permanently altered and the manufacturing commons will have to be recreated.[4]

While many may agree with this macroeconomic lament of the impact of the hollowing out of America's manufacturing core, what does this have to do with public policy in Pennsylvania today? There are two implications. The first is immediate. Our research and conversations with Pennsylvania's manufacturers show a clear ability to compete against the punishing headwinds of currency manipulation when firms engage in enterprise transformation. Such transformation is built on the foundation of a strong objective strategic plan; is followed by cutting waste, improving quality, and freeing up resources by fully deploying lean manufacturing techniques throughout the enterprise (in the back office and on the shop floor); measures what is important and establishes a culture of continuous improvement; empowers the core workforce and frees senior management to work on their businesses; and engages in product development in a niche market, which is coupled with a sales and marketing strategy. This is a recipe that is easy to recite, challenging to implement, and hard to stick with unless it is a core part of the company's operations. We have witnessed that the best-of-the-best can structure their operations to contain costs that reside in the middle of their balance sheet, while allowing company leadership the time and resources to put in place strategies to grow the top line of the balance sheet. In successful manufacturing, you cannot just focus on cost containment or on growth; the imperative is to do both.

In our discussions with the best manufacturers in Pennsylvania, this recipe is most effective when the secret sauce is applied: full disclosure of operating financials and performance metrics to the corporate team, which is then reinforced with meaningful gain-sharing on a monthly or quarterly basis with employees. This systematic approach to enterprise transformation among Pennsylvania's small- and mid-sized manufacturing is not taught in any business school. This knowledge resides in affordable form in the state's Industrial Resource Center Network. The IRCs function as applied graduate business schools, engaged not only in enterprise transformation, but in a slow grinding battle to transform the state's manufacturing base. Transferring knowledge of how the largest and most important contributor to Pennsylvania's wealth and prosperity can transform itself is the IRC's mission. The IRC program has a

[2] Autor, D., Dorn D., & Hanson, G. (2011, February). "The China Syndrome: Local Labor Market Effects of Import Competition in the U.S." MIT Department of Economics Working Paper. Available at: http://econ-www.mit.edu/files/6477

[3] Petrin, A., White, T., & Reiter, J. (2011, January). "The Impact of Plant-level Resource Reallocation and Technical Progress on U.S. Macroeconomic Growth." National Bureau of Economic Research Working Paper 16700. Available at: http://www.nber.org/papers/w16700.

[4] Pisano, G., & Shih, W. (2009). "Restoring American Competitiveness." *Harvard Business Review*.

stewardship responsibility to not only to add to that knowledge base, but to disseminate that knowledge.

Over the longer term, the competitive position of America's manufacturers will improve when the value of U.S. currency drops, which is inevitable. The speed of the snap-back will be dictated by the speed at which widespread enterprise transformation takes place or the speed at which new firms fill gaps created by the death of old ones. Here again, the IRC program positioned to accelerate this positive and necessary transition.

How Competitive Is Pennsylvania?

As has been detailed earlier, 2003 ushered in a difficult period of decline and ongoing struggle to catch up. Between 2003 and 2006, Pennsylvania's manufacturing GSP fell by $4.8 billion. If Pennsylvania's manufacturing industry had merely grown as rapidly as the national average for manufacturing over that time period, the sector would have contributed an increase of $16.8 billion in GSP. Pennsylvania's particular mix of manufacturing industries experienced disproportionate losses from 2003 to 2006, declining by a total of $7.3 billion. Yet, Pennsylvania's misfortune of having a concentration of challenged industries in its economic portfolio does not fully explain the state's substantial losses in manufacturing productivity. As the following table shows, some industries within the state experienced losses well beyond the national average. In fact, this "local competitive effect" was a drag on the state's productivity of more than $14.1 billion in losses. Combined, industry mix and local competitive effect amounted to a $21.6 billion hole.

This section of the report uses an economic development statistical technique called shift-share analysis. This technique decomposes the change in Gross State Product or employment over a period of time into three components: the national effect, the industry mix effect and the local competitive effect. Think of each effect as the answer to a specific "what if" question. The national effect asks the question, "What would the change in GSP (or employment) have been if this industry in Pennsylvania grew at the same rate as the overall growth rate of the national economy?" The industry mix effect asks the question: "What would the change in GSP or employment be if a specific industry in Pennsylvania grew at the same growth rate as that industry did nationally − after subtracting out the national average growth rate? (Subtracting the national average rate prevents double counting.) After the changes accounted for by the national average rate of growth and industry mix are calculated, what is left over is assumed to be due to local competitive conditions. This is known as the local competitive effect.

Change in GSP and employment in Pennsylvania has been doubly burdened over the 10-year period studied. Overall slow growth was followed by a steep recession. In addition, the Commonwealth is dominated by slow-growing industries, both in the manufacturing and nonmanufacturing sectors. Measuring the Commonwealth's competitive position within these industries requires looking closely at the local competitive effect. Take pharmaceuticals as an example. In the early part of the last decade, the industry was a darling: It was connected to the growing health-care sector, was high-tech and formed a strong cluster in the eastern part of the state. What no one saw coming was the fact that the

industry consolidated; innovation slowed, moved out of corporate labs and was purchased from boutique startup biotech labs; and manufacturing moved outside of the United States. As a result, the local competitive effect for pharmaceuticals looks lousy, and the industry mix effect is negative.

Pennsylvania's manufacturing sector continued to post losses in GSP after 2006, but those losses were not nearly as pronounced. Between 2006 and 2008, Pennsylvania's manufacturing sector accounted for a $1.9 billion loss in GSP. If the state had merely matched the national average for manufacturing, instead of posting a nearly $2 billion loss, the sector would have added $6.4 billion. Nearly all of this decline can be attributed to Pennsylvania' misfortune of having an economic portfolio reliant on disproportionately challenged industries. Industry mix accounted for $8.1 billion in losses between 2006 and 2008. Local competitive effect, which had been such a substantial drain on the state's economy between 2003 and 2006, was still a net negative (-$0.26 billion), but it represented a near-reversal in competitive environment in a short amount of time. **Such a dramatic turnaround is worthy of note. It demonstrates rapid-response to a changing economic landscape. Pennsylvania manufacturers – either on their own or aided by programs such as the IRC – managed to improve their level of competitiveness in this increasingly globally competitive market.**

Comparing Pennsylvania's Competitive Environment

		2003-2006 ($000)				2006-2008 ($000)			
	2008 PA GDP ($000)	Total Change	National Growth	Industry Mix	Local Competitive Effect	Total Change	National Growth	Industry Mix	Local Competitive Effect
Manufacturing Industries (NAICS 31-33)	$76,249,638	-$4,828,406	$16,808,177	-$7,530,795	-$14,105,787	-$1,917,726	$6,417,513	-$8,078,796	-$256,443
Technology Intensive Industries	$101,002,240	$583,611	$18,856,236	-$3,661,645	-$14,610,980	$7,309,906	$7,692,107	-$1,357,439	$975,238
Driver Industries	$58,923,662	$6,667,571	$10,036,218	-$5,988,426	$2,619,778	$2,699,041	$4,616,021	-$3,168,346	$1,251,366
Driver Manufacturing Industries	$11,080,313	$906,210	$2,177,200	-$2,122,182	$851,192	-$576,520	$957,022	-$1,672,200	$138,659
Driver Non-manufacturing Industries	$47,843,349	$5,761,361	$7,859,019	-$3,866,244	$1,768,586	$3,275,561	$3,659,000	-$1,496,146	$1,112,707
Total	$558,822,639	$28,105,713	$105,499,422	-$52,929,173	-$24,464,536	$9,779,653	$45,076,233	-$37,320,139	$2,023,558

It should be pointed out that the manufacturing industries that power Pennsylvania's economy were not the state's only driver industries facing disproportionate threats. The state's mix of non-manufacturing driver industries saw losses of nearly $3.9 billion from 2003 to 2006 and $1.5 billion from 2006 to 2008. For all drivers, both manufacturing and non-manufacturing, industry mix totaled losses of $6 billion from 2003 to 2006 and nearly $3.2 billion from 2006 to 2008. Overall growth nationwide and positive local competitive effect combined to offset these driver industry mix losses for both time periods examined.

When these same industries are examined in terms of employment, similarities in the drains on manufacturing's GSP competitiveness can be seen. The following table reveals that employment in Pennsylvania's manufacturing industries shrank by more than 41,000 workers in 2003-2006. If the state had merely matched the national average for employment growth among manufacturers, it would have seen 31,000 more workers employed in the industry. However, Pennsylvania's industry mix slashed nearly 50,000 workers from employment rolls and its local competitive effect accounted for nearly 25,000 more losses. In 2006-2008, average national growth had slowed dramatically for manufacturing, but it still would have resulted in positive employment growth of about 5,000 jobs. Local competitive

effect showed marked improvement over the significant jobs losses it cost in 2003-2006. From 2006 to 2008, local competitive effect added more than 13,000 jobs. However, dramatic improvement in local competitive effect and anemic national growth could not offset the 44,273 losses due to Pennsylvania's manufacturing industry mix. Overall, Pennsylvania lost 26,199 jobs in 2006-2008.

Pennsylvania's Employment Change Due to Manufacturing Industry Mix and Local Performance

		2003-2006				2006-2008			
	2008 Employment	Total Change	National Growth	Industry Mix	Local Competitive Effect	Total Change	National Growth	Industry Mix	Local Competitive Effect
Manufacturing Industries (NAICS 31-33)	643,541	-41,505	31,145	-47,781	-24,869	-26,199	5,068	-44,273	13,006
Technology Intensive Industries	623,573	17,226	24,927	-7,532	-169	37,103	4,438	12,714	19,950
Driver Industries	725,316	62,357	27,393	4,669	30,294	37,392	5,206	21,933	10,253
Driver Manufacturing Industries	78,462	-2,434	3,376	-5,113	-697	3,797	565	-3,819	7,051
Driver Non-manufacturing Industries	646,854	64,791	24,017	9,782	30,992	33,595	4,641	25,752	3,202
Total	5,920,905	135,430	251,862	-1,854	-114,578	33,785	44,552	13,439	-24,206

Pennsylvania manufacturers – either on their own or aided by support programs – learned from the crisis of 2003-2006. Local competitive effect went from costing the Commonwealth nearly 25,000 jobs in 2003-2006 to adding more than 13,000 jobs in 2006-2008. Among technology-intensive industries, Pennsylvania's amended competitive environment was fertile ground to grow nearly 20,000 jobs in 2006-2008, compared to the 169 that were lost in 2003-2006.

Overall, technology-intensive industries grew by 17,226 jobs from 2003 to 2006. If Pennsylvania's high-tech industries had matched the national average for the sector, it would have added $18.9 billion in GDP. However, challenges to the specific mix of these industries in Pennsylvania cost $3.7 billion in GDP. But threats to industry mix were overshadowed by the particularly poor performance of Pennsylvania establishments. Local competitive effect led to a loss of $14.6 billion in 2003-2006. Yet, Pennsylvania's high-tech industries experienced a reversal of fortune in 2006-2008, adding 37,000 total jobs and contributing $7.3 billion in GDP. National growth accounted for 4,440 of those jobs and much of the gain in GDP. However, local competitive effect went from being a nearly $14.6 billion drain to contributing nearly $1 billion in GDP.

Pennsylvania's identified driver industries added 62,400 jobs in 2003-2006. This was driven by overall national growth and local competitive effect. However, only Pennsylvania's non-manufacturing drivers saw job growth. Pennsylvania's non-manufacturing drivers added nearly $5.8 billion, compared to about $900 million contributed by manufacturing driver industries. In 2006-2008, the state's non-manufacturing drivers added more than 10 times the number of jobs as did manufacturing drivers, with employment levels among manufacturing drivers bolstered greatly by local performance but pulled down by industry mix.

Pennsylvania's Biggest Losers

Drilling down into Pennsylvania's 2003-2006 losses reveals that two areas accounted for much of the negative growth in manufacturing – pharmaceuticals and petrochemicals. The following is a list of industries, at the four-digit NAICS level, that experienced the greatest loss in GSP. In the lists below, the

loss in GSP from a specific industry is listed first, followed by the loss due to the local competitive effect noted within the parentheses:

- 3254 Pharmaceutical and Medicine Manufacturing: -$3.8 billion (-$6.2 billion)
- 3251 Petrochemical Manufacturing: -$2.4 billion (-$3.6 billion)
- 3252 Resin and Synthetic Rubber Manufacturing: -$948 million (-$1.3 billion)
- 3241 Petroleum and Coal Products Manufacturing: -$868 million (-$2.9 billion)
- 3259 Other Chemical Product and Preparation Manufacturing: -$519 million (-$735 million)

None of Pennsylvania's non-manufacturing industries experienced anything like the magnitude of contraction that occurred among the two manufacturing loss leaders. Only one – Scheduled Air Transportation – topped the billion-dollar mark. (This was due to consolidation among the route carriers and the decline of hub activities in Pittsburgh.) The non-manufacturing industries with the largest GSP losses (and their local performance) were:

- 4811 Scheduled Air Transportation: -$1.1 billion (-$749 million)
- 4242 Drugs and Druggists' Sundries Merchant Wholesalers: -$509 million (-$517 million)
- 4451 Supermarkets and Other Grocery (except Convenience) Stores : -$405 million (-$430 million)
- 4411 New Car Dealers: -$340 million (-$381 million)

In terms of manufacturing employment in 2003-2006, Pennsylvania's pharmaceutical and petrochemical industries experienced some of the largest losses, but the textile sector also witnessed sharp cuts. Pennsylvania's manufacturing industries that lost the most employment (and their local performance) sorted by total change are:

- 3261 Plastics Packaging Materials and Unlaminated Film and Sheet Manufacturing : -7,858 (-5,132)
- 3132 Broadwoven Fabric Mills: -7,354 (-4,363)
- 3254 Pharmaceutical and Medicine Manufacturing: -4,637 (-5,077)
- 3133 Textile and Fabric Finishing Mills : -3,007 (-2,145)
- 3152 Cut and Sew Apparel Contractors: -2,761 (-727)
- 3251 Petrochemical Manufacturing: -2,687 (-1,927)

Of the six industries, only Pharmaceutical and Medicine Manufacturing saw losses due to poor local performance that exceeded the losses due to national trend and industry mix.

Unlike the significantly deeper GSP losses for Pennsylvania's manufacturing industries, the loss leaders among both manufacturing and nonmanufacturing sectors cut similar numbers of jobs in 2003-

2006. In fact, the five worst-performing non-manufacturing industries in the state cut more jobs than did the five worst-performing manufacturing industries, 28,261 to 25,617, respectively. However, Plastics Packaging Materials and Unlaminated Film and Sheet Manufacturing slashed the largest number of jobs (7,858) among all industries in the state. The five non-manufacturing industries in Pennsylvania that lost the most employment in 2003-2006 (and their losses due to local performance) were:

- 4451 Supermarkets and Other Grocery (except Convenience) Stores: -6,446 (-5,887)
- 5182 Data Processing, Hosting, and Related Services: -6,349 (-5,050)
- 4521 Department Stores PHA Private Household Workers: -5,652 (-6,139)
- 2211 Electric Power Generation, Transmission and Distribution: -5,092 (-4,151)
- 5241 Direct Life, Health, and Medical Insurance Carriers: -4,722 (-2,531)

Of these five industries, only Department Stores PHA Private Household Workers saw losses due to poor local performance exceed the losses due to national trend and industry mix.

Pennsylvania's Biggest Winners

Five of Pennsylvania's six top-performing manufacturers in terms of GSP growth from 2003 to 2006 were involved in metals production. These are industries that have long represented some of Pennsylvania's strongest competencies. Iron and Steel Mills and Ferroalloy Manufacturing experienced growth in GSP of $1.8 billion, nearly half of which could be attributed to local competitive effect. The following is a list of manufacturing industries, at the four-digit NAICS level, that experienced the greatest growth in GSP from 2003 to 2006. Total change in GSP for each industry is listed first, followed by the gain due to the local competitive effect noted within the parentheses:

- 3311 Iron and Steel Mills and Ferroalloy Manufacturing: $1.8 billion ($873 million)
- 3315 Ferrous Metal Foundries: $935 million ($447 million)
- 3312 Iron and Steel Pipe and Tube Manufacturing from Purchased Steel : $897 million ($402 million)
- 3314 Nonferrous Metal (except Aluminum) Smelting and Refining: $677 million ($252 million)
- 3313 Alumina and Aluminum Production and Processing: $481 million ($266 million)
- 3364 Aerospace Product and Parts Manufacturing: $441 million ($331 million)

Among Pennsylvania's top-performing manufacturers, only Iron and Steel Mills Manufacturing had growth in GSP that put it among the state's biggest winners overall. However, it should be noted that Management of Companies and Enterprises, which saw growth in GSP of $3.1 billion from 2003 to 2006, is an industry with strong ties to manufacturing in Pennsylvania. Below, the state's top-performing non-manufacturing companies are listed in order of GSP growth. Where local competitive effect was a key component of growth, its contribution is included in parentheses:

- 5511 Management of Companies and Enterprises: $3.1 billion ($1.6 billion)
- 4251 Business to Business Electronic Markets: $2.8 billion
- 5312 Offices of Real Estate Agents and Brokers: $2.2 billion
- 5417 Research and Development in the Physical, Engineering, and Life Sciences: $1.6 billion ($928 million)
- 5241 Direct Life, Health, and Medical Insurance Carriers: $1.4 billion
- 5415 Computer Systems Design and Related Services: $1.3 billion
- 6211 Offices of Physicians: $1.2 billion
- 5242 Insurance Agencies and Brokerages: $1.2 billion
- 6221 General Medical and Surgical Hospitals: $1.1 billion

In terms of employment, growth among Pennsylvania's manufacturers was far eclipsed by growth among its non-manufacturing industries. The state's best-performing manufacturers from 2003-2006 in terms of employment growth were:

- 3327 Machine Shops: 1,620
- 3331 Agricultural Implement Manufacturing: 1,478
- 3364 Aerospace Product and Parts Manufacturing: 1,287
- 3359 Battery Manufacturing – total change: 925 (1,185)

It should be noted that only Battery Manufacturing saw significant positive growth in employment due to local competitive effect. However, it also should be pointed out that two of the state's biggest employment gainers were in industries related to manufacturing – Management of Companies and Enterprises and General Warehousing and Storage. Local performance was a key contributor to growth for both of these companies.

As with GSP, Management of Companies and Enterprises topped the list of Pennsylvania industries seeing the greatest employment growth from 2003 to 2006. Four of the top performers were related to health care or social service provision. The 10 non-manufacturing industries in Pennsylvania that added the most jobs from 2003 to 2006 are listed below. Where local performance was a significant contributor to growth, those numbers are included in parentheses.

- 5511 Management of Companies and Enterprises: 24,912 (20,220)
- 6241 Child and Youth Service - total change: 20,771 (12,344)
- 4931 General Warehousing and Storage: 15,034 (9,237)
- 2371 Utility System Construction: 4,618 (3,042)
- 5239 Miscellaneous Intermediation: 4,571 (2,412)
- 5613 Employment Placement Agencies: 13,618
- 6221 General Medical and Surgical Hospitals: 9,796
- 6211 Offices of Physicians: 9,204
- 5415 Computer Systems Design and Related Services: 7,975
- 6233 Community Care Facilities for the Elderly: 6,789

Three of the state's five biggest manufacturing winners in terms of GSP growth from 2006 to 2008 owed much of their gains to local competitive effect. As was seen in 2003-2006, many of these top-performing manufacturers were involved in metals work. In the list below, total change in GSP for the biggest gainers among manufacturing companies is noted first, followed, where appropriate, by the significance of local performance in parentheses:

- 3311 Iron and Steel Mills and Ferroalloy Manufacturing: $391 million
- 3364 Aerospace Product and Parts Manufacturing: $302 million ($169 million)
- 3327 Machine Shops: $216 million
- 3323 Architectural and Structural Metals Manufacturing: $193 million ($109 million)
- 3314 Nonferrous Metal (except Aluminum) Smelting and Refining: $76 million ($215 million)

Management of Companies and Enterprises maintained its spot at the top of the list of Pennsylvania's best performers in terms of GSP growth from 2006 to 2008. Computer Systems Design and Related Services and Offices of Physicians joined it on the list of top performers for both timeframes. Real estate industries posted the state's biggest gains. As can been seen in the list below, only three of the top-performing industries owed significant portions of its growth to local competitive effect (noted in parentheses):

- 5511 Management of Companies and Enterprises: $2.7 bill ($1.7 billion)
- 5313 Real Estate Property Managers: $2.7 billion
- 5311 Lessors of Residential Buildings and Dwellings: $2.6 billion
- 6211 Offices of Physicians: $1.1 billion
- 5415 Computer Systems Design and Related Service: $1 billion
- 2211 Electric Power Generation, Transmission and Distribution: $806 million
- 5613 Employment Placement Agencies: $337 million ($474 million)
- 5321 Passenger Car Rental and Leasing: $294 million ($286 million)

In terms of employment, Pennsylvania's manufacturing industries saw bigger and broader gains from 2006 to 2008, compared to the earlier timeframe. This turnaround was due almost entirely to local performance. Although metal industries again led the way, a broad mix of industries was represented among the top performers. Pennsylvania's manufacturing industries experiencing the greatest job gains from 2006 to 2008 are listed below, with the contribution of local performance noted in parentheses:

- 3323 Architectural and Structural Metals Manufacturing: 4,875 (5,005)
- 3327 Machine Shops: 4,259 (3,657)
- 3335 Metalworking Machinery Manufacturing: 3,217 (3,451)
- 3339 Pump and Compressor Manufacturing: 2,518 (2,305)
- 3353 Electrical Equipment Manufacturing: 2,355 (2,219)
- 3391 Medical Equipment and Supplies Manufacturing: 2,306 (2,159)

- 3345 Navigational, Measuring, Electromedical, and Control Instruments Manufacturing: 1,894 (2,024)
- 3272 Glass and Glass Product Manufacturing: 1,818 (2,092)
- 3222 Paperboard Container Manufacturing: 1,424 (2,224)
- 3273 Cement Manufacturing: 1,166 (2,007)

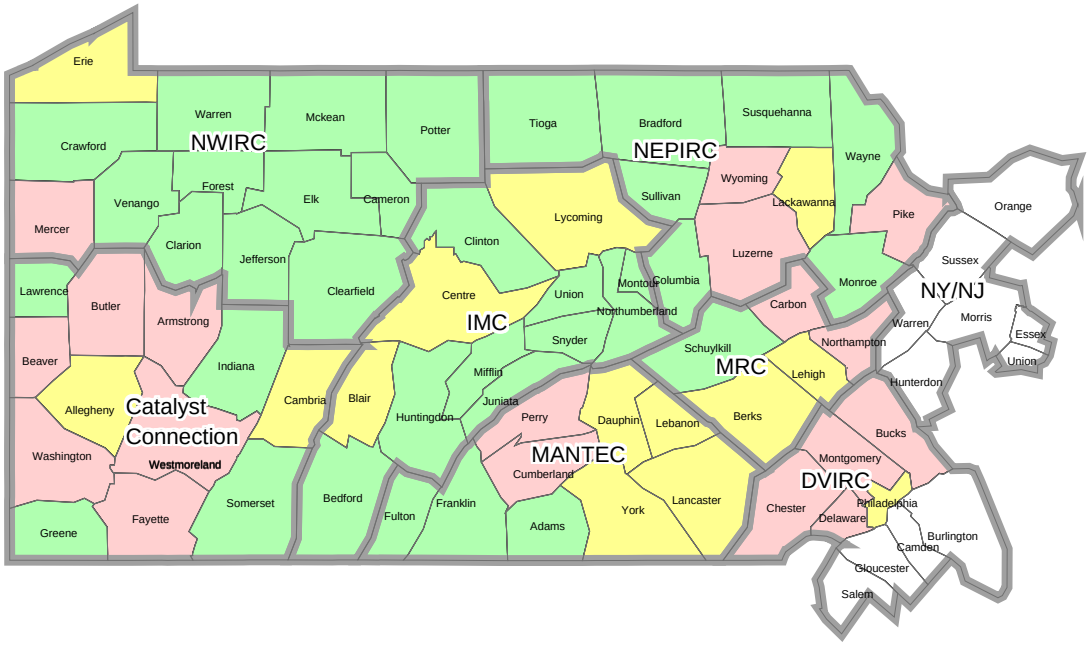
Local competitive effect drove employment gains for only two industries making the list of Pennsylvania's biggest non-manufacturing winners for 2006-2008. These were Management of Companies and General Warehousing and Storage, both industries related to manufacturing. The remaining four owed much of their gains to industry mix, as is noted below:

- 5511 Management of Companies and Enterprises: 14,466 (local component , 9,456)
- 4931 General Warehousing and Storage: 4,588 (local component, 2,454)
- 6244 Child Day Care Services: 10,088 (industry mix, 7,618)
- 6211 Offices of Physicians: 6,069 (industry mix, 4,208)
- 6221 General Medical and Surgical Hospitals: 6,040 (industry mix, 9,305)
- 6113 Colleges, Universities, and Professional Schools: 4,985 (industry mix, 4,773)

The Geography of Pennsylvania's Manufacturing

Overall, manufacturing contributed 13.6 percent to Pennsylvania's GSP and accounted for 10.9 percent of the state's total employment in 2008. In Pennsylvania's central counties—those counties where one of the state's central cities is located, where greater population and business densities exist—manufacturing contributed 11.4 percent of GSP and employed 9.6 percent of workers. In Pennsylvania's suburban counties—counties that are part of the metropolitan statistical area and abut a central county—manufacturing accounted for 14.3 percent of GSP and employed 10.6 percent of workers. **Manufacturing had the largest impact on the state's more rural counties, where it accounted for 22.6 percent of GSP and 16.4 percent of employment.** The following map details each county's designation for this analysis and indicates the specific mix of counties served by each IRC.

Mix of County Type Served by IRCs



As the map indicates, some IRCs serve nearly all one county type. Others have a mix of all three within their service boundaries. However, as will be demonstrated, the county types experience very different manufacturing realities. The following table shows how manufacturing's $76 billion contribution to the state's overall GSP and its 643,573 jobs were divided by county type. As can be seen, **although the actual dollar amount manufacturing contributed toward GSP and manufacturing's employment totals were far greater in the 14 central counties and the 18 suburban counties, manufacturing accounted for a much greater share of GSP and employment in the rural areas of Pennsylvania.**

Manufacturing's 2008 Impact by County Type

County Type	No. of Counties	GDP			Employment		
		Total ($000)	Manufacturing ($000)	Share of Manufacturing in Total, %	Total	Manufacturing	Share of Manufacturing in Total, %
ALL	67	$558,822,639	$76,249,638	13.6%	5,920,993	643,573	10.9%
Central County	14	$276,129,432	$31,501,627	11.4%	2,933,680	280,911	9.6%
Suburbs	18	$229,755,387	$32,768,897	14.3%	2,212,900	235,635	10.6%
Rural	35	$52,937,820	$11,979,114	22.6%	774,413	127,027	16.4%

Source: U.S. Census Bureau, County Business Patterns

Given manufacturing's disproportionate impact in the rural areas, it is not surprising that those counties suffered from the sharp contraction in the industry. However, the state's urban areas also suffered substantial losses. From 2006 to 2008, the Commonwealth's central counties experienced a 3.1 percent loss in manufacturing GSP and a nearly 4.5 percent loss in employment. Its rural counties experienced a slightly smaller percentage loss in GSP (2.8%) but a greater percentage loss in employment (5.5%). Of the state's total losses in manufacturing GSP from 2006 to 2008, central counties accounted for 41 percent. Those same counties also bore the brunt of 44 percent of total job losses in Pennsylvania's manufacturing sector. All three county types saw employment levels shrink more than GSP.

Manufacturing's GSP and Employment Losses by County Type, 2006-2008

County Type	No. of Counties	Manufacturing GSP ($000)			Manufacturing Employment		
		2006	2008	% Change	2006	2008	% Change
ALL	67	$78,167,364	$76,249,638	-2.45%	669,768	643,573	-3.91%
Central County	14	$32,509,298	$31,501,627	-3.10%	294,068	280,911	-4.47%
Suburbs	18	$33,338,905	$32,768,897	-1.71%	241,242	235,635	-2.32%
Rural	35	$12,319,162	$11,979,114	-2.76%	134,458	127,027	-5.53%

Source: U.S. Census Bureau, County Business Patterns

Despite the significant downturn in manufacturing, Pennsylvania managed to grow its total GSP from 2006 to 2008 by 1.8 percent. Change in overall employment levels was also positive, but at a stagnant 0.6 percent. The state's urban core saw the greatest improvement in overall GSP (2.2%), but employment grew at a sluggish pace of 0.5 percent. GSP grew at a rate 4.5 times as fast as employment did in the central counties. As lackluster as these numbers may seem, central counties accounted for 49 percent of the state's GSP in 2006; suburban counties contributed 37 percent and rural areas only 13 percent. Although employment growth was lackluster across the state, only the rural areas saw actual job losses from 2006 to 2008, as can be seen in the following table.

Pennsylvania's Overall GSP and Employment Change by County Type, 2006-2008

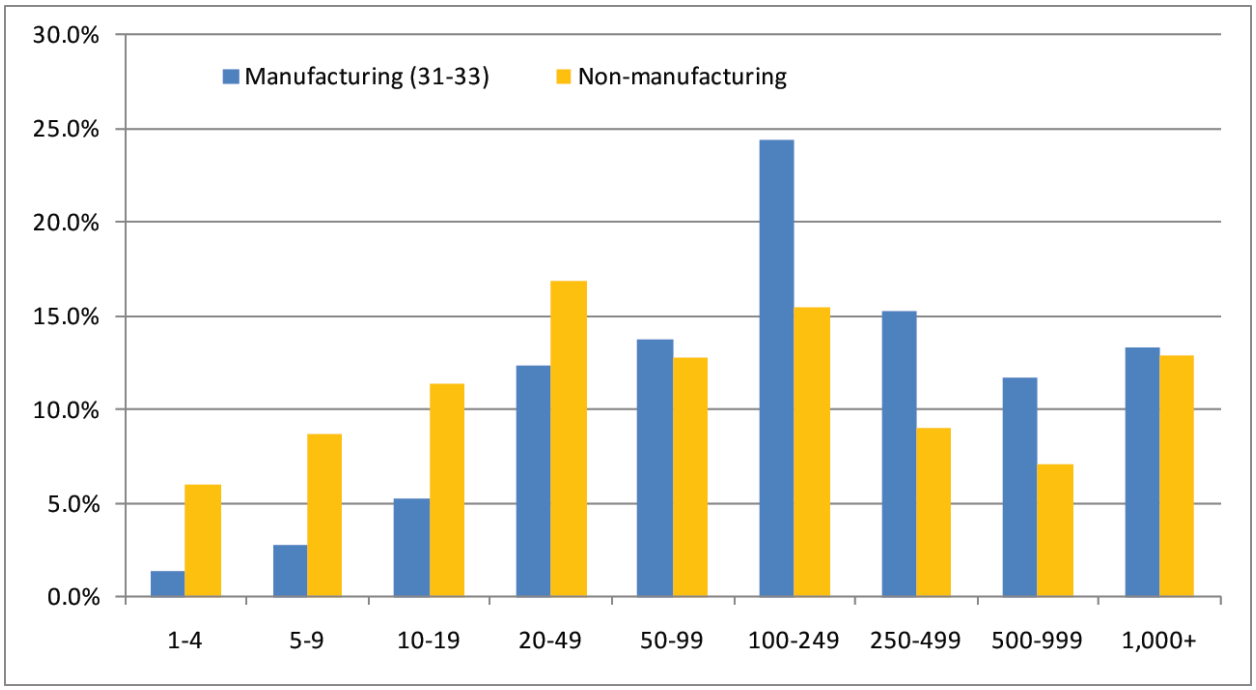
County Type	No. of Counties	Total GSP ($000)			Total Employment		
		2006	2008	% Change	2006	2008	% Change
ALL	67	$549,042,986	$558,822,639	1.78%	5,887,217	5,920,993	0.57%
Central County	14	$270,221,153	$276,129,432	2.19%	2,919,785	2,933,680	0.48%
Suburbs	18	$226,615,929	$229,755,387	1.39%	2,191,311	2,212,900	0.99%
Rural	35	$52,205,904	$52,937,820	1.40%	776,121	774,413	-0.22%

Source: U.S. Census Bureau, County Business Patterns

Pennsylvania's Employment by Establishment Size

Pennsylvania's manufacturing employment, which accounted for roughly 1 of every 7 jobs in the state in 2006, was concentrated in midsized establishments, with the most common sizes being 100 to 249 employees and 250 to 499 employees. Those two establishment sizes captured 39.5 percent of all manufacturing employment. By comparison, those two sizes capture only 24.4 percent of non-manufacturing employment. Of the nearly 664,000 Pennsylvania workers engaged in manufacturing in 2006, 262,000 worked in plants with 100-499 employees, and another 166,000 were in establishments with 500 or more employees.

Pennsylvania's 2006 Employment Distribution by Establishment Size



Between 2006 and 2008, Pennsylvania's largest manufacturing establishments – those with more than 1,000 employees – shed more than 16 percent of their jobs, idling 14,251 workers. As can be seen in the following table, manufacturers that employed 500 to 999 workers cut 6.9 percent of their workforce, and plants employing 100 to 249 workers contracted by 4.9 percent. Outsourcing likely explains the steep losses among the state's larger manufacturers. **Manufacturers employing 250-499 workers, which was the only establishment size to experience significant growth between 2006 and 2008, may represent the optimal size for a globally competitive yet flexible manufacturing establishment that can withstand cyclical and structural change.** Such plants would be small enough to be flexible and nimble and be at such a scale to be well-managed without excessive overhead employment, but large enough to endure, innovate and compete in a global market.

Employment Change by Establishment Size, 2006-2008

Establishment Size	Manufacturing (31-33)			Non-manufacturing		
	Employment 2006	2006-2008 Empl. Change	% 2006-2008 Empl. Change	Employment 2006	2006-2008 Empl. Change	% 2006-2008 Empl. Change
Total	**663,812**	**-25,131**	**-3.8%**	**4,526,137**	**66,208**	**1.5%**
1-4	9,320	42	0.5%	269,414	3,662	1.4%
5-9	18,099	-226	-1.2%	391,050	3,026	0.8%
10-19	35,063	-381	-1.1%	514,317	-2,441	-0.5%
20-49	81,888	120	0.1%	764,617	-48	0.0%
50-99	90,869	19	0.0%	580,086	12,855	2.2%
100-249	161,544	-7,967	-4.9%	698,151	25,146	3.6%
250-499	100,848	2,875	2.9%	405,457	4,072	1.0%
500-999	77,600	-5,362	-6.9%	320,352	14,735	4.6%
1,000+	88,581	-14,251	-16.1%	582,693	5,201	0.9%

Distribution of manufacturing employment differs significantly from employment in the non-manufacturing sector. Nearly 65 percent of all manufacturing workers are in establishments with 100 or more employees. That compares to roughly 45 percent of non-manufacturing workers. Notably, less than 22 percent of manufacturing employment is in "small" establishments, frequently defined as those with fewer than 50 employees. That compares to 43 percent of non-manufacturing employment. This would suggest that manufacturers tend to be disproportionately affected by federal and state policy changes, whether related to health care, family leave or other workplace issues, that create government mandates but exempt small businesses from compliance.

Employment Distribution & Losses by Establishment Size

Establishment Size	Manufacturing (31-33)			Non-manufacturing		
	2008 Employment Distribution	Distribution of 2006-2008 Employment Losses	Ratio of Employment Losses to Employment Distribution	2008 Employment Distribution	Distribution of 2006-2008 Employment Losses	Ratio of Employment Losses to Employment Distribution
Total	100.0%	100.0%	1.0	100.0%	100.0%	1.0
1-4	1.4%	-0.2%	-0.1	6.0%	5.5%	0.9
5-9	2.7%	0.9%	0.3	8.6%	4.6%	0.5
10-19	5.3%	1.5%	0.3	11.4%	-3.7%	-0.3
20-49	12.3%	-0.5%	0.0	16.9%	-0.1%	0.0
50-99	13.7%	-0.1%	0.0	12.8%	19.4%	1.5
100-249	24.3%	31.7%	1.3	15.4%	38.0%	2.5
250-499	15.2%	-11.4%	-0.8	9.0%	6.2%	0.7
500-999	11.7%	21.3%	1.8	7.1%	22.3%	3.1
1,000+	13.3%	56.7%	4.2	12.9%	7.9%	0.6

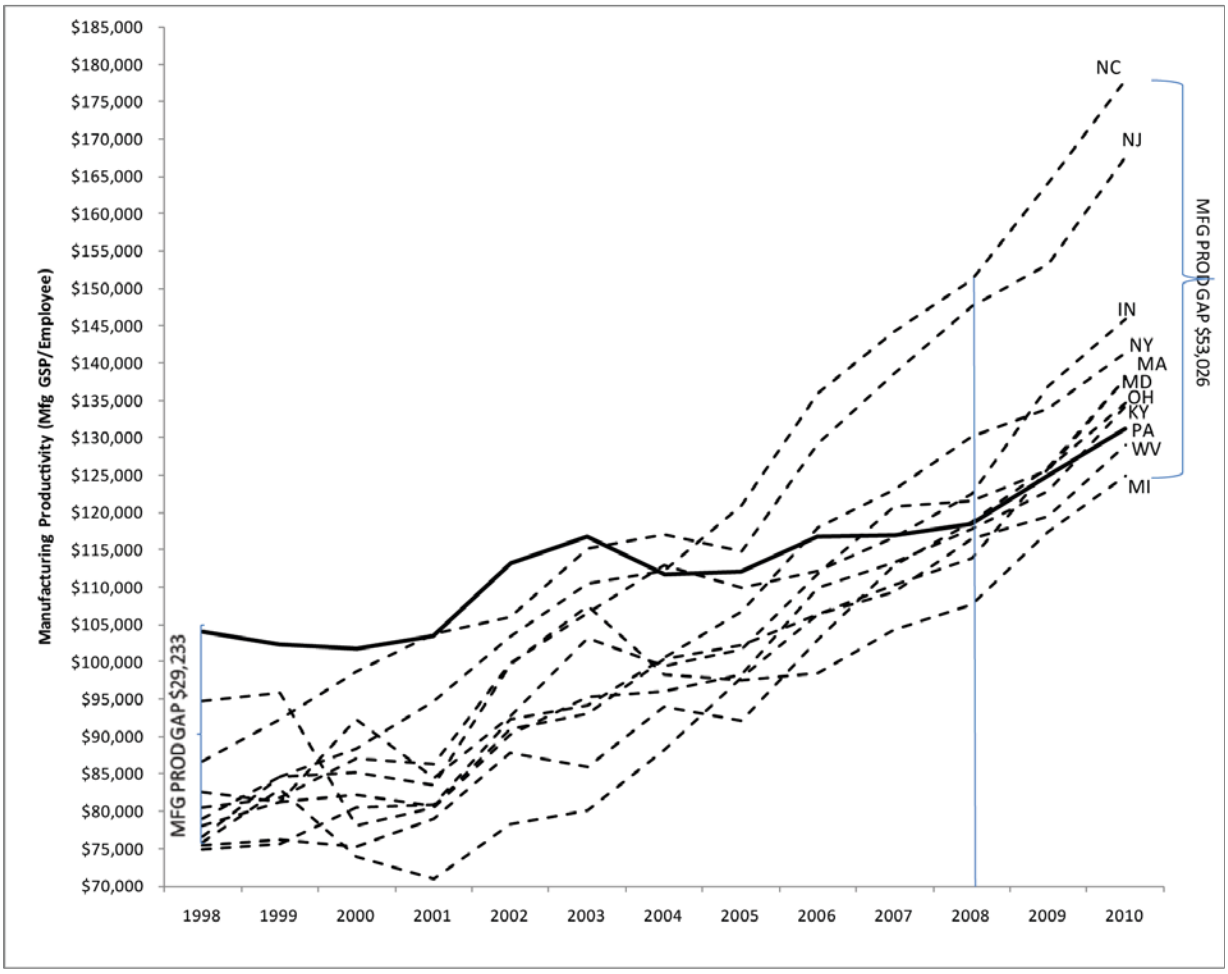
Examining Pennsylvania's Regional Competitiveness

A closer look at productivity among states that border with, or compete with, Pennsylvania reveals that Pennsylvania's manufacturers have not only fallen below the national average; they have fallen behind their competitors in neighboring states, as well. Back in 1998, Pennsylvania's manufacturing productivity was tops in the region. Its GSP per employee was roughly $10,000 higher than its closest competitor, Kentucky, and was nearly $30,000 higher than the poorest regional performer, New York. By 2008, Pennsylvania's manufacturing productivity had stagnated while several regional competitors had far outpaced it. Although Pennsylvania's manufacturing productivity showed growth from 2008 to 2010, it was not enough to keep the commonwealth ahead of all but two of its regional competitors – West Virginia and Michigan. What happened?

For all three states with the lowest productivity, the value of the goods produced as measured by Gross State Product from the manufacturing sector dropped. In Michigan's case the cause is clear – the decline of the Detroit three auto assemblers and their supply chain. In West Virginia's case, the challenge lies in chemical manufacturing and industries associated with natural resources. (Manufacturing in West Virginia is small when compared to Pennsylvania. In 2008, West Virginia's manufacturing Gross State Product was $6.7 billion, while Pennsylvania's was $76.2 billion). In Pennsylvania's case, the consolidation in the pharmaceutical industry and drop in the value of petrochemical products, combined with bitter competition among Tier 3 manufacturers in the metals industries, has triggered sluggish productivity gains. Just as Michigan needs new manufactured products; so does Pennsylvania. The lesson is that those regions that produce commodity products will

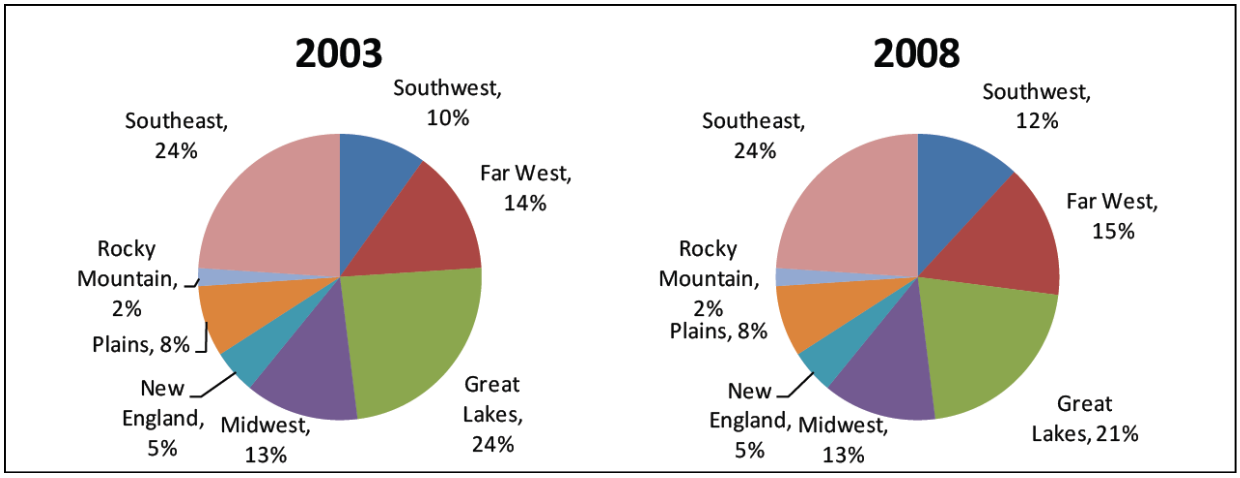
face commodity pricing, commodity margins and declines in productivity as measured by value added per job.

Regional Comparison of Pennsylvania's Manufacturing Productivity



The Midwest maintained its share (13%) of U.S. manufacturing GSP from 2003 to 2008. However, states in the Great Lakes region accounted for a smaller share of the nation's manufacturing GSP in 2008, down from 24 percent in 2003 to 21 percent. Most of this result is driven by the performance of Pennsylvania's neighbors—Michigan, Indiana and Ohio, with their reliance on the Detroit-based automotive supply chain. Conversely, states in the Southwest and Far West increased their contribution to U.S. manufacturing GSP, as can be seen in the following charts. Pennsylvania's contribution, specifically, shrank over the same time period, from 5.2 percent to 4.6 percent of the value of U.S. manufacturing Gross State Product.

U.S. Manufacturing GSP by Region



Source: Moody's Economy.com

Among benchmark states, Pennsylvania contributes the third-greatest share of U.S. manufacturing GSP. The table below lists manufacturing Gross State Product in 1998, 2003, 2005 and 2008. What drives these figures is the recession in 2008. Although its ranking among comparison states held constant over the decade, Pennsylvania's contributed share shrank. As noted earlier and as the following table indicates, Pennsylvania accounted for 5.2 percent of U.S. manufacturing GDP. By 2005, the state accounted for 4.6 percent of U.S. Gross Product from manufacturing. By 2005, North Carolina had replaced Michigan as the second-largest contributor among benchmark states. By 2008, Michigan's contribution to U.S. manufacturing GSP had dropped to sixth place among comparison states.

Benchmarking States' Share of U.S. Manufacturing

1998			2003			2005			2008		
State	Mfg. GSP ($000)	% of U.S. Mfg. GDP	State	Mfg. GSP ($000)	% of U.S. Mfg. GDP	State	Mfg. GSP ($000)	% of U.S. Mfg. GDP	State	Mfg. GSP ($000)	% of U.S. Mfg. GDP
OH	$113,359,944	6.3%	OH	$92,769,000	5.8%	OH	$92,326,882	5.6%	OH	$84,896,223	5.1%
MI	$93,735,823	5.2%	MI	$91,207,504	5.7%	NC	$76,084,859	4.6%	NC	$78,733,297	4.8%
PA	**$90,839,758**	**5.1%**	**PA**	**$82,995,755**	**5.2%**	**PA**	**$76,048,112**	**4.6%**	**PA**	**$76,249,638**	**4.6%**
NC	$81,239,136	4.5%	NC	$78,227,335	4.9%	MI	$73,664,199	4.5%	NY	$69,825,317	4.2%
NY	$78,777,945	4.4%	IN	$72,028,622	4.5%	IN	$69,859,500	4.2%	IN	$64,415,682	3.9%
IN	$70,666,044	3.9%	NY	$68,039,198	4.2%	NY	$68,740,480	4.2%	MI	$62,372,894	3.8%
NJ	$49,892,029	2.8%	NJ	$47,536,417	3.0%	NJ	$41,732,435	2.5%	NJ	$44,293,170	2.7%
MA	$43,022,059	2.4%	MA	$39,585,905	2.5%	MA	$34,559,534	2.1%	MA	$35,154,920	2.1%
KY	$38,650,622	2.2%	KY	$29,923,770	1.9%	KY	$28,697,170	1.7%	KY	$29,120,485	1.8%
MD	$17,508,435	1.0%	MD	$14,754,433	0.9%	MD	$14,256,725	0.9%	MD	$15,345,495	0.9%
WV	$7,873,126	0.4%	WV	$6,158,518	0.4%	WV	$6,836,633	0.4%	WV	$6,682,975	0.4%

Source: Moody's Economy.com

Concentration in Manufacturing

Pennsylvania is a manufacturing state. Even when the recession was at its most intense, manufacturing contribution to Gross Product was nearly 20 percent greater than the national average. This insight is derived from calculating the Location Quotient of Gross Product, which is also known as value added or GSP.

The location quotient (LQ) is a ratio of two percentages. In the first step of the calculation, manufacturing's percentage share of Gross Product is calculated both for Pennsylvania and the United States. In the second step, the percentage for Pennsylvania is divided by the percentage for the United States. This results in a ratio centered on the value of 1.00. If the ratio is equal to 1.00, the contribution of manufacturing to Pennsylvania's Gross Product is equal to the share of manufacturing to the nation's Gross Product. If the ratio is greater than 1.00, manufacturing in the state would make a greater than average contribution to Gross Product—in other words, the state has a demonstrated competitive advantage or specialization in this sector of the economy. If the ratio is less than 1.00, then the sector does not have a demonstrated competitive advantage. The industry can still be a large and important employer, specific firms may be exporters and part of the economic base, but, on the whole, the industry or sector is either largely population-serving or does not represent a demonstrated competitive advantage.

In the case of manufacturing in Pennsylvania in 1998 and 2008, the location quotient for Pennsylvania's manufacturing GSP in 2008 is estimated to be 1.18, indicating that Pennsylvania's manufacturing sector makes a nearly 20 percent larger contribution to Gross Product than does manufacturing nationally. The sector is large and a critical part of the Commonwealth's economic base. As the following table indicates, Pennsylvania's manufacturing concentration is similar to levels seen in Missouri, Texas, Connecticut, Minnesota and Illinois. Pennsylvania has a lower concentration in manufacturing than exists in North Carolina, Kentucky, Ohio and Michigan. However, it has a greater concentration in manufacturing than is seen in comparison states West Virginia, Massachusetts, New Jersey, New York and Maryland. Only Indiana, North Carolina and New Jersey saw their location quotient increase from 1998 to 2008. Manufacturing in Indiana and New Jersey is a strong export industry. Pennsylvania's manufacturing concentration declined by 0.04 points, similar to LQ decreases experienced by West Virginia, Maryland, Ohio and New York.

Benchmarking Manufacturing GSP Location Quotient

State	1998	2008	Change
Indiana	1.91	2.16	0.25
North Carolina	1.62	1.68	0.07
New Jersey	0.77	0.80	0.03
Ohio	1.57	1.54	-0.03
New York	0.56	0.52	-0.03
Pennsylvania	**1.22**	**1.18**	**-0.04**
West Virginia	0.97	0.93	-0.04
Maryland	0.52	0.48	-0.04
Massachusetts	0.88	0.82	-0.06
Michigan	1.47	1.40	-0.07
Kentucky	1.72	1.59	-0.13

Source: Moody's Economy.com

Growth Rates

All states with a significant presence of manufacturing experienced GSP declines from 1998 to 2008. Among comparison states, Pennsylvania ranked in the "middle of the pack" in terms of change in annual growth rate, with a decline of 1.7 percent. Three states in the comparison group – North Carolina, New York and Maryland – managed to turn the corner on decline between 2003 and 2008. However, Ohio, Michigan and Indiana – three states with some of the heaviest manufacturing presence – were still experiencing decline in manufacturing GSP during the last half of the decade. Pennsylvania's manufacturing presence is similar to these latter three, but its experience has been different. Unlike the auto-dependent Great Lakes states, **Pennsylvania's manufacturing GSP showed signs of modest recovery between 2005 and 2008.** Most of the states in the comparison group were seeing a rebound in manufacturing GSP from 2005 to 2008.

Manufacturing Gross Product by State

State	2008 GSP	05-08 CAGR	03-08 CAGR	98-08 CAGR
North Carolina	$78,733,297	1.1%	0.1%	-0.3%
Indiana	$64,415,682	-2.7%	-2.2%	-0.9%
New Jersey	$44,293,170	2.0%	-1.4%	-1.2%
New York	$69,825,317	0.5%	0.5%	-1.2%
Maryland	$15,345,495	2.5%	0.8%	-1.3%
West Virginia	$6,682,975	-0.8%	1.6%	-1.6%
Pennsylvania	**$76,249,638**	**0.1%**	**-1.7%**	**-1.7%**
Massachusetts	$35,154,920	0.6%	-2.3%	-2.0%
Kentucky	$29,120,485	0.5%	-0.5%	-2.8%
Ohio	$84,896,223	-2.8%	-1.8%	-2.8%
Michigan	$62,372,894	-5.4%	-7.3%	-4.0%

Source: Moody's Economy.com

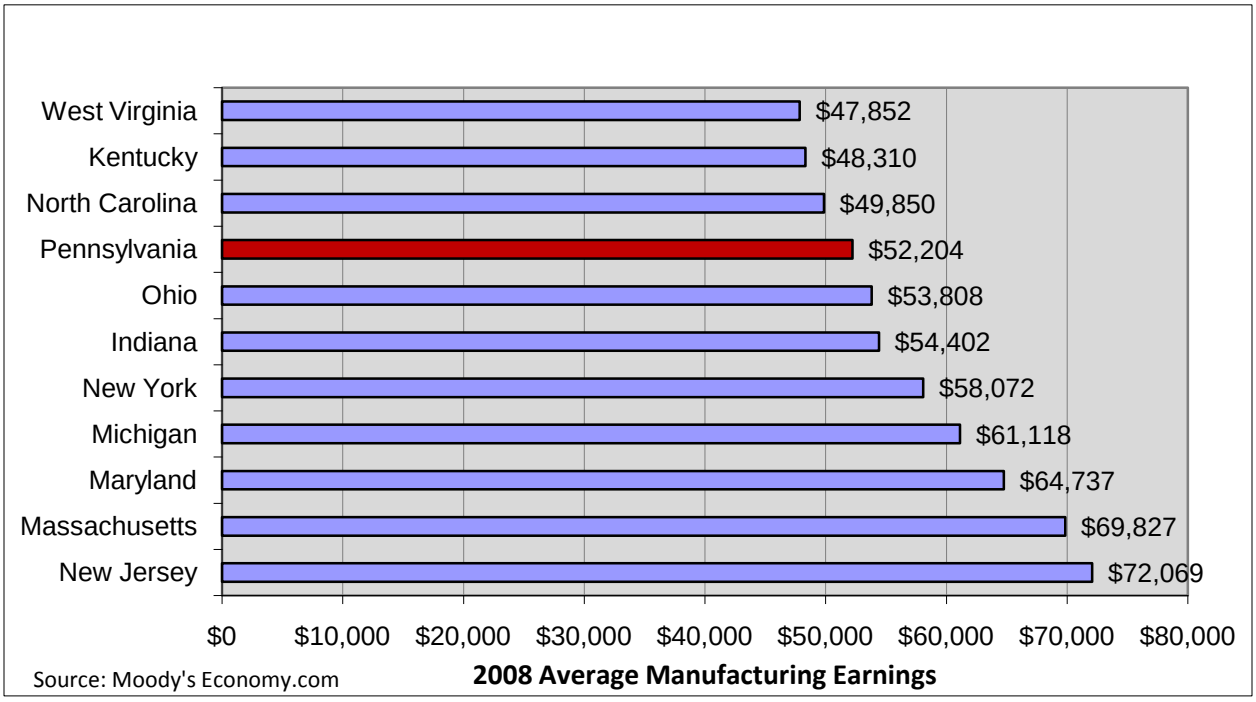
In the table above, the compound average growth rate (CAGR) of Gross State Product is displayed. The CAGR is the average growth rate, controlling for the effects of compounding.[5] Pennsylvania's progress in turning around the performance of its manufacturing sector is told in these numbers. Between 2003 and 2008, the average rate of decline in manufacturing Gross Product was 1.7 percent. From 2005 to 2008, as the national economy went below stall speed, the CAGR for manufacturing in Pennsylvania changed to a positive 0.1 percent. This is a positive swing of 1.8 percentage points. The benchmark states that experienced larger positive swings were states deeply involved in aeronautical production of large defense systems or states in which the pharmaceutical industry is re-concentrating—Maryland (1.7 percentage points), Massachusetts (2.9 percentage points), and New Jersey (3.4 percentage points).

Earnings

Manufacturing continues to pay high earnings compared to other industries. This is true in Pennsylvania as well as across comparison states. At $52,204, Pennsylvania's average earnings for manufacturing falls below the median ($54,402) for the benchmark states, as the following figure shows. Interestingly, North Carolina, which has a relatively large manufacturing sector that performed relatively well over the past 10 years, has average earnings that are relatively close to those paid in Pennsylvania. New York, another state with a sizable manufacturing sector that has seen signs of a rebound, has average earnings that are closer to those paid in Pennsylvania than to the top payer among the comparison states, New Jersey.

[5] The Compound Average Annual Growth rate (CAGR) is:
[(End year GSP/Beginning year) ^1/number of years] -1.

Average Annual Manufacturing Earnings by State



Technology and the Overall Growth of State Economies

The manufacturing sector of the economy has changed dramatically over the past two decades. Rapid changes in technology have transformed processes and created new product opportunities. At the same time, the composition of the manufacturing workforce has changed due to the integration of information technologies into the shop floor and along the entire value chain. No analysis of manufacturing would be complete without some understanding of the effect of technology on economic growth. Comparing states in terms of how technology intensive their manufacturing is reveals a relationship between technology and growth in Gross State Product over time. Specifically, the greater the share of Gross State Product that is generated by very technologically intense industries, the higher is the state's overall growth rate as measured by percentage change in Gross State Product. Overall growth in GSP in Pennsylvania, which has 28 percent of its manufacturing sector involved in high-intensity technology industries, grew by 16 percent from 1998 to 2008.

Our analysis of the impact of technology intensity involved classifying all industries, manufacturing and non-manufacturing, at the national level into one of three technology categories based on the educational requirements of the workforce in that industry: very technologically intensive, moderately technologically intensive, low technologically intensive. The group left over is categorized as having no technological intensity. The industries in each group are listed in an appendix to this report.

Total technology-intensive gross product (very intense, moderately intense, and low intensity) in Pennsylvania is 18.1 percent of overall gross product, compared to the national average of 19.5 percent.

Comparing Pennsylvania to its regional peers reveals the role that manufacturing plays in Pennsylvania's technology-based economic development. Pennsylvania lags in its dependence on technology intensive manufacturing.

There is a negative 5.7 percentage point difference between the contributions that technology-intense industries make to Pennsylvania's GSP and the average contribution of the peer group of states (18.1% vs. 23.7%). Yet, the very technology-intense industries contribute a larger share of GSP in Pennsylvania than occurs in the peer states (6.3% vs. 5.4%); moderately intense industries in Pennsylvania contribute 5.6 percent of GSP versus 3.9 percent in the peer-group states. And industries with low levels of technological intensity contribute 6.2 percent of GSP in Pennsylvania, compared to 14.3 percent in the peer group. In other words, it is low technologically intense service industries that creates the gap.

Technologically intensive manufacturing industries in Pennsylvania produce 3.8 percent of overall gross product. Such industries account for 4.4 percent of total U.S. gross product and, on average, 3.4 percent of gross state product for the comparison group. In North Carolina, technology-intensive industries account for 18.2 percent of overall gross product, with 6.7 percent of total GSP coming from technology-intensive manufacturing. New Jersey has 19.5 percent of its overall GSP growth coming from technology-intensive activities, with manufacturing accounting for 4.7 percent.

Pennsylvania's Share of GSP From Technology-Intensive Industries, 2008

	Pennsylvania	Regional Peers*	United States
Total Technology-Intensive GSP in Private Sector	18.1%	23.7%	19.5%
High Technology Intensity	**6.3%**	**5.5%**	**7.1%**
Very Technology-Intensive Manufacturing	1.9%	1.8%	2.2%
Very Technology-Intensive Pipeline & Telecommunication	0.1%	0.2%	0.3%
Very Technology-Intensive Service	4.3%	3.4%	4.6%
Moderate Technology Intensity	**5.6%**	**3.9%**	**6.8%**
Moderate Technology-Intensive Manufacturing	0.7%	0.6%	0.8%
Moderate Technology-Intensive Others	3.0%	1.9%	4.1%
Moderate Technology-Intensive Service	1.9%	1.4%	1.9%
Low Technology Intensity	**6.1%**	**14.3%**	**5.5%**
Low Technology-Intensive Manufacturing	1.2%	0.9%	1.3%
Low Technology-Intensive Pipeline & Telecommunication	2.1%	1.6%	2.0%
Low Technology-Intensive Service	2.9%	11.8%	2.2%
*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV			

Source: Moody's Economy.com

Technology-intensive industries account for 10.5 percent of Pennsylvania's employment, compared to 11.6 percent nationwide and 8.6 percent among regional peers. As can be seen in the following table, technology-intensive manufacturing accounts for 2.3 percent of Pennsylvania's employment. That compares to the U.S. average of 2.5 percent and 2.0 percent among Pennsylvania's regional peers. Pennsylvania's employment in low-intensity industries is above average for the nation and for the state's regional peers.

Pennsylvania's Employment in Technology-Intensive Industries

	Pennsylvania	Regional Peers*	United States
Total Technology-Intensive Employment in Private Sector	10.5%	8.6%	11.6%
High Technology Intensity	**3.8%**	**3.4%**	**4.4%**
Very Technology-Intensive Manufacturing	1.1%	1.1%	1.5%
Very Technology-Intensive Pipeline & Telecommunication	0.0%	0.0%	0.1%
Very Technology-Intensive Service	2.6%	2.2%	2.8%
Moderate Technology Intensity	**3.3%**	**2.7%**	**4.3%**
Moderate Technology-Intensive Manufacturing	0.5%	0.3%	0.4%
Moderate Technology-Intensive Others	1.7%	1.5%	2.7%
Moderate Technology-Intensive Service	1.2%	0.9%	1.2%
Low Technology Intensity	**3.4%**	**2.6%**	**2.9%**
Low Technology-Intensive Manufacturing	0.7%	0.5%	0.6%
Low Technology-Intensive Pipeline & Telecommunication	0.7%	0.6%	0.7%
Low Technology-Intensive Service	2.1%	1.4%	1.6%
*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV			

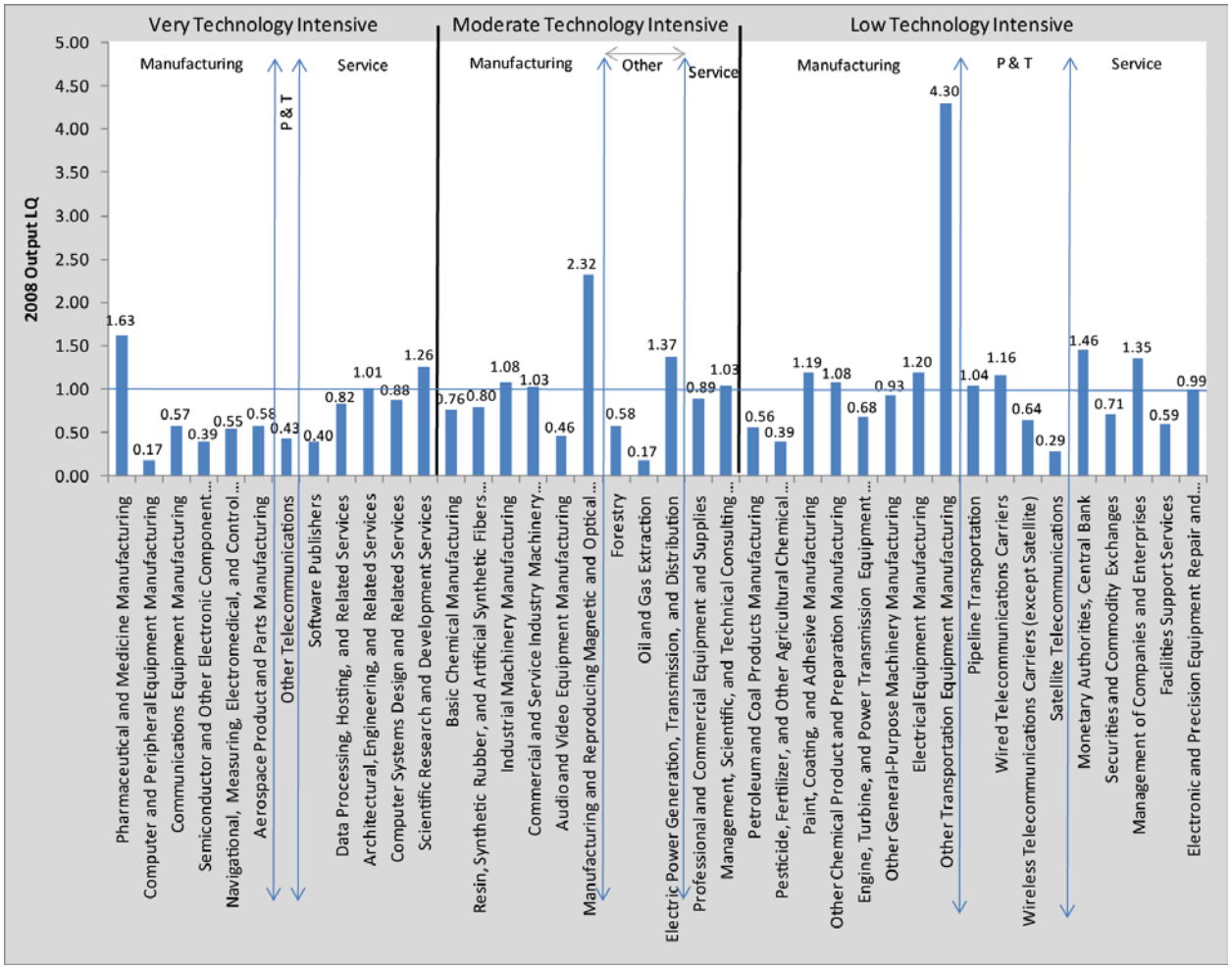
Source: Moody's Economy.com

The number of technology-intensive manufacturing industries with high concentration (LQ>1) in Pennsylvania decreased since the 2004 study of Pennsylvania's driver industries. Of 43 technology-intensive industries, all have a presence in Pennsylvania, with 20 of those in manufacturing. Since the 2004 study of Pennsylvania's driver industries, the definition of technology-intensive industries has been updated. One industry – NAICS 5191, Other Information Services – is excluded from the updated definition. Three Pennsylvania manufacturing industries have very high Gross Product LQ among technology-intensive industries. They are Pharmaceuticals (1.63, meaning that this industry's contribution to state GSP is 63% greater than its contribution nationally), Manufacturing and Reproducing Magnetic and Optics Media (2.32), and Other Transportation Equipment Manufacturing (4.30, meaning its contribution to GSP is 430 times its percentage contribution to Gross National Product). Pharmaceuticals is a very technologically intensive industry, whereas Manufacturing and Reproducing Magnetic and Optics Media has moderate technology intensity and Other Transportation Equipment Manufacturing has low technology intensity.

Location quotient for a few other Pennsylvania manufacturing industries indicate strong competitive advantage, with LQs for GSP greater than 1.10, or 10 percent greater than their contribution nationally. These industries are: Paint, Coating, and Adhesive Manufacturing (1.19) and Electrical Equipment Manufacturing (1.20). A few others make a contribution that is a bit higher than

the contribution of the same industry nationally (with LQs between 1.0 and 1.10). These are: Commercial and Service Industry Machinery (1.03), Industrial Machinery Manufacturing (1.08), and Other Chemical Manufacturing (1.08). The following figure details the location quotient for each technology-intensive industry in Pennsylvania. Two of these—Commercial and Service Industry Machinery and Industrial Machinery Manufacturing—are industries with moderate technology intensity; the other three have low technological intensity.

Level of Specialization Among Technology-Intensive Industries in Pennsylvania



Source: Moody's Economy.com.

Note: P & T abbreviates Pipeline and Telecommunication Industries. Forestry technology-intensive industries consist of NAICS 1131 and 1132. Pipeline Transportation technology-intensive industries consist of NAICS 4861, 4862 and 4869.

Manufacturing Patents: Critical to Pennsylvania's Innovation Infrastructure

To explore Pennsylvania's innovation infrastructure and to better understand the position that Pennsylvania's manufacturers play in that infrastructure, the study team examined the patents issued and filed by companies and individuals located in the state. Although a patent analysis does not capture all forms of innovation, it does provide an important perspective on the inventive and breakthrough activities occurring in Pennsylvania and how that activity level compares to the nation and other countries around the world.

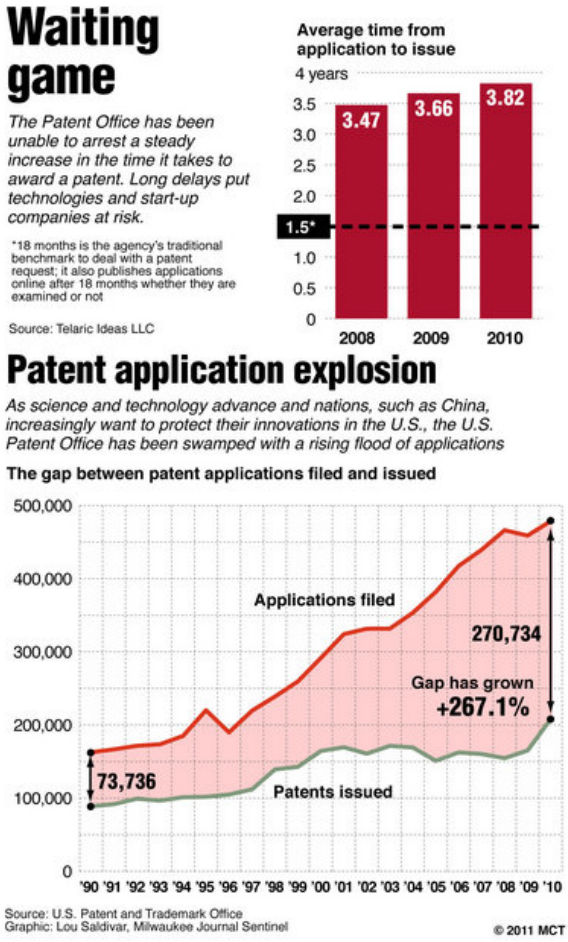
Pennsylvania Patenting Particulars:

- From 2001 to 2010, Pennsylvania companies and inventors living in Pennsylvania registered 57,175 patents and patent applications.
- Innovation is highly concentrated into specific knowledge areas. Forty-three percent of all patents registered by Pennsylvania companies and universities from 2001 to 2010 are in three fields of innovation − Medical, Biochemical and Data Processing.
- Of the 16,054 patents issued between 2001 and 2010 to Pennsylvania companies and universities:
    - 9,577 (59.7%) were assigned to manufacturing companies. (We consider this a conservative estimate. Data limitations prevent a full accounting.)
    - These 9,577 patents came from 20 different 4-digit NAICS industries.
    - 36 manufacturing companies accounted for 7,340 (45.7%) of the corporate and university patents.
    - 33.4% percent of all manufacturing patents assigned were in the Medical, Biochemistry, and Data Processing innovation fields.
    - Pennsylvania's manufacturing companies are also patenting in other areas, including optics and semiconductors, computer and electrical equipment manufacturing, transportation, and new product development.
    - Seven non-manufacturing companies accounted for 446 patents.
    - Seven universities accounted for 1,617 patents.
- Eleven of the most active patenting manufacturing companies are either in the medical equipment or pharmaceuticals industries.
- Global manufacturing companies with a research presence in Pennsylvania are leading sources of patents. Pennsylvania ranks sixth in the nation in terms of the number of establishments in semiconductor manufacturing, with more than 226 such establishments.
- Pennsylvania ranks seventh in the nation for both the number of establishments in communication equipment manufacturing (61) and in computer and peripheral equipment manufacturing (46).
- The three Pennsylvania manufacturing companies registering the most patents specialize in semiconductors, communication equipment manufacturing, and computer and peripheral equipment manufacturing.

These data demonstrate that innovation in Pennsylvania is firmly rooted in its manufacturing industries.

Why Focus on Filings With the U.S. Patent Office As an Innovation Measure?

There is currently a worldwide race to establish and commercialize intellectual property, and it is no surprise that patenting activity is concentrated in the three largest economies with strong legal intellectual rights protections. These are the United States, the European Union and Japan. These three regions are also global powerhouses in corporate research and development and in basic science supported by their respective governments. These three regional markets are so important that companies will frequently apply for patent protection in all three. Each has similar shares of economically valuable patents.[6] Combined, these three markets account for 90 percent of high-value patents.



Patenting activity is growing in the emerging Asian economies. The National Science Foundation groups patents from nine Asian countries together for analytical purposes. The nations in the Asia-9 are: India, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Taiwan, Thailand and Vietnam. The Asia-9 share of economically valuable patents increased from 1 percent in 1997 to 6 percent in 2006, with patenting activity in South Korea accounting for nearly all of this increase.

New growth economics has stressed the connection between knowledge and economic development, and there is widespread acceptance of innovation's role in economic progress. There are two ways of thinking about the connection between knowledge, innovation and economic development. The first is a business-centric view. As products age, both in terms of location along the product cycle and in terms of the chronological age of the product, competitors appear, prices are cut, margins erode, and productivity, measured in terms of value added per hour worked, declines. That is where margins play a key role in measured productivity. Margins are only maintained with a steady flow of innovation that prevents the business's product from becoming commoditized. A more broadly market-oriented view of the economic importance of innovation is generalized from the business view: Innovation is the source of regional competitive advantage. Science and technologies that are rapidly evolving mean that knowledge transfer occurs less from reading about the knowledge (this is termed codified knowledge), and more from learning by doing and through personal interactions (tacit knowledge). This leads to a regional aggregation of talent around the science or technology and the products that are spun off.

[6] National Science Foundation, Science and Engineering Indicators: 2010. http://www.nsf.gov/statistics/seind10/start.htm

Although not all of this knowledge exists in patents, patents are as good an approximation as is available. Bauer et al. (2006) linked the growth in state per capita personal income over time to its stock of patents.[7] The authors examined factors contributing to per capita income growth throughout the 48 contiguous states from 1939 to 2004. They found that a state's knowledge stocks (measured by its stock of patents and its high school and college attainment rates) are the main factors explaining a state's relative per capita personal income.

The point to be made is that, despite increasing global commercial competition, data from the U.S. Patent Office on patents issued and filed for serves as a reasonable measure of global technological innovation. Companies and individuals from the United States are the leading source of U.S. Patent and Trademark Office (USPTO) patent applications. However, foreign-based inventors, attracted by the size and openness of the U.S. market, have traditionally provided almost half of annual applications. In 2008, the U.S. share of patent applications declined to 51 percent, whereas both second-ranked Japan and the third-ranked EU saw gains. At 10 percent, the Asia-9 share of U.S. patent applications in 2008 was flat compared to 2007. Patent applications from India and China grew but remained modest, with India's share below and China's share barely above 1 percent. Trends are similar for patents granted.

For this research, we used the date when the patent application was filed in the patent office as marking the existence of innovative activity. This date better characterizes the pool of knowledge surrounding the patent activity because it disregards the time required for processing the application and for inspecting and granting a patent.[8]

There has been a marked upswing in the number of patents filed over the past 30 years, and the average time taken to issue a patent is nearing 4 years from the filing date (see charts). John Schmid of the *Milwaukee Journal Sentinel* reported that 1.2 million applications currently await the deliberations of the U.S. Patent Office.

To analyze the patenting activity of Pennsylvania's inventors, data were downloaded from the Thompson Delphion patent database for the years 2001 to 2010. Patents are classified according to the type of technology they incorporate into one of 568 patent subclasses of the International Patent Classification (IPC) system.

From 2001 to 2010, Pennsylvania companies and inventors living in Pennsylvania registered 57,175 patents and patent applications. Of the total patents and patent applications (both referred to simply as *patents* for the remainder of this discussion):

- **16,054** (28%) were owned by companies located in Pennsylvania, as noted earlier. Presumably, these patents have the greatest direct potential to benefit the state economy,

[7] Bauer, Paul W., Schweitzer, Mark E., & Shane, Scott A. (2006, May). "State Growth Empirics: The Long-Run Determinants of State Income Growth." FRB of Cleveland Working Paper No. 06-06. Available at SSRN: *http://ssrn.com/abstract=1022341*

[8] See *Wall Street Journal*, December 15, 2010, "A tech entrepreneur's eight year patient wait," and John Schmid, *Milwaukee Journal Sentinel*, January 16, 2011, "U.S. Patent approvals slow despite efforts to improve." Available: http://www.jsonline.com/watchdog/watchdogreports/113830084.html. This follows up on a June 2009 article that Schmid wrote, available: http://www.jsonline.com/business/53319162.html

but there is no guarantee that the company will either implement the patent into a product or process or implement it in Pennsylvania. As we will detail later in this section, Pennsylvania's most innovative companies are globally active.

- **21,946** (38%) were owned by inventors living in Pennsylvania. These patents may be commercialized in Pennsylvania, and thus directly benefit the state economy, or they may be commercialized outside the Commonwealth, yielding indirect benefits through royalty payments.
- **19,175** (nearly 34%) were developed by Pennsylvania inventors but owned by non-Pennsylvania companies. Even if these patents are commercialized outside of the state, knowledge developed in preparation of these patents may have benefited the Pennsylvania economy due to knowledge transfers to in-state companies through social networks and contractual and corporate relationships.

Signs of Specialized Knowledge

Pennsylvania's patent activity is concentrated in a handful of IPC subclasses. Twenty-five patent subclasses, or only 4.4 percent of the 568 subclasses, capture 54 percent of all patents registered by Pennsylvania companies and universities from 2001 to 2010. There were more than 550 patents in each of these 25 subclasses. This suggests significant knowledge agglomeration is taking place within each of these areas of technological development. In Pennsylvania, three fields of innovation − Medical, Biochemical and Data Processing − account for 80 percent of activity in these 25 subclasses. The following list details the activity in each of these three fields.

Medical Innovation - 11,366 patents (37% of applications in Pennsylvania's 25 most active subclasses):

- A61K Preparations for Medical, Dental or Toilet Purposes – 7,513 (13.1%)
- A61B Diagnosis; Surgery; Identification – 2,088 (3.7%)
- A61F Filters Implantable into Blood Vessels; Prostheses – 953 (1.7%)
- A61M Devices for Introducing Media into, or onto, the Body – 812 (1.4%)

Biochemical Innovation – 6,632 patents (22% of applications in Pennsylvania's 25 most active subclasses):

- C07D Heterocyclic Compounds – 1,011 (1.8%)
- C07K Peptides – 975 (1.7%)
- B01D Separation in Physical or Chemical Processes – 858 (1.5%)
- C12N Micro-organisms or Enzymes; Compositions Thereof – 691 (1.2%)
- C07C Acyclic or Carbocyclic Compounds – 686 (1.2%)
- B01J Chemical or Physical Processes, e.g. Catalysis, Colloid Chemistry – 646 (1.1%)
- C08G Macromolecular Compounds Obtained Otherwise – 626 (1.1%)
- C08F Macromolecular Compounds Obtained – 575 (1%)
- B29C Shaping or Joining of Plastics – 564 (1.0%)

Data Processing Innovation – 6,583 patents (21% of applications in Pennsylvania's 25 most active subclasses):

- G06F Electric Digital Data Processing – 3,548 (6.2%)
- G06Q Data Processing Systems or Methods – 1,352 (2.4%)
- H04L Transmission or Digital Information, e.g. Telegraphic Communication – 844 (1.5%)
- G06K Recognition of Data; Presentation of Data; Record Carriers – 839 (1.5%)

The following table provides detailed information on the 25 most active patent subclasses for Pennsylvania, presented in the order of frequency.

Top 25 Patent Subclasses in Pennsylvania

Patent Subclass		Frequency	Percent	Cumulative Number of Patents	Cumulative Percent of Patents
A61K	PREPARATIONS FOR MEDICAL, DENTAL, OR TOILET PURPOSES	7,513	13.1	7,513	13.1
G06F	ELECTRIC DIGITAL DATA PROCESSING	3,548	6.2	11,061	13.2
A61B	DIAGNOSIS; SURGERY; IDENTIFICATION	2,088	3.7	13,149	19.4
G06Q	DATA PROCESSING SYSTEMS OR METHODS	1,352	2.4	14,501	23.0
B32B	LAYERED PRODUCTS, i.e. PRODUCTS BUILT-UP OF STRATA OF FLAT OR NON-FLAT.	1,055	1.8	15,556	25.4
C07D	HETEROCYCLIC COMPOUNDS in Organic Chemistry	1,011	1.8	16,567	27.2
H01R	ELECTRICALLY-CONDUCTIVE CONNECTIONS	988	1.7	17,555	29.0
C07K	PEPTIDES	975	1.7	18,530	30.7
A61F	FILTERS IMPLANTABLE INTO BLOOD VESSELS; PROSTHESES; BANDAGES, DRESSINGS OR ABSORBENT PADS; FIRST-AID KITS	953	1.7	19,483	32.4
B01D	SEPARATION in PHYSICAL OR CHEMICAL PROCESSES	858	1.5	20,341	34.1
H01L	SEMICONDUCTOR DEVICES; ELECTRIC SOLID STATE DEVICES	854	1.5	21,195	35.6
H04L	TRANSMISSION OF DIGITAL INFORMATION, e.g. TELEGRAPHIC COMMUNICATION	844	1.5	22,039	37.1
G06K	RECOGNITION OF DATA; PRESENTATION OF DATA; RECORD CARRIERS;	839	1.5	22,878	38.5
A61M	DEVICES FOR INTRODUCING MEDIA INTO, OR ONTO, THE BODY	812	1.4	23,690	40.0
G01N	INVESTIGATING OR ANALYSING MATERIALS BY DETERMINING THEIR CHEMICAL OR PHYSICAL PROPERTIES	800	1.4	24,490	41.4
B65D	CONTAINERS FOR STORAGE OR TRANSPORT OF ARTICLES OR MATERIALS	713	1.2	25,203	42.8
C12N	MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF	691	1.2	25,894	44.1
C07C	ACYCLIC OR CARBOCYCLIC COMPOUNDS	686	1.2	26,580	45.3
H04N	PICTORIAL COMMUNICATION, e.g. TELEVISION	669	1.2	27,249	46.5
B01J	CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS, COLLOID CHEMISTRY THEIR RELEVANT APPARATUS	646	1.1	27,895	47.6
G02B	OPTICAL ELEMENTS, SYSTEMS, OR APPARATUS	644	1.1	28,539	48.8
C08G	MACROMOLECULAR COMPOUNDS OBTAINED OTHERWISE THAN BY REACTIONS ONLY INVOLVING CARBON-TO-CARBON UNSATURATED BONDS	626	1.1	29,165	49.9
B05D	PROCESSES FOR APPLYING LIQUIDS OR OTHER FLUENT MATERIALS TO SURFACES	582	1.0	29,747	51.0
C08F	MACROMOLECULAR COMPOUNDS OBTAINED BY REACTIONS ONLY INVOLVING CARBON-TO-CARBON UNSATURATED BONDS	575	1.0	30,322	52.0
B29C	SHAPING OR JOINING OF PLASTICS	564	1.0	30,886	53.0
	TOTAL	**57,175**	**100.0**	**57,175**	**100.0**

Drop in Patenting During the Recession

Despite the Great Recession and the slowdown leading into the recession, patent activity in the Commonwealth grew over the last half of the decade examined. Applications nearly doubled. More patent applications were submitted from 2005 to 2010 (7,956 annually, on average) compared to the four previous years, which saw an average of 4,225 patent applications filed annually. This phenomenon was counter to the national trend, which saw a drop off in patenting activity.

As the following table shows, all three of the state's most active innovation fields decreased their share of the state's patents within the top 25 technologies and within all patent fields. Even though the actual number for Medical patents increased by 240 to 4,805, the innovation field's share of Pennsylvania's patents declined from 18 percent in 2001-2004 to 15.1 percent in 2005-2010. Biochemical filings showed the greatest of decline, dropping from 16.9 percent of all filings and grants to 9.5 percent. (The actual number decreased from 4,293 to 3,022.) Patent filings and grants, as well as market share, also decreased for Data Processing, Pennsylvania's third primary area of innovation concentration.

Change in Innovation Field's Share of Pennsylvania Patents, 2001-2010

	2001-2010		2001-2004		2005-2010	
	# of Patents	% of Total	# of Patents	% of Total	# of Patents	% of Total
Medical	11,366	19.9%	4,565	18.0%	4,805	15.1%
Bio-Chemical	6,632	11.6%	4,293	16.9%	3,022	9.5%
Data Processing	6,583	11.5%	2,387	9.4%	1,962	6.2%
Top 25 total	30,886	54.0%	13,769	54.3%	17,365	54.6%
Total	**57,175**		**25,352**		**31,823**	

Patenting Activity of Pennsylvania's Corporations and Universities

Of the total 16,054 patents registered to Pennsylvania organizations, 9,344 (58.2%) were assigned to 50 companies. More notably, 36 manufacturing companies accounted for 7,340 of those patents. Seven non-manufacturing companies accounted for 417 patents, and seven universities accounted for 1,587 patents, or nearly 10 percent of the total for Pennsylvania companies. These universities are:

- The University of Pennsylvania
- The Penn State University
- The University of Pittsburgh
- Carnegie Mellon University
- Drexel University
- Thomas Jefferson University
- Temple University

In total, 9,577 (60%) of the 16,054 patents were assigned to manufacturing companies. We consider this a conservative estimate. To identify manufacturing companies, we had only two quarters of data from a database maintained by the State of Pennsylvania and made available through the efforts of the Central Pennsylvania Workforce Development Corporation. To supplement that data, we used public databases, including Referenceusa.com, Manta.com, Harris Selectory database, and Highbeam.com. In cases of conflicting information, we consulted companies' websites.

Manufacturing: Part of Pennsylvania's Innovation Infrastructure

Pennsylvania manufacturing companies patent across 414 technology subclasses. Nearly half (48.5%) of all patents assigned to manufacturing companies were in 21 subclasses. Each of these top subclasses had at least 100 patents. Seventy percent of manufacturing patents in these 21 subclasses, or 33.4 percent of all manufacturing patents assigned to Pennsylvania companies, were in the Medical, Biochemistry and Data Processing innovation fields.

Top 21 Patent Subclasses Among Pennsylvania Manufacturing Companies

Patent Subclass		Number of Patents	Percent	Cumulative Number of Patents	Cumulative Percent
A61K	PREPARATIONS FOR MEDICAL, DENTAL, OR TOILET PURPOSES	539	5.6	539	5.6
G06F	ELECTRIC DIGITAL DATA PROCESSING	537	5.6	1,076	11.2
H01R	ELECTRICALLY-CONDUCTIVE CONNECTIONS	443	4.6	1,519	15.9
A61B	DIAGNOSIS; SURGERY; IDENTIFICATION	363	3.8	1,882	19.7
A61M	DEVICES FOR INTRODUCING MEDIA INTO, OR ONTO, THE BODY	287	3.0	2,169	22.6
H01L	SEMICONDUCTOR DEVICES; ELECTRIC SOLID STATE DEVICES	244	2.5	2,413	25.2
H04N	PICTORIAL COMMUNICATION, e.g. TELEVISION	203	2.1	2,616	27.3
H04L	TRANSMISSION OF DIGITAL INFORMATION, e.g. TELEGRAPHIC COMMUNICATION	199	2.1	2,815	29.4
B65D	CONTAINERS FOR STORAGE OR TRANSPORT OF ARTICLES OR MATERIALS	186	1.9	3,001	31.3
G06K	RECOGNITION OF DATA; PRESENTATION OF DATA; RECORD CARRIERS;	181	1.9	3,182	33.2
B29C	SHAPING OR JOINING OF PLASTICS	179	1.9	3,361	35.1
B01D	SEPARATION in PHYSICAL OR CHEMICAL PROCESSES	177	1.8	3,538	36.9
C08G	MACROMOLECULAR COMPOUNDS OBTAINED OTHERWISE THAN BY REACTIONS ONLY INVOLVING CARBON-TO-CARBON UNSATURATED BONDS	166	1.7	3,704	38.7
B32B	LAYERED PRODUCTS, i.e. PRODUCTS BUILT-UP OF STRATA OF FLAT OR NON-FLAT.	134	1.4	3,838	40.1
C08F	MACROMOLECULAR COMPOUNDS OBTAINED BY REACTIONS ONLY INVOLVING CARBON-TO-CARBON UNSATURATED BONDS	122	1.3	3,960	41.3
G02B	OPTICAL ELEMENTS, SYSTEMS, OR APPARATUS	120	1.3	4,080	42.6
B01J	CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS, COLLOID CHEMISTRY; THEIR RELEVANT APPARATUS	118	1.2	4,198	43.8
G01N	INVESTIGATING OR ANALYSING MATERIALS BY DETERMINING THEIR CHEMICAL OR PHYSICAL PROPERTIES	117	1.2	4,315	45.1
C07C	ACYCLIC OR CARBOCYCLIC COMPOUNDS	115	1.2	4,430	46.3
H04B	TRANSMISSION (transmission systems for measured values)	114	1.2	4,544	47.4
C07D	HETEROCYCLIC COMPOUNDS in Organic Chemistry	100	1.0	4,644	48.5
TOTAL		**9,577**			

On average, manufacturing companies registered more than twice as many patents annually from 2005 to 2010 (1,389) as they did from 2001 to 2004 (670). The Biochemical field saw its share of the number of patents and applications from manufacturing companies fall significantly, but Medical and Data Processing both gained share over the last half of the decade.

Change in Innovation Field's Share of Pennsylvania Manufacturing Patents, 2001-2010

	2001-2010		2001-2004		2005-2010	
	# of Patents	% of Total	# of Patents	% of Total	# of Patents	% of Total
Medical	1,189	12.4%	468	11.6%	721	13.0%
Biochemical	1,094	11.4%	653	16.2%	399	7.2%
Data Processing	917	9.6%	270	6.7%	628	11.3%
Top 21 total	4,644	33.4%	2,025	54.3%	2,745	54.6%
Total	**9,577**		**4,020**		**5,557**	

In addition to the Biochemical, Medical and Data Processing innovation fields, Pennsylvania's manufacturing companies are patenting in optics and semiconductors, computer and electrical equipment manufacturing, transportation, and new products development. All Pennsylvania manufacturing companies that patented were distributed across 64 NAICS codes, with 20 NAICS classifications capturing more than 90 percent of all manufacturing patents.

Top 20 NAICS Codes Among Pennsylvania Manufacturing Companies

Primary NAICS	Industry Name	# of Patents	Percent	Cumulative Percent
3391	Surgical and Medical Instrument Manufacturing	1,363	14.2	14.2
3344	Semiconductor and Related Device Manufacturing	1,012	10.6	24.8
3254	Pharmaceutical and Medicine Manufacturing	794	8.3	33.1
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	754	7.9	41.0
3341	Other Computer Peripheral Equipment Manufacturing	732	7.6	48.6
3342	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	714	7.5	56.1
3251	Petrochemical Manufacturing	713	7.4	63.5
3345	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Mfg.	365	3.8	67.3
3261	Urethane and Other Foam Product (except Polystyrene) Manufacturing	357	3.7	71.0
3313	Aluminum Extruded Product Manufacturing	270	2.8	73.9
3331	Oil and Gas Field Machinery and Equipment Manufacturing	249	2.6	76.5
3353	Relay and Industrial Control Manufacturing	218	2.3	78.7
3335	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing	215	2.2	81.0
3371	Wood Kitchen Cabinet and Countertop Manufacturing	168	1.8	82.7
3329	Small Arms Ammunition Manufacturing	165	1.7	84.5
3327	Precision Turned Product Manufacturing	158	1.6	86.1
3219	Wood Container and Pallet Manufacturing	138	1.4	87.6
3334	Heating Equipment (except Warm Air Furnaces) Manufacturing	119	1.2	88.8
3399	Sporting and Athletic Goods Manufacturing	118	1.2	90.0
3339	Pump and Pumping Equipment Manufacturing	100	1.0	91.1
	TOTAL	**9,577**	**100.0**	**100.0**

There is an important set of establishments involved in manufacturing related to the information technology industry in the state. Pennsylvania ranks sixth in the nation in terms of the number of establishments in semiconductor manufacturing, with more than 226 such establishments. And it ranks seventh in the nation for both the number of patents issued in communication equipment manufacturing (61) and in computer and peripheral equipment manufacturing (46). In fact, the three Pennsylvania manufacturing companies registering the most patents specialize in semiconductors, communication equipment manufacturing, and computer and peripheral equipment manufacturing.

Agere Systems, Inc., was the top patenting manufacturing company in Pennsylvania. The following table lists Pennsylvania's leading manufacturing companies for patenting. General Instrument Corp. is a private company specializing in semiconductors and cable television, specifically in manufacturing radio broadcasting equipment. The company was acquired by Motorola and, in 2007, was renamed to Home and Networks Mobility. Tyco Electronics is a $10.3 billion global provider of engineered electronic components for thousands of consumer and industrial products; network solutions and systems for telecommunications and energy markets; undersea telecommunication systems; and specialty products. According to the company's website, it designs, manufactures and markets products for customers in a broad array of industries, including automotive; data communication systems and consumer electronics; telecommunications; aerospace, defense and marine; medical; energy; and lighting.

Pennsylvania's Manufacturing Companies Registering the Most Patents, 2001-2010

Company Name	Location	# of Patents in 2001-2010	Primary NAICS	Industry Name
AGERE SYSTEMS, INC.	ALLENTOWN, PA	912	3344	Semiconductor and Other Electronic Component Manufacturing
GENERAL INSTRUMENT CORP.	HORSHAM, PA	650	3342	Communications Equipment Manufacturing
TYCO ELECTRONICS CORPORATION	MIDDLETOWN, PA	623	3341	Computer and Peripheral Equipment Manufacturing
SIEMENS MEDICAL SOLUTIONS USA,	MELVARN, PA	601	3391	Medical Equipment and Supplies Manufacturing
AIR PRODUCTS AND CHEMICALS, IN	ALLENTOWN, PA	600	3251	Basic Chemical Manufacturing
GLAXOSMITHKLINE PLC	PHILIDELPHIA, PA	466	3254	Pharmaceutical and Medicine Manufacturing
ROHM AND HAAS COMPANY	PHLADELPHIA, PA	372	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing
GRAHAM PACKAGING COMPANY, L.P.	YORK, PA	244	3261	Plastics Product Manufacturing
ALCOA, INC.	PITTSBURGH, PA	228	3313	Alumina and Aluminum Production and Processing
BAYER MATERIALSCIENCE LLC	PITTSBURGH, PA	227	3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing
LUTRON ELECTRONICS COMPANY, IN	COOPERSBURG, PA	198	3353	Electrical Equipment Manufacturing
CNH AMERICA, LLC.	NEW HOLLAND, PA	196	3331	Agriculture, Construction, and Mining Machinery Manufacturing
GRACO CHILDREN'S PRODUCTS INC.	EXTON, PA	159	3371	Household and Institutional Furniture and Kitchen Cabinet Manufacturing
KENNAMETAL, INC.	LATROBE, PA	155	3335	Metalworking Machinery Manufacturing
MEDRAD, INC.	INDIANOLA, PA	139	3391	Medical Equipment and Supplies Manufacturing
CERTAINTEED CORP.	VALLEY FORGE, PA	135	3219	Other Wood Product Manufacturing
SYNTHES (USA)	WEST CHESTER, PA	129	3391	Medical Equipment and Supplies Manufacturing
CHEMIMAGE CORP.	PITTSBURGH, PA	123	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
YORK INTERNATIONAL CORPORATION	YORK, PA	113	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Mfg.

Among the 36 manufacturing companies that make up Pennsylvania's top 50 patenting entities, patenting activity is concentrated in just 18 technology categories. This reinforces an observation made earlier in this section: There are agglomeration effects evident in Pennsylvania's patenting results. Agglomeration effects are unpriced spillovers of knowledge that occur due to the close location of establishments, the sharing of a common talent pool, or a shared base of suppliers and customers. The table below has concentrations in medical and medical equipment, electronic equipment and telecommunications, materials, biochemistry with pharmaceutical applications, and data processing.

Top 18 Technology Fields for Manufacturing Patents, 2001-2010

Patent Subclass	IPC	Number of Patents
PREPARATIONS FOR MEDICAL, DENTAL, OR TOILET PURPOSES	A61K	486
ELECTRIC DIGITAL DATA PROCESSING	G06F	466
ELECTRICALLY-CONDUCTIVE CONNECTIONS	H01R	428
DIAGNOSIS; SURGERY; IDENTIFICATION	A61B	244
DEVICES FOR INTRODUCING MEDIA INTO, OR ONTO, THE BODY	A61M	200
SEMICONDUCTOR DEVICES; ELECTRIC SOLID STATE DEVICES	H01L	199
PICTORIAL COMMUNICATION, e.g. TELEVISION	H04N	197
TRANSMISSION OF DIGITAL INFORMATION, e.g. TELEGRAPHIC COMMUNICATION	H04L	196
RECOGNITION OF DATA; PRESENTATION OF DATA; RECORD CARRIERS	G06K	173
MACROMOLECULAR COMPOUNDS OBTAINED OTHERWISE THAN BY REACTIONS ONLY INVOLVING CARBON-TO-CARBON UNSATURATED BONDS	C08G	155
SHAPING OR JOINING OF PLASTICS	B29C	126
CONTAINERS FOR STORAGE OR TRANSPORT OF ARTICLES OR MATERIALS	B65D	124
SEPARATION in PHYSICAL OR CHEMICAL PROCESSES	B01D	120
ACYCLIC OR CARBOCYCLIC COMPOUNDS	C07C	108
HETEROCYCLIC COMPOUNDS IN ORGANIC CHEMISTRY	C07D	106
CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS, COLLOID CHEMISTRY; THEIR RELEVANT APPARATUS	B01J	104
MACROMOLECULAR COMPOUNDS OBTAINED BY REACTIONS ONLY INVOLVING CARBON-TO-CARBON UNSATURATED BONDS	C08F	104
TRANSMISSION	H04B	102

Six of the top 36 patenting manufacturing companies are active innovators of Medical Equipment and Supplies Manufacturing (NAICS 3391). These companies are:

- Siemens Medical Solutions USA, Inc.
- Medrad, Inc.
- Synthes (USA)
- Medical Components, Inc. (Medcomp)
- Respironics, Inc. (Philips Respironics)
- McKesson Automation, Inc.

Another five companies are in Pharmaceutical and Medicine Manufacturing (NAICS 3254):

- GlaxoSmithKline PLC
- Cephalon, Inc.
- Centocor, Inc.
- Adolor Corporation
- 3-Dimensional Pharmaceuticals, Inc.

Cluster Analysis

A cluster analysis identified 25 industries as drivers of Pennsylvania's economy. These are industries with high LQs, indicating a demonstrated competitive advantage, increasing competitive advantage over time (the LQS have gotten larger since 2002), and strong growth rates during the recovery from the 2002 recession. Ten of the identified drivers are manufacturing industries, and one other driver industry – NAICS 5511, Management of Companies and Enterprises – is related to manufacturing, capturing the headquarter function of companies.

The statewide manufacturing drivers show the diversity of excellent manufacturing in the Commonwealth, but they are, in another sense, watered down by the state's sheer size and the complexity of its regional economies. This leads us to discuss the manufacturing drivers in two passes. The first is a discussion of the statewide drivers—those with a presence so strong and so dispersed over the state that they register. The section that follows presents the regional manufacturing drivers.

Pennsylvania's 25 Driver Industries

NAICS	Industry	2008 GSP (in $M)	2005-08 GSP CAGR	2003-08 GSP CAGR	1998-2008 GSP CAGR	2008 GSP LQ	2002-08 GSP LQ Growth	2002-2008 GSP LQ Growth Rate
	Manufacturing Drivers							
3222	Paperboard Container Manufacturing	$2,984	0.9%	-1.8%	-1.1%	2.39	0.40	20.3%
3359	Battery Manufacturing	$2,083	8.6%	5.3%	-0.2%	2.67	0.36	15.4%
3113	Sugar Manufacturing	$1,111	1.5%	-7.5%	-0.9%	3.63	0.30	9.0%
3321	Forging and Stamping	$1,029	1.0%	4.3%	-1.4%	2.49	0.15	6.6%
3362	Motor Vehicle Body and Trailer Manufacturing	$855	1.9%	13.5%	3.5%	1.97	0.69	53.4%
3272	Glass and Glass Product Manufacturing	$832	-7.2%	-12.9%	-7.7%	1.90	-0.55	-22.6%
3313	Alumina and Aluminum Production and Processing	$741	-0.7%	15.9%	7.6%	1.97	0.59	42.3%
3369	Other Transportation Equipment Manufacturing	$688	12.3%	15.9%	6.6%	4.30	1.84	74.6%
3111	Animal Food Manufacturing	$480	7.2%	-0.9%	1.6%	1.91	0.18	10.5%
3346	Manufacturing & Reproducing Magnetic & Optical Media	$278	2.1%	4.4%	-5.3%	2.32	0.81	53.8%
5511	Management of Companies and Enterprises	$401	8.5%	17.2%	6.7%	1.35	0.46	52.3%
	Population-serving Industries							
8134	Civic and Social Organizations	$15,295	0.0%	-0.4%	1.7%	1.83	0.01	0.8%
6233	Community Care Facilities for the Elderly	$15,145	2.9%	4.8%	7.8%	2.38	0.61	34.6%
6222	Psychiatric and Substance Abuse Hospitals	$2,254	-3.2%	-4.1%	0.0%	2.13	-0.48	-18.4%
6232	Residential Mental Retardation Facilities	$2,195	0.5%	1.2%	3.7%	2.33	0.08	3.5%
6221	General Medical and Surgical Hospitals	$1,903	1.1%	3.3%	2.4%	1.39	-0.03	-2.0%
6219	Ambulance Services	$1,644	2.1%	4.4%	6.3%	1.93	-0.16	-7.6%
6223	Specialty (except Psychiatric & Substance Abuse) Hospitals	$813	6.1%	10.5%	5.1%	2.89	0.41	16.7%
	Educational Sector							
GVL	Local Government	$30,149	-70.0%	-69.6%	-29.7%	0.83	-0.01	-0.8%
6112	Junior Colleges	$1,273	14.9%	15.1%	2.0%	3.11	0.65	26.6%
4854	School and Employee Bus Transportation	$710	-0.7%	4.3%	2.4%	2.46	0.15	6.5%
	Other Industries							
4931	General Warehousing and Storage	$3,395	4.9%	14.1%	8.1%	2.05	0.42	25.7%
2121	Coal Mining	$1,419	4.3%	9.7%	-0.9%	1.94	-0.32	-14.3%
5259	Open-End Investment Funds	$1,226	-12.7%	-3.3%	5.4%	5.68	1.09	23.7%
5179	Other Telecommunications	$173	-2.7%	-6.5%	-2.0%	0.43	-0.08	-15.7%

Statewide Drivers of the Economy

Four of the statewide driver industries contributed more than $1 billion in value added, or GSP, to the state's economy in 2008. All had positive average growth rates from 2005 to 2008, with two of them turning around their economic fortunes in the 2003-2005 time period. In addition, they had extremely high GSP LQs.

Battery Manufacturing produced $2.1 billion in GSP and experienced growth in its LQ, indicating a deepening competitive position in the state. The same can be said for a nearly $3 billion industry, Paperboard Container Manufacturing. This is a cyclically sensitive industry, yet its concentration in Pennsylvania grew and its average growth rate turned around just before the Great Recession hit. Forging and Stamping is an industry that has experienced great changes, is present across the Commonwealth, contributes more than $1 billion in GSP, and has seen its competitive position strengthen as the industry has experienced significant global competitive challenges nationally.

In the next tier of statewide manufacturing drivers are those contributing in excess of a half-billion dollars of GSP in 2008. Motor Vehicle Body and Trailer Manufacturing is the largest, with increasing competitive concentration, followed by a strong aluminum industry and Other Transportation Equipment. The competitive position of all three of these related industries has grown in the state over the past decade. Some of that growth can be attributed to defense production; innovative new products, such as shipping cases for aircraft parts, and revived competitiveness of the railroad system also have played a role in the growth.

We note the presence of two food products manufacturing industries in the mix of drivers, demonstrating the interdependence of agriculture and manufacturing. These are Sugar Manufacturing and Animal Food Production.

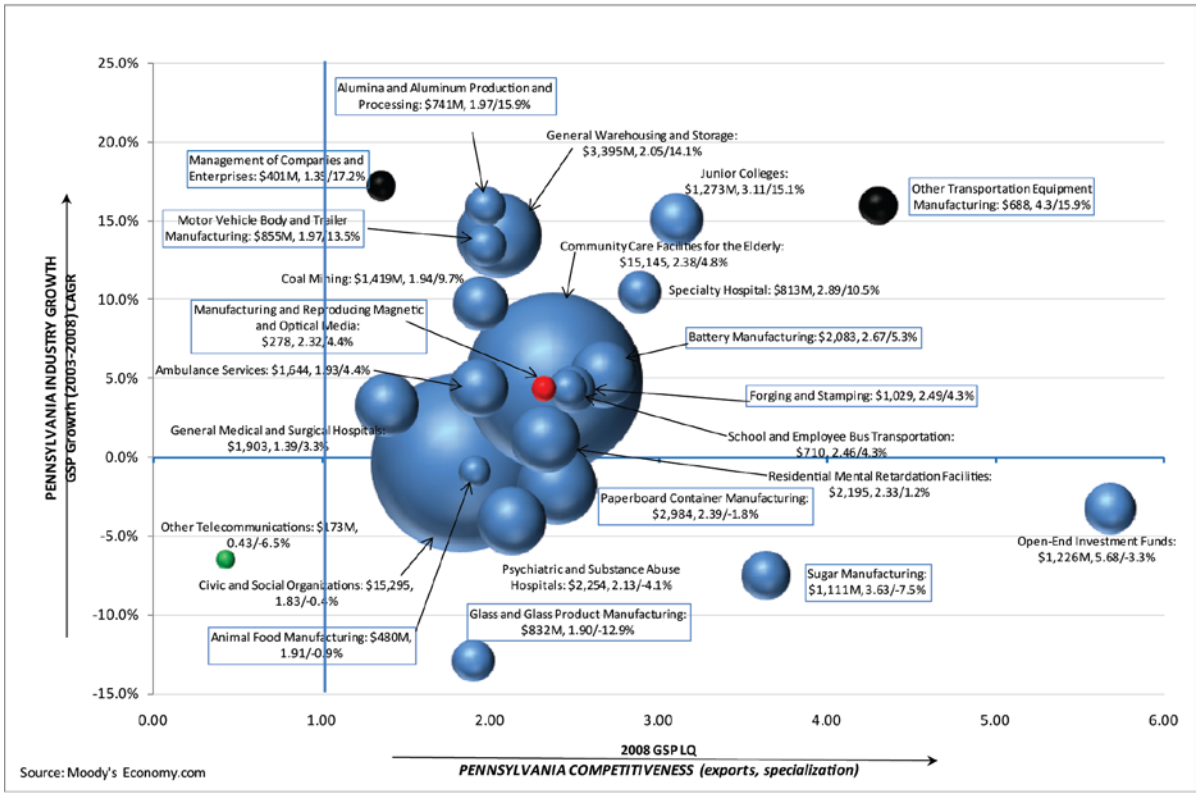
The following figure indicates the change in annual growth rate from 2003 to 2008 and the location quotient for Pennsylvania's driver industries. As can be seen, two-thirds of them grew over the five-year span, despite the recession. The figure also shows that four of Pennsylvania's driver industries are technology-intensive, with two of those in manufacturing:

- NAICS 3369 – Other Transportation Equipment Manufacturing is a very technology-intensive industry.
- NAICS 5511 – Management of Companies and Enterprises
- NAICS 3346 – Manufacturing and Reproducing Magnetic and Optical Media is a moderately technology-intensive industry.
- NAICS 5179 – Other Telecommunication

These four industries each had less than $1 billion in GDP in 2008, making them the smallest of Pennsylvania's driver industries. All except Other Telecommunication have high concentrations of production in the state.

Three other distinct industry sectors reflect specific characteristics of Pennsylvania's economy. Pennsylvania's large aging population has fueled a driving presence of population-serving industries, in addition to a well-established health-care industry. The education sector is also helping to drive the state's economy. The presence of Local Government among educational drivers reflects the fact that Moody's Economy.com follows the Bureau of Labor Statistics' rule and classifies publicly owned hospitals and schools under government. Local Government should also be present in the population-serving sector of industries. The "Other Industries" sector reflects new— Financial Services and Telecommunications—and traditional—Coal Mining and Logistics—economies in Pennsylvania.

Growth & Competitiveness of Pennsylvania's Driver Industries



Manufacturing industries are boxed. Driver GVL is omitted from the graph.

= $2B in 2008 Output

Very Technology-Intensive Industries

Moderately Technology-Intensive Industries

Low Technology-Intensive Industries

Regional Manufacturing Drivers

IRC members work in all counties of an economically diverse state. Each economic region has its own competitive strengths, costs, resources and talents. Research for this report was built up from in-depth economic analyses of the individual IRC regions and, in so doing, identified the economic drivers of each region. These drivers are in the manufacturing, service and governmental sectors of the economy. (Because publicly provided higher education shows up in the economic accounts as governmental employment, we included the government sector.)

The list of manufacturing industries that are drivers of their regional economies makes clear statewide importance of diversified manufacturing. The deep specializations run from food processing activities across the state to a restructuring pharmaceutical industry in Philadelphia. Metalworking is part of the economic base in the Pittsburgh region, as well as in Bethlehem, Erie, Wilkes-Barre and Williamsport. Wood and fiber-based manufacturing is deeply present in Williamsport. Sophisticated durable goods production is spread across the state from defense-oriented production in York and Philadelphia to a critical national resource in railroad rolling stock in Erie and Pittsburgh. We see fragments of the manufacturing industry playing critical roles in the economies from Pittsburgh, where headquarters − often of globally competitive manufacturing companies − is critical, to York and Wilkes-Barre, where the logistics industry is an asset.

Manufacturing and Manufacturing-related Industries That Are Regional Economic Drivers

Catalyst Connection (Pittsburgh)

Manufacturing

- Iron and Steel Mills and Ferroalloy Manufacturing
- Iron and Steel Pipe and Tube Manufacturing from Purchased Steel
- Metalworking Machinery Manufacturing
- Nonferrous Metal (except Aluminum) Smelting and Refining
- Glass and Glass Product Manufacturing
- Railroad Rolling Stock Manufacturing
- Pottery, Ceramics, and Plumbing Fixture Manufacturing

Management of Companies and Enterprises

DVIRC (Philadelphia)

Pharmaceutical and Medicine Manufacturing
Iron and Steel Pipe and Tube Manufacturing from Purchased Steel
Other Transportation Equipment Manufacturing
Manufacturing and Reproducing Magnetic and Optical Media

IMC (Williamsport)

Wood and Fiber based manufacturing

- Paperboard Container Manufacturing
- Wood Kitchen Cabinet and Countertop Manufacturing
- Millwork
- Pulp Mills
- Veneer, Plywood, and Engineered Wood Product Manufacturing

Sawmills and Wood Preservation

Metal Manufacturing

Iron and Steel Mills and Ferroalloy Manufacturing

Nonferrous Metal (except Aluminum) Smelting and Refining

Iron and Steel Pipe and Tube Manufacturing from Purchased Steel

Alumina and Aluminum Production and Processing

Food Manufacturing

Frozen Food Manufacturing

Other Manufacturing

Glass and Glass Product Manufacturing

Other Transportation Equipment Manufacturing

Mattress Manufacturing

MANTEC (York/Harrisburg)

Food Manufacturing

Snack Food Manufacturing

Dairy Product (except Frozen) Manufacturing

Animal Food Manufacturing

Sugar Manufacturing

Durable/Industrial

Agricultural Implement Manufacturing

Ferrous Metal Foundries

Battery Manufacturing

Motor Vehicle Body and Trailer Manufacturing

Nonferrous Metal (except Aluminum) Smelting and Refining

Other Transportation Equipment Manufacturing

Forging and Stamping

Alumina and Aluminum Production and Processing

Nondurable

Printing

Paperboard Container Manufacturing

Transportation and Logistics

General Freight Trucking, Local

General Warehousing and Storage

MRC (Bethlehem)

Non-food Manufacturing

Iron and Steel Mills and Ferroalloy Manufacturing

Ferrous Metal Foundries

Nonferrous Metal (except Aluminum) Smelting and Refining

Iron and Steel Pipe and Tube Manufacturing from Purchased Steel

Other Manufacturing
Battery Manufacturing
Food Manufacturing
Sugar Manufacturing

NEPIRC (Wilkes-Barre)
Food Manufacturing
Sugar Manufacturing
Other Manufacturing
Paperboard Container Manufacturing
Ferrous Metal Foundries
Carpet and Rug Mills
Transportation and Logistics
General Warehousing and Storage

NWIRC

Railroad Rolling Stock Manufacturing
Forging and Stamping
Iron and Steel Pipe and Tube Manufacturing from Purchased Steel

When the current data was compared to the data in the 2004 report, change was evident. Clusters were weaker as products became more commoditized and margins shrank. However, this data was counterbalanced with observations derived from the focus groups of manufacturing leaders. World-class manufacturing techniques and competitive excellence now cross traditional industrial value chains. In the Greater Philadelphia region, as an example, we found competitive strengths that were less by industrial grouping and more by executive leadership and the ability to innovate niche products in companies that are well-managed. This held for companies whether in the defense supply chain or restaurant equipment. The future of manufacturing rests on three foundations: One set will be a traditional cluster of economic activity driven by an original equipment manufacturer that gathers subassemblies from very complicated supply chains. Here, think of locomotives in Erie. The second will come from well-established manufacturing firms that, although small, are global in vision and are relentless product innovators. Here, we can point to everything from an industrial flashlight manufacturer to a customized metal fabricator that does finishing for the defense industry. The third leg consists of startup corporations and spinoff companies that are moving new platform technologies into the marketplace. Pittsburgh's medical instrument companies are providing a roadmap. What is important for public policy is their commonalities. These are discussed in the section of the report we call "View From the Top."

VIEW FROM THE TOP: Focus Groups of the Regions' Best

As the prior analysis makes clear, Pennsylvania's manufacturing losses in GSP and employment have been substantial and profound. The past decade has been a difficult one for those engaged in making products, particularly those who make products in Pennsylvania. However, all is not doom and gloom. Pennsylvania manufacturers are succeeding despite this challenging environment. They are developing new products, offering new services and creatively adding new value. Learning the lessons of those on the frontlines of remaking their industry for the 21st century is critical to tailoring policies and developing programs that will support and accelerate this transition. With this goal in mind, the study team asked all the IRCs to identify manufacturers who would represent the "best of the best" in their region. These manufacturers who have not only survived but have managed to thrive in this challenging environment were surveyed and invited to share their insight through a series of seven focus groups, one in each of Pennsylvania's IRC regions, conducted in September and October, 2010. Nearly 80 executives, representing a wide range of manufacturing activities, participated in these listening sessions. Loud and clear came this message: Manufacturing is not dead. To paraphrase Mark Twain, news of its demise has been greatly exaggerated. One of the nearly 80 participants captured the frustrating disconnect between perception and reality even more colorfully: "We are not the Easter bunny. We do exist."

Overwhelmingly, focus group participants spoke positively of their industry and of their particular prospects. They shared their love of manufacturing. Many proudly spoke of a connection to the industry that has extended multiple generations. They take their role as producers and wealth generators seriously. And, despite the difficulties of the past decade, they anticipated growth and opportunity.

They see themselves as leaders, not simply survivors. Leaders who are willing to take proactive steps, re-envision core products, rethink old practices, embrace wholesale cultural change and even make painful choices in order to compete in the increasingly global market and weather the protracted economic downturn. They talked of doing whatever it took to survive. One Philadelphia-area manufacturer employing about 50 workers with annual sales of $10 million in 2007 recounted losing "half the workforce." The cuts were difficult, but necessary to sustain the business. "We're back into growth mode now," he said. "We're much leaner coming back on the other side. Our margins are better."

"We cut staff from 140 to 80," said a York-area manufacturer. In addition, the firm made a concerted effort to reduce cycle time for new products. As a result, "our productivity is way up. Sales have gone up." The lesson, he said, is the need to adapt to changing expectations of the market. "People expect you to deliver the product quicker. People expect to have good service and good support. That's the game. If you can't do that, you're not in the game. What you're doing may be great, but that's the game today. The bar is always going to be raised. That's why we have to select our markets carefully. We don't waste our time on stuff that's not going to pay off for us."

Another York-area manufacturer weathered tough economic times by laying off his entire staff in 2009 except for two sales positions. The layoffs were so extensive, he even laid himself off. Sales had

fallen by 50 percent. However, “we’ve hired five people in the last two months” and sales are up significantly. “Right now we’re excited by the hires,” he said. “We’re having an infusion of new people. It’s the best motivated workforce in a long time.”

Despite the troubles within the industry and the economic downturn, a Bethlehem-area manufacturer said his company had managed to exceed its plan of doubling its business. “We’ve had to redefine ourselves because of the need to find new markets,” he said. “We have taken the approach that we will delight the customer base. We do things faster and better than the competition. That permeates the company top to bottom.”

The very nature of what makes for a globally competitive manufacturer is different today, these successful manufacturers agreed. Flexibility and innovation are central to the new managerial mindset of successful manufacturers. Great manufacturers a decade ago produced high-quality product, on time and at a competitive price. They had laser-like focus on the middle lines of their income statements. Today, they have to manage both the top line of the income statement (sales and revenue), along with the middle line (expense items). They have to succeed at doing both today’s job (shipping great products) and tomorrow’s job (inventing new products). A York-area manufacturer summed up this challenge in a focus group: “Ten years ago, we were a fantastic manufacturing company. Now we are a very good sales and service organization. The flexibility is throughout the organization. If we start beating our head against the wall, we just move to a new product.”

“This is our banner year,” said a larger manufacturer located in Greater Philadelphia and served by the DVIRC. “We’ve increased 40 percent. We make custom equipment. We’re diverse; we don’t rely on one product. It’s all about knowing what our customers want. We’re just hoping that sales continue.”

An Erie-area focus group participant talked of the growing need for speed: “Our approach is let’s get close and then jump in with both feet and learn as we go. We have to leverage our strengths. … We don’t have to be perfect; we just have to be good enough to live to fight another day.”

Repeatedly, these sessions returned to the value of listening to customers and responding deliberately to their customers’ needs. Many referred to customer-focused innovation as an integral part of their business strategy and a new part of corporate leadership. Instead of an “aha” moment, one Erie-area manufacturer touted the “but” moment. “We look for ‘I need this but…’ I love the but because that’s where we can do something. We’re looking for volumes that are large enough that we can have some impact but small enough that China is not going to be interested. … We’re not sitting around in a think tank, thinking what’s the next best thing. We’re looking at what we can make better and make better for your application. We’re telling representatives, ‘What can we do to solve your problem?’ ”

“We’re pretty versatile,” said a manufacturer in the York area. “We’re not afraid to try things we’ve never tried before. Our product mix has changed over the past five years. That’s probably why we’re still around now – product flexibility.”

The challenges of the past few years have been significant, even transformative. But, as the saying goes, “what doesn’t kill you, makes you stronger.” It’s a view the focus group participants have

widely accepted. “As we emerge from this, I think we will have a lot bigger piece of the pie," said a Williamsport-area manufacturer. “The recession has cleaned out a lot of companies that were teetering on the edge.”

What Keeps Manufacturers Up at Night?

At each focus group, participants were asked: “What keeps you up at night?” Topping the list was workforce worries. This is a surprising result coming at the tail end of the Great Recession and in the early stages of an anemic recovery. Among focus group participants surveyed, 94 percent rated "human-capital acquisition, development and retention" as important to their company's success over the next five years; 60 percent described it as highly important. In particular, these top performers fretted over skills, attitude and interest. Workforce issues constrained their ability to grow. They pointed to a deficit of workers with skills critical to manufacturing activities. “We can’t find machinists, welders, hands-on guys who used to be the backbone of this country,” said a Philadelphia-area manufacturer. “We have the opportunity to grow. But we can’t find the people.”

Only 18 percent of focus group participants surveyed considered cost of entry-level labor to be a problem, but 50 percent or more said availability and skill level were. For semi-skilled jobs, 25 percent of survey respondents considered cost of labor to be a problem, while more than 50 percent said availability and skill level were. Half or more respondents cited technical labor costs, availability and skill levels to be problems, with a quarter describing availability and skill level as "major" problems.

Another participant served by the DVIRC echoed the difficulty in finding workers with the right “middle” skills. “If we’re hiring engineers, engineers will be lined up down the block. But if we’re looking for welders or fitters, we may find three candidates, and they’ll all be 50 or older,” said a Philadelphia-area manufacturer.

Many believe few young people today are attracted to what is seen as a dead-end, dirty job in manufacturing. Manufacturing leaders are frustrated by what they consider to be a perception problem and by what they see as a wholesale writing off of the industry by political leaders, school teachers and career counselors. Young people – and their parents – are led to believe that few opportunities exist today in manufacturing, they said. Few people outside the industry understand how much the manufacturing workforce has changed, how critical computer and other technical skills are on the plant floor. “There are not young people willing to go into the industry,” said one Erie-based manufacturer. Another added: “Parents say that for my kid to be successful they have to go to college. Nobody’s telling the parents or the parents just aren’t believing that there are good jobs in manufacturing. It’s not sexy to be in manufacturing.”

“A few years ago we were looking to hire people, and a company laid off a bunch of machinists after shutting down,” said another Philadelphia-area manufacturer. “Those guys were told there was no future in manufacturing and they should look at health care.” A participant in the Williamsport focus group shared a similar story of workers with in-demand manufacturing skills being steered away from the industry. Her local plant was forced to wring enough costs out of production to keep her parent company from moving operations to a lower-cost country. That meant letting a number of people go.

"One of our tool-and-die guys who got laid off, he couldn't go to school to further his tool-and-die skills because he couldn't get tuition credits. It wasn't seen as a sustainable job. So he went into the health-care industry instead. That's not what he wanted to do. That's one reason why we're missing those skills."

Although they decried the lack of focus on and training for skills critical to manufacturing, they worried even more about work ethic and attitude. Finding good workers is limiting their ability to seize on opportunities, they said. "In the tool-and-die business, we need a particular skill set. Now we find that people with the skill set don't have the mental aptitude we need," said a York-area manufacturer. "They're too entrenched in old industrial norms. There's a pervasive attitude that [they] will build no die before it's time. It's an arts and crafts mentality. We've taken to hiring based on attitude and then we'll train."

"We had one position open up; 100 applied and we didn't hire one," said a Bethlehem-area manufacturer. "We're extremely picky. We go through a screening process about the attitude piece. The position we were looking for was higher skill. When we find people with the right attitude, we hire them. We don't start with skill and work backward."

A Pittsburgh-area manufacturer agreed: "We're going to

A Quick Word on Unemployment and Pay Scales

In focus group after focus group, the topic of the current job market arose. Many manufacturers told of the negative impact of extended unemployment benefits. They said they couldn't find people willing to accept jobs until after all possible unemployment benefits had been exhausted. However, manufacturers paying a higher hourly wage, even if it was only a couple of dollars, said they didn't experience the same problem. Instead, they viewed the high unemployment rate as a workplace bonanza, an opportunity for them to hire workers who previously would have been priced out of their reach.

In rough terms, Pennsylvania's unemployment compensation replaces half of a laid-off worker's gross weekly wage. It is reasonable to assume that an idled experienced machinist accustomed to making $22 an hour would not be enticed off of unemployment for a job paying considerably less. The Bethlehem focus group produced this illuminating exchange about earnings and unemployment:

Manufacturer 1: "Our starting wage is $10-$12 an hour. At those rates, we're really competing against unemployment. We went to hire five people who turned us down flat. We offered them $11.50 and they turned us down. For a secretary, we had 200 apply and they were good people. But [a job offer for] plant help gets turned down."

Manufacturer 2: "I think it's all about how much you're paying. If you're at $14 to $15 an hour, you won't have that problem."

Manufacturer 3: "I've taught all my managers, don't focus on the wage rate; focus on the productivity. Our hourly wage rate is way up, but our productivity is way up too. I would much rather pay someone $20 [an hour] and get three times the work out of them of the $10 an hour worker. I want the higher productivity people."

At the end of the interchange the first manufacturer said that he learned one thing from the focus group: He had to go back to his company and raise his entry-level earnings. In a follow-up conversation in the hallway, he said that he realized that turnover, search costs, and training costs were eating up any savings from the lower wage rate. He also noted that, probably as a result of his low wage rate, he did not have any employee whom he could promote to a position requiring a greater level of skill and responsibility.

be trying to hire 25 to 30 percent more people in the next year. At least half don't pass the drug test. That's going to be a huge problem for us. We can try to be more efficient, but it will be a detriment to our growth if we don't find them."

Beyond the issues of skills, attitudes and drugs, many focus group participants spoke of being in "competition with the government" for workers. They suggested that unemployment benefits were giving workers little incentive to find jobs. "We have had three cases of people turn down jobs because of unemployment benefits," a Philadelphia-area manufacturer said. "We would have paid $22 an hour." But even at that rate, the job didn't seem worth crossing the bridge and giving up New Jersey unemployment benefits. "The benefits outweigh the compensation." Most other participants in the Philadelphia session and at focus groups in other parts of the state indicated similar experiences. "We cannot in any way, shape or form find the people to expand our operation. We have looked everywhere for skilled machinists. Even semi-skilled," said a Pittsburgh-area manufacturer. "We can't get people to come to work. People nowadays just don't want to come to work. They're more satisfied to stay home and collect unemployment. We're turning away business because I cannot get the people."

This is not a problem limited to the more urban areas of the state. "It's tough finding the people and the resources to get the work out," said a Williamsport-area manufacturer. "I see a lot of people coming in six months after they were laid off from their last job. A lot who were making high earnings at other manufacturers can make more on unemployment than [they can] working for us." An Erie-area manufacturer echoed the complaints of his counterparts around the state: "We have no one walking through our doors. We have jobs, but nobody will come through the door because they can get paid to stay at home."

Varying Views on Temporary Employment

The manufacturing hiring process appears to be shifting away from direct access to full-time work. Instead, many focus group participants reported growing through temporary agencies to find workers and conduct preliminary screening for aptitude, attitude and potential substance abuse. Some temp agencies appear to be responding to this change in the job market by tailoring their services to fit the particular needs of manufacturing clients. However, not all interactions with temp agencies have been productive and smooth, as this exchange among participants in the Pittsburgh-area focus group showed.

Manufacturer No. 1: "For entry-level jobs, we have been using temp agencies."

Manufacturer No. 2: "Do they actually screen? We used them once. They just sent bodies."

Manufacturer No. 1: "We went with a second group. They actually interview us and look at our work situation before they will send anyone over. The temp agency doesn't screen for drugs. We're not looking for anything exotic. We had people come over and work for three months that we wanted to hire and then they failed the drug test."

Manufacturer No. 2: "We tell them before that we're going to test for drugs and they still fail."

Manufacturer No. 1: "They will work a month and then they're gone. I don't know if anyone wants to work anymore."

Despite the number of focus group participants who suggested that the federal government's extension of unemployment benefits was making it difficult for them to find workers, several focus group participants described the current difficult job market as an unparalleled opportunity to hire top talent. "We have managed to improve the caliber of our workforce," said a Bethlehem-area manufacturer. "We have been in heaven the past three years. We do everything not to lay off people. We wish we could hire more. One of the challenges in the past is that we couldn't compare with higher-paying firms. Now we can get anybody we want at a great price with fabulous attitude and skills."

Learn to Earn

The focus groups indicated a change in the hiring process, particularly for entry-level, or "gateway," manufacturing jobs. Increasingly, manufacturers are using temporary employment as a screening tool to allow them to "try out" applicants before offering them permanent, full-time work. Among focus group participants surveyed, 43 percent indicated that new hires for entry-level, low-skilled jobs are culled from top-performing temporary workers. "We have gone from directly hiring employees to hiring temps and then only hiring the best of those as full time. … It's very difficult to get good trained employees," said a participant in the Wilkes-Barre focus group.

Another benefit is that workers employed through a temporary service don't come with the same workplace mandates as those hired directly through the company. "We don't have problems with employment laws if we go through a temp agency," said a Philadelphia-area manufacturer. Or health-care mandates, as a Wilkes-Barre-area manufacturer pointed out: "We're looking at the whole way we do business with employees. We pay 65 percent of COBRA now. That's a cost that continues. If we bring people back, then we're going to use temps. If that demand goes away, then if we have to lay them off, then we won't face that 65 percent of health care costs. I think more people will be using temps because of that."

"So much of our work is cyclical," said a York-area manufacturer. "We can put the responsibility of benefits on the temp agency. We do 30-60-90 days to hire. There are specialized [temp] firms out there. Their workers come in and hit the ground running. It's a great screening tool."

Among the Erie-area manufacturers who indicated they were using temp workers, one said agencies are how he gets unskilled workers in the door. Those who show a commitment to the work are given opportunity for advancement. "We use one agency who knows what we are looking for, not just technical skills, but the kinds of people. When they walk through the door, they bring their mind with them. They show up on time," he said. Even among temporary workers, "we try to create a work environment that people want to stay with us. I can't afford to be the highest paid place to work. We sponsor them at PMI (Precision Manufacturing Institute) and then there's some loyalty. But you have to show me that you are the kind of person I want to commit to."

But outsourcing hiring to temporary agencies is not a solution to the primary issue of limited skills and poor attitude, as one Philadelphia-area manufacturer pointed out. "We usually use temp-to-hire so we can get a sense of their work ethic," she said. "We've just about given up on that because they seem

to be picking up the dregs. Once in awhile, we may latch onto people we can keep. But usually we get lots of drama. Temp is a good way to hire, but the quality of the person is tough."

Training

Aside from the growing shift toward temp agencies, focus group participants indicated a proactive, creative mix of tactics successful manufacturers are using to attract, retain and engage talent. "We hire a fair number of young engineers and train them ourselves," said a York-area manufacturer. "Internship and co-op programs have been very useful to see what they're like. For our salaried group, eight years ago we started working with a group ... that does personality profiles. … The profile helps us hire, but it also helps people work together and gives us all language and skill in keeping people and using their talents."

But training isn't only extended to the more highly skilled workers. "We've been taking unskilled workers and having them sign a contract that if they will stay four years, we'll pay for their training," said an Erie-area manufacturer. Echoed another: "A good part of our hourly workers will be gone in about five years. We can't find anyone who will fill their jobs. We're bringing in relatively inexperienced workers and training them so we can get overlap. We're trying to avoid a problem where a third of our workforce leaves [at once]. Training is shadowing, learn to earn and formal programs." Among focus group participants surveyed, 49 percent estimated they devoted 9 to 20 hours of formal training to each employee every year. Another 33 percent indicated that their workers received 21 to 40 training hours annually.

"We've changed our model," said a Pittsburgh-area manufacturer. "We used to just hire anybody who came in the door. Now, we're starting to put small facilities where we can find workers. We're locating near clusters of talent. … We went out to Amish country [in Indiana]. We took the building to the place where we could find people."

Management Practices

Focus group participants, who were selected as being among the "best of the best" manufacturers in their regions, frequently credited embracing new management practices as key to keeping pace with changing economic, industrial and technological environments. Whether they "saw the light," as one manufacturer put it, through lean production, strategic planning, Rockefeller Habits or the Boy Scout Code of Honor, focus group participants repeatedly talked of the need to manage differently in the 21st century workplace. Rockefeller Habits, based on the business strategy book by Verne Harnish, encourages aligning practices to goals and improving internal communication. One focus group participant told of adapting Boy Scout principles and practices into a strategy for management and advancement. However, the management philosophy most often cited was lean, which focuses on eliminating activities and expenditures that don't create value and "preserving value with less work." "If you're not doing lean, if you're not doing some sort of continuous improvement, I don't know how you're still around," said an Erie-area focus group participant.

"We've done lean so that we can be very efficient," said a Philadelphia-area manufacturer. "We've cut our costs substantially." In particular, focus group participants spoke of receiving help from IRC staff in their management transformation. "We engaged DVIRC and started down the lean path about four years ago and became very efficient," another manufacturer said.

A Williamsport-area manufacturer credits IMC and lean with "still being around. In the late 1990s, we had about 50 percent of our business go overseas. We started with IMC with lean training. We essentially re-engineered the process. … We used to have a chaotic stack of bundles when we processed panels to put together a cabinet. With the new system, robotics bundle panels into 4-hour kits that are presented to every operator. The benefits that are derived from really diving into these types of processes is really great."

A Pittsburgh-area manufacturer noted that his company is "only starting its lean journey. We had been successful and never saw any reason to do any different. If in any way you were associated with the automotive or transportation industry, you got a big wake up call. Now we're making a lot more changeovers, a lot more shorter runs, which is a lean principle. But workers weren't trained to do that. It's something that has to be done. I believe in it."

"We continually try to remove time from every process," said a York-area manufacturer. "We have taken lean through the entire process."

One Wilkes-Barre manufacturer described his "80-20" strategy. "We focus on the 20 percent of components that drive 80 percent of profits and business. We shed the rest that we're not good at. A lot of people chase the top line; we chase the bottom line. … You have to simplify your business, eliminate stuff that doesn't make you money. … We make it really easy to decide what business to go after and what we don't. Lean is part of that. Every employee has gone through lean training. … The challenge is to grow but you have to know where you can win and where you can't and don't lose a lot of sleep over where you can't win. That's probably been one of best things we've done and we didn't look back. We have had similar revenue levels where we had 125 employees; now we have 45 employees. When we did value stream, we found that our flashlights were traveling about a mile and being picked up 50 times. Now they go about 3 yards and get picked up 20 times. We're eliminating waste that doesn't add value."

Although lean is a production management strategy, focus group participants frequently described it as a culture shift that everyone in the company – top to bottom – needs to trust. "I'm trying to change toolmakers' mindset that they have had over 35 years. I have to sell that it is the best way to get better. I had to say this is starting with me. We need to evolve and change to become the next level supplier," said a Philadelphia-area manufacturer.

"Ninety percent of our workforce has gone through lean," said one Bethlehem-area manufacturer. "One hundred percent has gone through team-building," noting the assistance his company received from the Manufacturers' Resource Center in accessing the training.

The entire workforce, from managers to production-line staff, need to develop a trust that pruning encourages growth, focus group participants said. "The overarching theme is people," said a Philadelphia-area manufacturer. "Change the culture. Change the mind, and the body follows. You're saving the whole for the sacrifice of a few. You need to develop trust of the people that lean is a growth strategy. Reduce your footprint or workforce so that you can grow overall. It becomes really clear-cut once you get that lifeline for everyone to understand that you have to get that reduction. … Usually one person takes a training class and then says let's do lean. Good luck with that. It takes a whole culture."

Said another: "We change for two reasons: We change because we feel heat or pressure or we change because we see the light. That's the sustainable. The challenge with lean is getting people to see the light. If we can get our organizations to really see the light, then our job is done. You can get out of the way then. We really work hard on communication. In every meeting, I say if you're having problem seeing the light, come see me."

Continuous Improvement/Employee Involvement

Among focus group participants surveyed, 56 percent described process improvement as highly important to their company's success over the next five years. Many focus group participants spoke of implementing strategies to help employees "see the light." Several have adopted gain-sharing programs to provide employees with incentives to increase production, streamline processes, eliminate waste and focus on company goals. Some of this has grown out of a difficulty in attracting and retaining workers with the necessary skills.

"Incentives have produced some really good results," said a York-area manufacturer. Noting that her company produces commoditized products, she described the employee incentive program as an attempt to reduce cost. Quarterly bonuses are based on a targeted number of pallets per shift and worker hours per pallet. "Of course, we have to maintain quality. [But it's] been a way to get people excited."

"We tied lean to gain-sharing," said a manufacturer from the Wilkes-Barre area. "They get a monthly bonus based on performance. Now it's affecting their paycheck. We want to get them 7 percent bonus on their paycheck every month. [They know that a] hopper filled with trash is $1,000 in gain-sharing. That's not just case a beer; it's a car payment."

Another Wilkes-Barre focus group participant described his gain-sharing program in which 40 percent of profits go to employees. "I joked with employees that I'm going to change gain-sharing to loss-sharing. It has really helped improve morale, but it's hard to make it visible and people lose track of it. It's hard to keep [the program] visible, particularly when times are good."

"We put in a [gain-sharing] program 13 years ago," said a participant in the Williamsport focus group. "Every Wednesday at 2:50, I stand out and look at what we shipped previously and see if we came out ahead or behind. If, in a 4-week period, we came out ahead, everyone gets a bonus. If we don't, then they don't. It doesn't carry over. It's a companywide effort, and people are more interested in the business. It's really helped us."

Adding Value

Several focus group participants raised the threat of commoditization. Managing to wring more and more time and cost out of their products is a top-of-mind concern. “We need to make sure that we don’t stand still or we will become a commoditized product,” said a York-area manufacturer. “It’s not just about the product but about our expertise.” Another ticked off the demands they face: “We have to be much more nimble, provide faster delivery, have lower prices. Quality is a given.”

Despite the challenges, participants at each focus group spoke positively and proudly of their successes in reforming processes, re-engineering products and redefining markets. At times creative, innovative and pragmatic, they talked of being willing to let go of the old and embrace opportunities where they existed. "I choose to play in a market that is about $150 million," said a Wilkes-Barre focus group participant. "I choose niches where customers pay for value, where there is some sort of entry barrier."

Focus group participants repeatedly spoke of the need to add value as a way of winning business and staving off commoditization. This added value often comes in the form of added service. “Ten years ago, we were a fantastic manufacturing company. Now we are a very good sales and service organization,” said a York-area manufacturer. “Flexibility is [now built] throughout the organization. If we start beating our head against the wall, we just move to a new product.”

“We have had to be much more service-focused. We have to be the experts to help companies find solutions … We had to understand the whole lean process of helping clients find ways to use lean processes. We invest in service-focused people. Those people are getting older and we’re trying to find people with the same mindset. The whole company is focusing on the customer and developing an understanding of what their challenges are instead of just what we want to sell.”

Many described their lean journey as transforming how they do business and enabling them to add value in an increasingly fast-paced, highly competitive and increasingly commoditized market. “We were 10 to 12 weeks,” said one Williamsport-area manufacturer, echoing an experience shared by other focus group participants. “Now we’re down to 8 or 9 days. …. We can now schedule a date and promise it and have confidence we’ll do it. We deliver 97 percent to promise. That was more important to customers than taking the lead time down. We learned a lot in the process. If companies aren’t doing lean, they’re in a world of hurt. If you get into some of the Chinese manufacturing companies, you would be amazed how far behind they are. They are doing so much by hand. They’re not doing what we are doing in the U.S. to adapt technology.”

Product Development

Among surveyed focus group participants, 52 percent labeled the launch of new products and services as highly important. Yet, new product development, even among these good performers, has been largely driven by customer requests. Nearly two-thirds of survey respondents described "customer-focused innovation" as highly important over the next five years. Investment in research and development, it would seem, tended to be cut when survival was on the line. Sixty-two percent of survey respondents said they invested 5 percent or less of sales in new product development or

research and development. "We decimated our research development," said a York-area manufacturer. "We were in survival mode." This disinvestment may have long-term consequences given that nearly half of survey respondents (44%) attributed up to a quarter of annual sales to products that had been introduced within the past three years. Another 25 percent of respondents said new products accounted for 26 percent to 50 percent of sales.

"It's as much culture as chemistry trying to get new products," said an Erie-area manufacturer. "We don't have an R&D budget. We just have a handful of people to focus on that. We're trying to see where we can get resources outside from suppliers. They've been pretty good at lending their knowhow, such as screening new polymers. Input from those guys saves us a little time. We look for ways to partner."

"We do virtually no product development. Our customers are telling us what they want," said a Pittsburgh-area manufacturer. "We will make suggestions. We're probably closer to [being a] Tier 3 [supplier] than to Tier 2. In the last year, we have made a lot of inroads in getting to sit down and make suggestions. They are beginning to see a value in that."

"We have increased our direct sales force. I want them to call on the end user to generate pull-through demand plus develop what customer needs are," said a Wilkes-Barre-area manufacturer. "If you listen to your customer, you can really develop some niche products. … At the end of the day, listening to customers is the best way to get new products."

Another Wilkes-Barre focus group participant echoed the customer-focused development approach: "I decided to go out and talk to customers. That's where we get product ideas. Most of our R&D is at the vendor level. That helps us decide what products to go with. Then you have to sell your management, your board, all the way down to the floor when trying to sell a new idea."

A participant in the Philadelphia-area focus group noted the importance of new products to her company's bottom line, but indicated that customer request was a primary source for development ideas. "This year's product development is next year's revenue," she said. "We have incentives for marketing but also incentives for engineering to speed up the product cycle. We have trained customers to come to us now. It takes years to have them know how we do business and how they fit in."

A Williamsport-area manufacturer gave voice to the challenge of aligning the creative process of product development with lean principles: "We cannot put the same techniques of taking apart a standard process into making something that we don't even know what it is. We're rethinking, being very specific about what we are targeting. When we think of lean, it's one at a time. When we think of lean product development, it's a lot at the same time. It's about trying to get a lot better at increasing the chances of finding a viable product to sell. Whenever we try to apply lean to product development, it falls apart. It's a different discipline."

For one Erie-area manufacturer, close is good enough in a marketplace that moves so quickly. "Our approach is let's get close and then jump in with both feet and learn as we go. Only don't be so bad as to get kicked out of game. Currently we're doing packaging for medical and food products. We're

going up against huge companies. … Our chemists have the freedom to work with loose parameters. Our suppliers know that if they bring a new idea to us, that we will get it out in six months instead of sitting on the shelf of a competitor. We can get it on the market. We have to leverage our strengths. It's guerrilla warfare. We don't have huge buying power. We don't have to be perfect; we just have to be good enough to live to fight another day."

Financing

Turmoil in the financial market has rippled through manufacturing. Although only 12 percent of survey respondents described availability of bank loans as a "major problem," several focus group participants said they had taken to financing business investments and improvements out of their own pocket. Some have found it difficult to borrow money. Others, who may have no problems accessing financing themselves, have seen their customers unable to tap credit.

"If we needed a loan, we could get one. But our customers can't," said an Erie-area manufacturer. "Whether they needed $10,000 or $250,000, they can't get those. That's what has hurt us. We changed terms on our small orders to let our customers pay by credit card."

Several focus group participants indicated that a growing number of industrial customers were paying for orders of less than $10,000 with credit cards as a way of securing their payments from industrial customers. This reflects the demise of the factoring industry as a source of credit security during the credit freeze of September 2008 and the deterioration of the credit position of many industrial customers. One participant reported purchasing receivable insurance, which was the first time the research team heard of this European practice entering the U.S. market.

"We became world-class bankers," said a manufacturer in the Wilkes-Barre area. "The bank we were working with wouldn't extend our line of credit. We were building a workforce. We had great receivables, we had money, but no one would do anything for us. We started selling the business to banks for 18 months. We got NEPIRC to do another low-interest loan with us."

Said a Philadelphia-area focus group participant: "We're trying to maintain the P&Ls that the banks require. We did lose a lot of money. We embraced lean in the early 2000s. That's why we're still here. But the banks are so tied to P&Ls. We're a slave to them instead of being able to grow business."

In the section below that discusses supply chain relationships, the issue of credit and the evolution of mid-sized manufacturers into becoming part of a shadow financial system becomes clear. The math is straightforward. To secure discounts from their suppliers, the best manufacturers pay within a 7- to 10-day window. This is especially true if the vendor is a much larger company. Then these same manufacturers provide credit to their customers, and the larger the customer, the more frequently onerous terms are applied. What was once paid with a 2 percent discount in 30 days is now being paid with the same discount 45 to 90 days after receipt of product.

Information Technology

Among focus group participants surveyed, more than 20 percent estimated their companies' investment in information technology as more than 5 percent of annual sales. "The manufacturing of tomorrow is going to be here faster than it was in yesteryears. You have to stay ahead of that or only shortly behind in order to stay effective. That's difficult," said an Erie-area manufacturer. "It's that technology moving forward that we as company owners have to watch and embrace or be left behind. And we can't even imagine it."

"We're becoming more instant now, even in manufacturing," said a York-area manufacturer. "When changes are made to order, it has to be instantaneous. It really is becoming a world that, without IT, we don't exist. … It's amazing how we're doing more and relationships are closer and closer. We're all in the relationships business."

"Our business has gone from traditional to unreasonably low lot sizes and time schedules," said a Philadelphia-area manufacturer. "IT has allowed us to keep up. It's unlikely that people in China and India can keep up and get inventory here as quickly as we can." Just-in-time inventory management on the part of customers with short order, or lead, times given to suppliers provides a competitive edge to production locations that are near the customers.

Manufacturing and Social Media

Discussion of information technology use prompted this exchange among participants in the Erie focus group.

Manufacturer 1: "I think we put up our first website in 1995. We're on our fourth version. This is the first version that is driving business toward us. … We're at the point now where we get one or two qualified leads a week. It's ridiculous to think that we had been missing out on those opportunities. I've been amazed. It's better than any call center or sales rep we have used over the years."

Manufacturer 2: "Our website is really generating leads. One of the big things was developing a good quote request form. Most of our customers are working during the day. We will get quote requests from 6 p.m. to 1 a.m. We get most of our traffic when the East Coast workday is over."

Manufacturer 3: "If you're not involved in social networking, you should be. That's been big for us."

Manufacturer 2: "We have Twitter and Facebook pages and YouTube pages for all of our products. It's throwing things out there. … Essentially we have a virtual community about the use of the product. One other thing, when you have those profiles out on the Internet, if somebody searches our product, you're not just going to get our website, you're going to get our Facebook page, Twitter page, YouTube. That makes you look legitimate to potential customers. It's a credibility check. It's almost like a reference check, the fact that we have so much referred back to us."

Manufacturer 4: "We use [Internet requests for information] all the time to get leads. If they took the time to fill all that out, then they're a good lead."

"We couldn't have grown our business the way we have without an update of our system," said a Williamsport-area manufacturer. "When I was asked to take over, we didn't know where we were making money. Our financial system was so archaic. … It's our fifth go on software. We won't go through another while I'm there. I mandated that there would be no modifications to it. We would use the

system how it was designed. As hard as that was, it has paid dividends. Now we know exactly where we are making money. I know where to put our resources and where not to."

"For us, be it our supplier portal or how we are gathering and looking at data along the production line, IT has allowed computers to do a lot of the tactical heavy lifting and allows humans to focus on the more human and strategic side," said a Pittsburgh-area focus group participant. "We also leverage bar codes. We average 56,000 [transactions] per day. If we had to write all those down, the mistakes and loss of value time would be tremendous. It's gotten rid of an incredible amount of mistakes. It decreased assembly errors by almost 80 percent by going to paperless work orders. You can calculate the ROI."

"Our IT has extended to our customers' IT," said a Williamsport-area focus group participant. "We developed their order forms within their systems. If we didn't bridge that gap, we could never have gotten the business because they couldn't do it themselves. The integration of that supply chain lets you reach right into your customers' operation and try to figure out what they need."

Small to midsized manufacturers are recognizing the need for upgraded information technology, but they often struggle with selection and investment criteria. "The tough thing with IT is that it is a necessary evil. When you get to a certain size, you have to have it," said a Bethlehem-area manufacturer. But "the difficulty with ERP or any other IT system is that, once you make the decision and make the investment, you're tied [to it]."

"It's not only that you don't buy ERP every week, but you're not a good enough expert to know what you're buying," said a Pittsburgh-area manufacturer. "That's why we're going with a consultant that we found through Catalyst. I can make screw machine parts, but I don't know a dang thing about business systems. You have to use outside expertise."

A participant in the York focus group also emphasized the "necessary evil" of technology theme. This manufacturer spoke of the yoke that ERP systems can pose for manufacturing processes: "The problem with big ERP systems is that the counts become the big issue. We said we don't care if the count is right. All we cared about was how many products were available and the burn rate. It removes all the accounting mentality out of the process and replaces it with a more realistic estimating of what the process is. We find that despite all the focus on visibility, it is constrained by the accounting mindset of ERP."

Williamsport manufacturers echoed the potentially double-edged sword of information technology. It is both time-saving, yet time-consuming, meaning that it is both cost-saving and cost-producing. "Lean has not played well with our ERP system. We have gotten to the point that we have people spending a lot of time fixing transactional problems that add no value." Added another: "We quickly became concerned about the cost of data and the cost of fixing data. … Literally, we had it where we could produce product and have it on the truck faster than we could do the paperwork."

A Bethlehem-area focus group participant summed up the technology challenge, particularly for small and midsized manufacturers: "You can sink a lot of time and money into IT. Also, if you don't have the right people, don't bother. We discovered it was technology for technology's sake."

"IT should never drive your business," said a Pittsburgh-area manufacturer. "IT should enable your business. When IT starts driving your business, you need to start asking questions."

Yet, some focus group participants are seizing on new technological devices and the Internet connections to update their images and develop new ways to sell products. "We send all of our programs to our machines wirelessly," said a Pittsburgh-area manufacturer. "We're starting to put iPads in the plant. We have iPads for all the supervisors. They can talk to each other whenever they want. We can move our programs through the iPad process. We can look at data and drawings. … We're a 50-year-old company. It looks like we are young, hip, ready to move."

A Bethlehem-area manufacturer told of a new online interface designed to improve customer service while also increasing sales. "What we do is a lot of requoting. We have about 50,000 line items that we're making available to customers online so that they can go through and run any kind of pricing scenario. They can see a real-time pricing on parts. They can order online and then get an email order confirmation. We can get insight for marketing that they were in there looking at a part but didn't order. It always seems like one of the departments is slow. Now we can offer discounts online for underutilized departments."

Supply Chain

Focus group participants indicated that they feel caught in the middle between suppliers and customers, financing longer periods between orders and payments. "We used to get good turnaround on cash," said a Wilkes-Barre manufacturer. "Where previously we could get net 2 percent 30 days, that net 2 percent is 45. Now it's out 90 days. We have become a bank. We've been good over the years managing cash flow. It's just that it's a pain. … We had a great March, lots of overtime and raw materials. Then we had to wait for our money. We had good cash to pay our bills, but we had to wait for payment."

"We have tightened up our credit terms from the good old days of 90 to 120 days," said another participant in the Wilkes-Barre focus group. "I won't let anyone go past 60 days. We'll cut them off. With new business, we're asking for money up front."

Yet to get any discounts from suppliers, "we have to pay in 7 days. … The supply chain is very tight, but the lead times are very long. We don't have the silver bullet."

Focus group participants talked of greater partnerships with suppliers and vendors. "We're leaning more and more on suppliers," said an Erie-area manufacturer. "Our suppliers are more involved. They're bringing more of their services to the table for them to be competitive. What else can they provide?" Among focus group participants surveyed, 59 percent described supply chain management and collaboration as important to their company's success.

"Every month, we give [suppliers] an update on our needs so they can have it accessible," said a participant in the Bethlehem focus group. "Then we provide them with a quarterly report card on how

they have done. Our philosophy is don't take the last nickel off the table. We don't leave dollars on the table, but we we'll leave nickels."

On the other end of the supply chain, "Our vendors … are offering to co-market with us because they can't beat the price of one of their competitors," said another Erie-area manufacturer. "They're open to that."

A Pittsburgh-area manufacturer noted that customers are expecting more from him, which in turn makes him expect more from his suppliers. "We are forced by our customers. They really are not going to allow too much sloppiness in the system. We have our hands full just taking care of the other side of our business, our suppliers. That's a big part of our thrust now, getting a better handle on our supply chain."

A manufacturer summed up the challenge when he said: "What I've been hearing is stay away from the commodities. Go after the niche market. Probably a lot of us collect a crapload of data but we're not good about transforming that data into product and opportunity."

Opportunities for Policies and Programs

The focus group sessions indicated several areas for programmatic support for manufacturing. These include:

- Targeted workforce development efforts designed to increase the number of potential workers with skills critical to manufacturing.
- An integrated suite of services that build on a foundation of strategy and management practices that use lean and other tools to promote cultural change.
- A one-stop source for help with product development, continuous improvement and marketing. Providing enterprise-wide approaches to company transformation should be a priority service goal of the IRCs.
- Assistance with information technology evaluation and acquisition, particularly regarding the costly, critical choice of an enterprise resource planning system. This should also include assistance in turning data collected through ERP systems into opportunity for product and process transformation.
- Help with harnessing the potential of online networking. This could come in the form of peer-to-peer exchanges facilitated by the IRCs.

VIEW FROM THE MIDDLE: Manufacturing & Middle-Skilled Employment

Following up on the focus group observations about a lack of workers with skills critical to manufacturing, the research team explored the state of middle-skill occupations in Pennsylvania. Research and news media accounts, as well as discussions with manufacturers, suggest a changing manufacturing environment. Christopher Rugaber, an economics reporter with the Associated Press, wrote in an October 2010 article that "the job crisis has brought an unwelcome discovery for many unemployed Americans: Job openings in their old fields exist. Yet they no longer qualify for them." The manufacturing plant of today, Rugaber wrote, requires that factory assembly workers be able to program the computers that run the machinery; plant managers are hired not only for their experience but for their certifications in lean manufacturing. The machine tenders of old are now quality inspectors in a manufacturing environment where computers run the machines. David Altig, research director at the Atlanta Federal Reserve Bank, said manufacturing workers are not only being asked to increase their GSP but to "broaden it as well." Human resource specialists, on the lookout for multiskilled employees, have dubbed job candidates with this desired rare new skill set "purple squirrels" – and they would rather wait for the rare squirrel than settle for less.

Visiting a contract drug maker near Cleveland, Ohio, that supplies pharmaceutical companies, *New York Times* reporter Motoko Rich found that supervisors had reviewed 3,600 applications over the past year and had hired only 47 people for jobs paying $13 to $15 an hour, or about $31,000 a year. Large numbers of the would-be workers reportedly were disqualified because they failed to meet expectations that they be able to read, do ninth-grade math and demonstrate modern soft skills, such as working in team situations and showcasing motivation.

The Great Recession of 2008 has raised concerns about the ability of the U.S. economy to generate jobs paying earnings that enable workers to support their families. This has led to an intense examination of the structure of the economy, discussion of the resulting income distribution, and consideration of public policies that support long-term prosperity and economic opportunity. There is widespread consensus that the economic restructuring that has been under way since the 1980 to 1982 double-dip recession may have accelerated with the current recession. The erosion of earnings from the middle has led to an overall shift in the distribution of incomes. This redistribution of earnings has been associated with an overall reduction in the proportion of jobs in middle-skill occupations.

Two Major Sets of Studies on Middle-Skill Occupations

MIT economist David Autor has surmised that the skill profile of the United States and other advanced economies has taken on an hourglass shape and will continue to do so in the years ahead. He based this observation on conclusive evidence that job growth has become concentrated in high- and low-skilled occupations, with little growth being seen in middle-skill ones. Despite being on opposite ends of the labor market structure, low- and high-skilled occupations share two key characteristics: They are not routine and are difficult to automate.

Autor examined the implications of such restructuring of advanced economies and made the following observations:[9]

1. Employment growth is polarizing, with the growth in new jobs concentrated in relatively high-skill, high-wage jobs and low-skill, low-wage jobs.
2. This employment polarization is widespread across industrialized economies; it is not a uniquely American phenomenon.
3. Key contributors to job polarization are the automation of routine work and, to a smaller extent, the international integration of labor markets through trade and offshoring.
4. The Great Recession of 2008 has quantitatively but not qualitatively changed the trend toward employment polarization in the U.S. labor market. Employment losses during the recession have been far more severe in middle-skill white- and blue-collar jobs than in either high-skill, white-collar jobs or in low-skill service occupations.
5. As is well-known, the earnings of college-educated workers relative to high school-educated workers have risen steadily for almost three decades.
6. Less widely discussed is that the rise in the *relative* earnings of college graduates are due both to rising *real* earnings for college-educated workers and falling *real* earnings for workers without a college degree, particularly less-educated male workers.
7. Gains in educational attainment have not generally kept pace with rising educational returns, particularly among men. This slowing pace of educational attainment has contributed to the rising gap in college versus high school earnings.

Autor's observations are in contrast with a November 2007 paper by Urban Institute economists Harry Holzer and Robert Lerman. After examining the U.S. Department of Labor's occupational projections, Holzer and Lerman concluded that, while a shift was occurring in the composition and growth rate of employment, demand for middle-skill workers would continue, not because of employment growth but because of job openings triggered by an aging middle-skill workforce. Holzer and Lerman argued that "the demand for workers to fill jobs in the middle of the labor market – those that require more than high-school, but less than a four-year degree – will likely remain quite robust relative to its supply, especially in key sectors of the economy. Accordingly, we see a need for increased U.S. investment in high-quality education and training in the middle of the skills range – not just for college graduates in science, technology, engineering, and math (STEM) fields." (p. 3)

Evidence continues to support Holzer and Lerman's view:

- Even though the proportion of middle-skill jobs in the economy has shrunk from 55 percent to 48 percent, middle-skill occupations still represent almost half of all U.S. employment.
- Within the middle-skill jobs class, many occupations have seen large increases in employment.
- Wage gains *per year of schooling* are comparable between associate and bachelor degrees.

[9] An accessible review of Autor's arguments is offered in the Economic Focus section of the September 9, 2010, issue of the *Economist*, titled "Automatic reaction: IT spending has hollowed out labor markets, to the detriment of middle-income workers."

- The U.S. Bureau of Labor Statistics projected that 45 percent of all job *openings* between 2004 and 2014 would be in middle-skill occupations, compared to 33 percent for high-skill and 22 percent for low-skill occupations.

Holzer and Lerman wrote: "Jobs in all of the middle-skill categories combined (including positions requiring substantial on-the-job training) will generate 21 million openings over the decade (2004-2014), or nearly 40 percent of the total. Within this category, jobs specifically requiring postsecondary vocational awards or associate degrees will grow at more than 20 percent, a rate above the growth in jobs requiring only a bachelor's degree or a bachelor's degree plus work experience" (p. 19).

It should be noted that Holzer and Lerman's review, as well as the BLS projections, were made before the Great Recession of 2007 upended the economy. As such, the projections and timing will not be fulfilled. However, the information they provided on the trend in job creation should reassert itself once economic recovery is fully under way. Reports of a "hollowed out" middle of the labor market and an "hourglass economy" have been overstated, they concluded, and analysis of Pennsylvania's labor market lends support to their position.

Middle Skill vs. Middle Wage

Before discussing findings specific to Pennsylvania's labor market, it should be noted that there is a degree of confusion surrounding middle-skill occupations and middle-wage jobs. Although a strong correlation exists between the human capital, or the knowledge content, of a job and its earning potential, some lesser-skill jobs have higher earnings than some higher-skill jobs. This occurs when employers have the ability to pass along wage costs to their customers. Traditionally, this has been in strongly unionized manufacturing industries, but it is now more likely to be found in the public sector. A second area of confusion exists in measuring the skill content of an occupation and the educational attainment (number of years of schooling and the degree earned) and training required for new positions with occupations. U.S. Department of Labor projections are published for 10 highly aggregated occupational groupings. As such, Holzer and Lerman, as well as individual state studies that followed their lead, confined their examination to these major occupational groups. Although this is appropriate for examining broad trends, it makes it difficult to look at occupations and their required skill levels within industries.

Where there is little confusion is in the erosion in the share of middle-skilled occupations in the U.S. economy, as measured in the commonly accepted aggregated form, which was triggered by a shift in the structure of work. Specifically:

- Proportionately, more high-skill jobs and low-skill jobs have been generated than middle-skill positions.
- Low-skill job creation has been concentrated in the service sector.
- Manufacturing has witnessed a dramatic decrease in the number of positions − a decrease that has not been paired with an equal drop in the value of production.

- Productivity, particularly in manufacturing, has increased dramatically.
- Some job loss is a statistical artifact, as hiring that used to be accounted for in the manufacturing sector of the economy has been outsourced to temporary staffing agencies (resulting in the jobs being labeled as “service sector” positions) and has been contracted out to independent service providers.
- Major gains in productivity in manufacturing are associated with increased automation driven by the widespread adoption of computer technology into machine tools and assembly lines and the integration of computer-controlled equipment.
- Major gains in total factor productivity in manufacturing have also been achieved through automation decreasing requirements for supervisory personnel and the removal of back office, administrative support staff.
- Increased trade exposure has resulted in lower-skill manufacturing operations, especially of long-established consumer products, to shift to regions and nations with low-cost unskilled labor.
- This shift in the number of positions and the type of jobs is mainly due to the harnessing of distributed but integrated computer power on the factory floor, coupled with the adoption of lean manufacturing techniques (also known as the Toyota Production System) and the movement of lean techniques into the back offices of manufacturing corporations.
- Substantial middle-skill job creation will take place due to the size of this occupational sector and due to large-scale expected retirements over the next decade. This will result from job demand to fill middle-skill job openings rather than net new job growth.

The widely accepted definition of a middle-skill occupation is one that generally requires new hires to have attained more than a high school diploma, or a GED equivalent, but less than a bachelor’s degree. For this analysis, we compared educational attainment in the Commonwealth for adults age 25 and over to the distribution of attainment for the nation as a whole. This age cohort was chosen because the majority would have already completed their formal education. The following table provides an idea of the potential workforce in each educational category.

Percent Distribution of Educational Attainment of PA and U.S. Adults (age 25 and older)

	United States	Pennsylvania	Difference
Educational Attainment	201,952,383	8,609,133	(PA-US)
Less than high school	14.70%	12.10%	-2.70%
High school/GED	28.50%	37.70%	9.20%
Some postsecondary	28.90%	23.90%	-5.00%
Bachelor's degree	17.60%	16.20%	-1.40%
Graduate/professional	10.30%	10.20%	-0.10%
Low-attainment	43.20%	49.70%	6.50%
Middle-attainment	28.90%	23.90%	-5.00%
Advanced-attainment	17.60%	16.20%	-1.40%
High-attainment	10.30%	10.20%	-0.10%
Notes: Low-attainment = high school graduates & less than a high school education			
Middle-attainment = some post-secondary education & less than a bachelor's degree			
Advanced-attainment = terminal bachelor's degrees			
High-attainment = post-bachelor's, graduate and professional degrees			
Source: Tables C15003 and S1501 Educational Attainment			
U.S. Census Bureau, 2009 American Community Survey			

The 2009 American Community Survey shows that there are 8.6 million people age 25 or older living in Pennsylvania. As the table indicates, disproportionately more (9.2 percentage points) Pennsylvania adults have only a high school education than in the nation as a whole. However, Pennsylvania has fewer high school dropouts and fewer residents who have completed postsecondary education and training of some sort. For this study, low educational attainment refers to the percentage of adults who have only a high school education or less. In Pennsylvania, this accounts for nearly half of the adult population. The percentage of adults with middle levels of educational attainment, meaning those with some postsecondary education and training, is 5 percentage points lower in Pennsylvania than the national average. This represents the largest gap between the national and state levels of educational attainment. The data indicate that the immediate challenge to the Commonwealth is to improve the postsecondary education and training rate among the adult workforce to better reflect the economy of 2009, not 1979.

Undoubtedly, some of the gap in middle-level educational attainment is due to the fact that the Pennsylvania population is, on average, older than the nation overall. This demographic reality makes it more difficult to raise educational attainment levels in the state because the older the worker, the lower the return for undertaking additional education and training. Data from the 2010 Census, due to be

released in April 2011, should provide some insight as to whether younger adults in Pennsylvania are pursuing postsecondary education at a rate comparable to the rest of the nation. Regardless of whether gains are beginning to be seen among younger adults, too many Pennsylvanians have stopped their education after receiving their high school diploma. More must be done to raise educational levels among these underperformers and link skill-attainment with middle-skill occupations. The data presented below also indicate that large amounts of on-the-job training or experience are also required for supplying the skills needed to enter and hold middle-skill occupations.

Classifying Occupations by Skill

Educational attainment does not translate directly into skill levels that are relevant to the workplace. Nearly all jobs require at least some on-the-job training, no matter how modest. Data from the U.S. Bureau of Labor Statistics' Occupational Employment Statistics (OES) survey for Pennsylvania were used to classify occupations by skill level. Data regarding the number of Pennsylvania jobs reported in each occupation are for 2000 (the year before the 2001 recession), 2006 (the year before manufacturing in Pennsylvania experienced the start of the Great Recession) and 2008 (a recession year but the year for which the most current data are available).

The OES classifies more than 800 occupations covering all but the self-employed. For each occupation, the most significant source of postsecondary education and training is indicated. We use this information to place each occupation into one of four skill categories. We use much more detailed occupational data than the national studies cited previously. This provides two advantages in identifying middle-skill occupations. First, we can tie the categories to the concept of career ladders. Second, we can avoid misclassification that comes from using aggregated data. As an example, Holzer and Lerman (2007) classify all production occupations in manufacturing as middle-skilled. Our investigation of the data from Pennsylvania demonstrates that manufacturing production occupations cross all of the skill categories developed for this report. Instead of using a three-tier classification scheme of low-skill, middle-skill and high-skill, we use four classifications based on the amount and type of postsecondary education and training that is required for the typical new entrant into that occupation. The four skill categories are:

- **Low-skill occupations,** or occupations where short-term on-the-job training is the dominant form of postsecondary training.
- **Gateway-skill occupations,** or occupations that can be viewed as the start of career ladders and can be gateways to middle-skill occupations. These occupations require "moderate-term" on-the-job training.
- **Middle-skill occupations,** or occupations that require either long-term on-the-job training, work-related experience, postsecondary vocational certificate, or an associate's degree.
- **High-skill occupations,** or occupations that require a bachelor's degree, bachelor's degree and work experience, an advanced degree, or specialized professional education.

As can be seen in the following table, the number of jobs in Pennsylvania increased by 1.6 percent, from 5.8 million to 5.9 million from 2000 to 2008. That represents a net increase of 93,000 positions. Looking at individual sectors:

- Manufacturing lost 219,000 jobs.
- Non-manufacturing gained 288,000 positions.
- Government (which includes most K-12 education, as well as the public university and college system) was relatively flat, with an increase of 24,000 positions.

Growth was strongest in the highest skill category, advanced-skill occupations, with growth concentrated in the Non-manufacturing sector of Pennsylvania's economy (11.2%, or 60,000 positions). The greatest loss was in Gateway-manufacturing, which saw a steep 26 percent decline, or 91,105 positions. Overall, manufacturing as a sector experienced a devastating loss of nearly 25 percent of its positions. The loss was concentrated from 2000 to 2006. From 2006 to 2008, job losses continued but at a greatly reduced rate (3.8%). As was noted earlier in this report, the competitive position of manufacturing in Pennsylvania changed after 2006. This change is reflected in the job loss figures: The annual average loss from 2000 to 2006 was 4.1 percent per year, while it slowed to 1.9 percent per year from 2006 to 2008.

Percentage Change in the Number of Jobs by Sector and Skill Level, 2000-2008

Percentage Change	**Occupational skill level**				
2000 to 2008	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	-23.9%	-26.0%	-24.8%	-21.9%	-24.7%
Non-manufacturing	6.2%	5.0%	6.0%	11.2%	6.9%
Government	4.4%	4.3%	3.4%	1.5%	3.3%
Total by skill level	3.1%	-4.9%	1.2%	6.2%	1.6%
Percentage Change	**Occupational skill level**				
2000 to 2006	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	-20.1%	-22.2%	-21.9%	-23.5%	-21.8%
Non-manufacturing	5.1%	4.3%	4.7%	8.1%	5.4%
Government	3.7%	3.6%	2.9%	1.2%	2.8%
Total by skill level	2.5%	-4.2%	0.6%	3.8%	0.9%
Percentage Change	**Occupational skill level**				
2006 to 2008	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	-4.8%	-4.9%	-3.7%	2.1%	-3.8%
Non-manufacturing	1.1%	0.6%	1.2%	2.9%	1.4%
Government	0.7%	0.6%	0.5%	0.3%	0.5%
Total by skill level	0.6%	-0.8%	0.6%	2.4%	0.7%

What does the data have to inform us about middle-skill occupations in Pennsylvania? From Autor's work, we expected to see a movement toward an "hourglass" distribution of jobs by skill level. This did not happen in Pennsylvania. Growth was, in fact, concentrated among high-skilled occupations and low-skilled occupations (about 65,000 positions in each category) as expected from the earlier studies, but, using our definition, which differs from those who use more aggregated occupational data than we do, middle-skill occupations increased by nearly 18,000. As noted above, losses were concentrated in Gateway manufacturing occupations (-91,000), and those losses could not be offset by gains in Gateway service positions (36,000).

As the table below shows, contrary to expectations, middle-skill occupations did not decline. They remain the second-largest skill category, with 1.6 million positions. Gateway occupations have declined, reflecting the decline of occupations that require a high school diploma coupled with a moderate level of on-the-job training. More than 50,000 Gateway jobs disappeared between 2000 and 2008. The largest number of positions in Pennsylvania's economy is in low-skill occupations, with 2.2 million positions. This represents an increase of 66,000 positions.

Jobs in Pennsylvania by Sector and Occupational Skill Level, 2000, 2006 & 2008					
Year: 2000	**Occupational skill level**				
	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	207,584	350,227	225,325	100,856	883,992
Non-manufacturing	1,755,541	603,798	1,078,078	745,429	4,182,846
Government	143,192	150,655	250,274	180,934	725,055
Total by skill level	2,106,317	1,104,680	1,553,677	1,027,219	5,791,893
Year: 2006	**Occupational skill level**				
	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	165,814	272,466	176,068	77,122	691,470
Non-manufacturing	1,844,397	629,920	1,129,266	805,645	4,409,228
Government	148,548	156,071	257,547	183,099	745,265
Total by skill level	2,158,759	1,058,457	1,562,881	1,065,866	5,845,963
Year: 2008	**Occupational skill level**				
	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	157,882	259,122	169,485	78,768	665,257
Non-manufacturing	1,864,840	634,000	1,143,208	828,918	4,470,966
Government	149,525	157,066	258,907	183,590	749,088
Total by skill level	2,172,247	1,050,188	1,571,600	1,091,276	5,885,311

As can be seen in the next table, the distribution of jobs by skill level did not change much in the Commonwealth from 2000 to 2008, despite the losses in manufacturing and gains in non-manufacturing.

- Low-skill occupations contribute a bit more than one-third of all jobs (36.4% in 2000 and 36.9% in 2008).
- Advanced-skill occupations constitute 18.5 percent of all positions, with growth being concentrated in the non-manufacturing sector.
- As the Great Recession was ending, 37 percent of Pennsylvania's jobs were in low-skill occupations, 18 percent were in Gateway occupations, 27 percent were middle-skill, and 18.5 percent required advanced skills.
- Manufacturing jobs, in general, declined as a share of Pennsylvania's total employment, with the greatest losses coming in low-skill and Gateway occupations.

Distribution of Jobs in Pennsylvania by Sector and Occupational Skill Level, 2000, 2006 & 2008					
Year: 2000	**Occupational skill level**				
	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	3.6%	6.0%	3.9%	1.7%	15.3%
Nonmanufacturing	30.3%	10.4%	18.6%	12.9%	72.2%
Government	2.5%	2.6%	4.3%	3.1%	12.5%
Total by skill level	36.4%	19.1%	26.8%	17.7%	100.0%
Year: 2006	**Occupational skill level**				
	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	2.8%	4.7%	3.0%	1.3%	11.8%
Nonmanufacturing	31.5%	10.8%	19.3%	13.8%	75.4%
Government	2.5%	2.7%	4.4%	3.1%	12.7%
Total by skill level	36.9%	18.1%	26.7%	18.2%	100.0%
Year: 2008	**Occupational skill level**				
	Low	Gateway	Middle	Advanced	Total by sector
Manufacturing	2.7%	4.4%	2.9%	1.3%	11.3%
Nonmanufacturing	31.7%	10.8%	19.4%	14.1%	76.0%
Government	2.5%	2.7%	4.4%	3.1%	12.7%
Total by skill level	36.9%	17.8%	26.7%	18.5%	100.0%

We labeled Gateway occupations optimistically. They are in reality positions that are semi-skilled, and the only difference between them and low-skill occupations is the amount of training required. Middle-skill and advanced-skill positions require more formal training and education, which has created a bifurcated labor market because of credential and training barriers. Gateway positions can only become true gateways to occupational ladders if they are intentionally linked by public policy, education and training to middle-skill positions. However, gates can swing both ways. If a job ladder does not exist, the economy will undoubtedly push some Gateway occupants into low-skill occupations.

The Structure of Manufacturing Occupations in Pennsylvania

In 2008, near the end of the Great Recession, there were about 665,000 manufacturing jobs in Pennsylvania, down from 884,000 only eight years earlier. Dramatic losses took place from 2000 to 2006, with a total decline of 21.8 percent. Although losses in the manufacturing sector continued in 2007 and 2008, the rate of loss abated dramatically. The rate of job loss was similar across all skill categories from 2000 to 2008, with the highest percentage loss (26%) being among Gateway positions, and the smallest (22%) being among jobs requiring advanced skills. From 2006 to 2008, there was modest employment growth among manufacturing positions requiring advanced skills. Middle-skill positions saw a loss of 3.7 percent over the same two-year period.

An in-depth look at the occupational structure within Pennsylvania's manufacturing sector in 2008 reveals that over half (54.5%) of the 660,000 Pennsylvania jobs in manufacturing establishments are in production occupations, with most of those being nonsupervisory. It should be noted that production positions that are part of the Temporary Staffing industry have been included in this

examination. Focus group interviews indicated that temporary staffing agencies play an important role in filling the manufacturing hiring pan and in recruiting the full gamut of production workers.

It should also be noted that data are for business establishments primarily involved in producing physical products. Some are parts of businesses with multiple establishments and others are standalone, fully integrated manufacturing enterprises.

Number of Manufacturing Jobs in Pennsylvania by Occupational Skill Category and Level of Educational Attainment

	SOC*	Total	Skill Category				Level of Educational Attainment			
Occupation Title	Code	Employment	Low	Gateway	Middle	Advanced	Low	Middle	Advanced	High
Total Number of Manufacturing Jobs		**661,430**	**151,668**	**246,265**	**167,008**	**78,768**	**353,267**	**181,607**	**79,903**	**28,850**
Management		**60,965**		**13**	**14,530**	**46,421**	**8,755**	**17,166**	**23,485**	**11,549**
Management	11-0000	32,042			7,751	24,290	5,226	8,892	11,856	6,064
Business and financial operations	13-0000	18,363			5,183	13,180	2,907	5,658	6,962	2,834
Computer and mathematical science	15-0000	10,355			1,553	8,801	612	2,590	4,645	2,505
Legal	23-0000	205		13	43	150	10	26	22	146
Research, Design and Product Development		**43,012**	**2**	**142**	**11,927**	**30,942**	**4,879**	**12,069**	**17,004**	**9,046**
Architecture and engineering	17-0000	30,394		4	8,861	21,530	3,328	9,354	12,091	5,617
Life, physical, and social science	19-0000	8,848			2,665	6,183	1,034	1,575	3,249	2,984
Arts, design, entertainment, sports, & media	27-0000	3,770	2	138	401	3,229	517	1,140	1,664	445
Back-office/Support		**64,656**	**29,406**	**26,493**	**8,270**	**485**	**26,985**	**26,514**	**9,130**	**2,013**
Office and administrative support	43-0000	63,821	29,371	26,478	7,971		26,859	26,226	8,862	1,866
Other Support**		835	35	15	299	485	126	288	268	147
Sales/Marketing	41-0000	**20,106**	**2,742**	**576**	**15,871**	**917**	**5,057**	**6,311**	**7,282**	**1,455**
Skilled Trades and Maintenance		**43,998**	**725**	**17,059**	**26,212**		**24,874**	**16,025**	**2,619**	**464**
Construction and extraction	47-0000	11,366	238	2,047	9,080		7,320	3,357	570	112
Installation, maintenance,& repair	49-0000	32,631	487	15,012	17,132		17,554	12,668	2,049	352
Production		**360,208**	**55,497**	**201,079**	**85,915**		**232,700**	**88,552**	**17,441**	**3,781**
Supervisors, Production Workers	51-1000	24,181			24,181		12,577	7,978	2,860	766
Supervisors from temporary staffing agencies		171			171		89	56	20	6
Production workers***		318,138	55,497	201,079	61,563		220,034	80,518	14,561	3,009
Prod workers, Temporary staffing agencies****		17,718	5,606	10,680	1,434		12,574	4,138	845	161
Transportation, material moving	53-0000	**60,512**	**56,579**	**553**	**3,376**	**3**	**44,394**	**13,189**	**2,475**	**447**
Buildings and grounds***		**7,973**	**6,717**	**350**	**907**		**5,623**	**1,781**	**467**	**95**

* SOC represents Standard Occupational Classification, http://www.bls.gov/SOC/

** Other support occupations consists of SOC: 21, 25, 29, 31, 39

*** Nonsupervisory production occupations consist of SOC: 51-2000, 51-3000, 51-4000, 51-5000, 51-6000, 52-7000, 51-8000, 51-9000

**** Data are for production workers employed in the Temporary Staffing industry

***** Buildings and grounds occupations are SOC: 33, 35, 37, 45

Manufacturing in Pennsylvania accounts for 79,000 jobs requiring advanced skills, and more than 100,000 of Pennsylvania's manufacturing workers hold bachelor's or advanced degrees. In terms of business functions that exist within manufacturing establishments:

- 61,000 jobs are management.
- 43,000 jobs are involved in technical aspects, such as research, product design, product development and product testing.
- 65,000 jobs are in back-office support.

- 44,000 jobs are in skilled trades and industrial maintenance. Of the 33,000 industrial maintenance jobs, about half are Gateway positions and the other half are middle-skill.

Of greatest public policy concern regarding manufacturing employment are **lower-skill and Gateway positions.** Nearly 23 percent of all manufacturing positions are low-skill, and 37 percent are Gateway positions. Someone with just a small amount of on-the-job training can fill low-skill occupations; Gateway positions require a moderate amount of training on the job. A bit more than half of all manufacturing employees have low levels of educational attainment, meaning they graduated high school but pursued no further studies or they never completed high school. Another 27 percent have mid-level educational attainment, meaning they either have received large amounts of on-the-job training or they pursued postsecondary education up to an associate's degree. Advanced production positions appear to require either large amounts of on-the-job training or some degree of certification that is less than an associate's degree.

Percentage Breakdown of Skill and Educational Composition of Pennsylvania's Manufacturing Occupations

	SOC*	Total	Skill Category				Level of Educational Attainment			
Occupation Title	Code	Employment	Low	Gateway	Middle	Advanced	Low	Middle	Advanced	High
Total Manufacutring Jobs		**100.0**	**22.9**	**37.2**	**25.2**	**11.9**	**53.4**	**27.5**	**12.1**	**4.4**
Management		**100.0**			**23.8**	**76.1**	**14.4**	**28.2**	**38.5**	**18.9**
Management	11-0000	100.0			24.2	75.8	16.3	27.8	37.0	18.9
Business and financial operations	13-0000	100.0			28.2	71.8	15.8	30.8	37.9	15.4
Computer and mathematical science	15-0000	100.0			15.0	85.0	5.9	25.0	44.9	24.2
Legal	23-0000	100.0		6.3	20.9	73.0	4.9	12.7	10.7	71.1
Research, Design and Product Development		**100.0**		**0.3**	**27.7**	**71.9**	**11.3**	**28.1**	**39.5**	**21.0**
Architecture and engineering	17-0000	100.0			29.2	70.8	10.9	30.8	39.8	18.5
Life, physical, and social science	19-0000	100.0			30.1	69.9	11.7	17.8	36.7	33.7
Arts, design, entertainment, sports, & media	27-0000	100.0	0.1	3.7	10.6	85.7	13.7	30.2	44.1	11.8
Backoffice/Support		**100.0**	**45.5**	**41.0**	**12.8**	**0.8**	**41.7**	**41.0**	**14.1**	**3.1**
Office and administrative support	43-0000	100.0	46.0	41.5	12.5		42.1	41.1	13.9	2.9
Other Support**		100.0	4.2	1.8	35.8	58.1	15.1	34.5	32.1	17.6
Sales/Marketing	41-0000	**100.0**	**13.6**	**2.9**	**78.9**	**4.6**	**25.2**	**31.4**	**36.2**	**7.2**
Skilled Trades and Maintenance		**100.0**	**1.6**	**38.8**	**59.6**		**56.5**	**36.4**	**6.0**	**1.1**
Construction and extraction	47-0000	100.0	2.1	18.0	79.9		64.4	29.5	5.0	1.0
Installation, maintenance ,& repair	49-0000	100.0	1.5	46.0	52.5		53.8	38.8	6.3	1.1
Production		**100.0**	**15.4**	**55.8**	**23.9**		**64.6**	**24.6**	**4.8**	**1.0**
Supervisors, Production Workers	51-1000	100.0			100.0		52.0	33.0	11.8	3.2
Supervisors from temporary staffing agencies		100.0			100.0		52.0	32.7	11.7	3.5
Production workers***		100.0	17.4	63.2	19.4		69.2	25.3	4.6	0.9
Prod workers, Temporary staffing agencies****		100.0	31.6	60.3	8.1		71.0	23.4	4.8	0.9
Transportation, material moving	53-0000	**100.0**	**93.5**	**0.9**	**5.6**		**73.4**	**21.8**	**4.1**	**0.7**
Buildings and grounds***		**100.0**	**84.2**	**4.4**	**11.4**		**70.5**	**22.3**	**5.9**	**1.2**

* SOC represents Standard Occupational Classification, http://www.bls.gov/SOC/

** Other support occupations consists of SOC: 21, 25, 29, 31, 39

*** Nonsupervisory production occupations consist of SOC: 51-2000, 51-3000, 51-4000, 51-5000, 51-6000, 52-7000, 51-8000, 51-9000

**** Data are for production workers employed in the Temporary Staffing industry

***** Buildings and grounds occupations are SOC: 33, 35, 37, 45

As noted earlier, temporary staffing agencies play an important role in manufacturing. Nearly 18,000 production workers, accounting for 5.3 percent of all non-supervisory positions, are employees of temporary staffing agencies. Given that the data analyzed come before the economic recovery was fully under way, we expect that this share of production employment is low. The data also indicate that "temped-out" production work is disproportionately low-skill. Of the production workers provided by temporary staffing agencies, 32 percent are employed in low-skill occupations, and 71 percent have low levels of educational attainment. What is interesting to note is that 60.3 percent of temporary workers are in Gateway occupations, positions requiring moderate amounts of on-the-job training or experience.

Given the sector's shifting employment structure, does manufacturing continue to be an important source of middle-skill occupations in Pennsylvania? The data say yes:

- In 2008, middle-skill manufacturing jobs accounted for 10.8 percent of all middle-skill positions in Pennsylvania and 2.9 percent of *all jobs* in the Commonwealth.
- Middle-skill occupations make up 25 percent of all manufacturing jobs, with half of them being in production. The next-largest occupational grouping for middle-skill manufacturing jobs is in the skilled trades and industrial maintenance.
- Sales positions are the third-largest source of middle-skill occupations within the manufacturing sector.

Conclusions

- Manufacturing is an important source of middle-skill work in Pennsylvania.
- As productivity continues to increase in the manufacturing sector and production jobs come back slowly, we expect to see increased demand for workers with mid-level skills. Job creation will occur mostly through turnover.
- Public policy should recognize and support career ladders that are tied to middle-skill positions, noting the key role that on-the-job experience plays.
- The greatest jobs threat is to Gateway occupations across the entire spectrum of work in the Commonwealth.
- Understanding how to build career ladders for those in Gateway positions, particularly production occupations, is critical to both the success of the manufacturing sector and to the economic success of workers who do not go on to earn college degrees.
- The growth in middle-skill non-manufacturing positions in Pennsylvania is an unheralded economic success story of the past decade. From 2000 to 2008, manufacturing lost 56,000 middle-skill jobs, while middle-skill jobs in the non-manufacturing private sector grew by 65,000 positions and similarly skilled work in government increased by 8,600 positions. In other words, gains offset manufacturing losses.
- The same cannot be said for Gateway occupations. There was growth in non-manufacturing Gateway positions, but not enough to offset the substantial losses in the manufacturing sector.

VIEW FROM THE BOTTOM LINE: IRC Impact

Despite the precision that is implied in all economic analyses, with impacts stated down to the dollar, all have variability built into them. Responses may be skewed by which firms respond to a survey, and all economic models are built on a foundation of assumptions and confront data limitations. In this sense, reporting the impact of any program is like finding your way in a forest: Getting multiple points of reference is good, and triangulation works best. Therefore, the research team examined the impact of the state of Pennsylvania's investment in the IRC program using two approaches.

We first examined the impact of the program using fiscal data coupled with a client survey that is independently administered by contractors to the National Institute of Standards and Technology's Hollings Manufacturing Extension Partnership (NIST/MEP). Impact of the program is gauged in terms of sales and then in terms of the efficiency of employment creation and retention. This financial impact analysis is then complemented with an economic impact assessment using input-output analysis. The input-output model estimates value added from the companies that were assisted by the IRCs and employment impacts, as well as the fiscal impact to government through tax payments. In this section, we first present a summary of the findings of these two separate modeling efforts. This is followed by an in-depth discussion of the financial impact model and then the economic impact model.

Summary of the Findings on the Impact of: Manufacturing

- Every $1 increase in final demand for products manufactured in Pennsylvania leads to a total increase in gross value-added by all industries of $2.52. This is the highest multiplier for any industry in the state.
- Every $1 of final demand for manufactured products generates, on average, an additional $0.98 in indirect purchasing from other industries in manufacturing's supply chain. This is by far the highest level of inter-industry spending in the state.
- The total employment impact of $1 million of final demand for manufactured products made in Pennsylvania is 4.2 jobs. This is the highest of any industrial sector in the state. Mining has the second-largest job multiplier, with 3.4 jobs per $1 million in external final demand, and Management of Companies and Enterprises is third, with 2.8 jobs generated. It should be noted that many management establishments in Pennsylvania have a strong relationship to manufacturing operations.
- A $1 million increase in final demand for manufactured products generates 2.9 jobs directly and indirectly in manufacturing and an additional 1.3 jobs through the spending of employees of the manufacturers and the employees in their supply chain for a total job-generating impact of 4.2. Manufacturing once again has the highest jobs multiplier.
- This adds to our previous finding that manufacturing has the largest share of GSP of any industry in the state of Pennsylvania.
- Manufacturing has the highest income multiplier of any of Pennsylvania's economic sectors. Every $1 increase in income for manufacturing employees and proprietors generates another

$2.60 in income in the state's economy (the total multiplier is $3.60). Agriculture and forestry has the second-highest total multiplier, at $1.44 for every $1 increase (total of $2.44); followed by the logistics industry, with a multiplier of $1.87, meaning a $1 increase in incomes in the logistics industry generates another $0.87. Manufacturing's multiplier is so extraordinarily high because of the length of its supply chain; its indirect income multiplier is 1.74.

The IRC Program

From the Financial Impact Analysis:

- Every $1 of DCED funding for the IRC program in fiscal year 2008 returned $51 in new and retained sales. In fiscal year 2009, the yield dropped to $46, coinciding with a drop in program income.
- The cost to the state of Pennsylvania per job created or retained by the IRC program in FY 2009 was $2,187. This is the lowest cost per job among a set of analogous programs found through a literature search; the cost of those programs ran from $6,000 to $11,000 per job created or retained. The per job cost stemming from IRC activities is also far below maximum costs listed in program guidelines of other economic development programs, which run from $15,000 to $100,000 per job created or retained.
- IRC clients reported creating or retaining 6,331 manufacturing jobs due to services delivered in fiscal year 2009.
- Job creation and retention are estimated to have had a direct addition to GSP of $729 million for fiscal year 2010.
- Based on fiscal year 2009 program income from DCED, this represents a return of $52 in GSP for each $1 of DCED funding.
- Each dollar of state funding to the IRC program was associated with $1.50 in additional funds raised and program earnings in fiscal years 2008 and 2009.
- The IRC program meets a market test by collecting client revenues that partially cover the cost of services delivered. The client share of core program funding, which we define as funds from clients, DCED and the NIST/MEP, accounted for between 38 percent and 41 percent of revenue.

From the Economic (Input-Output) Analysis:

- Companies that received IRC services are estimated to have paid an additional $31 million in state and local taxes in 2009 due to increased sales alone. State and local governments collected nearly $17 million in business sales and property taxes and nearly $5 million in personal income tax.
- Indirect and induced benefits from federal investment of $5.3 million in 2009 to support operation of the IRC program resulted in increased demand for Pennsylvania products and services valued at nearly $6 million. (Direct benefits of these investment dollars from outside the state were calculated into the analysis of increased sales among companies served by the IRCs.)
- The federal investment in Pennsylvania's IRC program led to an increase of nearly $3.5 million in value added and the creation of 43 jobs within the Commonwealth.

- Labor income for the state grew by more than $2 million from the NIST/MEP grant.
- Federal investment in IRC operations added nearly $465,000 in the form of personal income and business taxes paid to state and local governments.
- The model estimated that nearly 4,300 jobs were created in the state just by the direct, indirect or induced result of new sales in companies that used IRC services in one year. Note the job figure in the section above (6,331) is for both new and retained jobs directly generated by IRC manufacturing clients, but does not include the indirect or induced multiplier effects.
- As a result of job growth and increased sales, labor income in the state increased by nearly $236 million.
- Total value added increased by nearly $411 million as a result of increased sales at companies that used IRC services. Retained sales were not included in this estimate.

Financial Impact Model

Analysis of the financial impact of Pennsylvania's investment in the seven regional Industrial Resource Centers indicates a significant return in terms of both economic output, as measured by new and retained sales, and jobs. The IRC program leveraged nearly $14 million in Department of Community and Economic Development (DCED) funding in fiscal year 2009 into more than 6,300 new and retained jobs statewide, and into $633 million in new and retained sales. In fiscal year 2008, $15.2 million in state funds resulted in $782.2 million in increased or retained sales and 5,981 new and retained jobs.

The financial analysis uses two sources of data; one for the IRC revenues and another for the IRC impact on jobs and company sales. IRC financial or revenue data were analyzed for FY2008, FY2009, and FY2010 using each organization's U.S. Internal Revenue Service Form 990. The impact data were obtained from a quarterly survey conducted by the NIST/MEP.

An independent survey firm hired by the NIST/MEP program collects data from business establishments that use MEP-supported services. The data are then transferred to the MEP and shared with the IRCs. The data file contains information on the firm, including its industry classification. The surveyed firm is asked to provide its estimate of the net benefits derived from the services provided by the MEP affiliate over the previous 6 to 12 months for all services received.[10] The survey is conducted two quarters after a project closes. The most recent data the project team received was for surveys completed in the second quarter of 2010. Because of the lag time between the delivery of services and impact, the most recent impact data is associated with the second quarter of 2009 in terms of funding. The data obtained from NIST/MEP allowed the research team to associate project impacts with DCED investments through the end of FY 2009. Therefore, the FY 2008 revenue data are associated with program impacts from the third quarter of 2008 to the second quarter of 2009. The FY 2009 revenue data are associated with impacts that begin in the third quarter of 2009 and stretch to the second

[10] See Voytek, Kenneth P., Karen L. Lellock, and Mark A. Schmit (May, 2004) "Developing performance metrics for science and technology programs." *Economic Development Quarterly* 18(2): 174-185 and *Delivering Measurable Results to Its Clients: FY 2008 Results*, January 2010 (NIST/MEP).

quarter of FY 2010. This is the reason why impacts are only reported for FY 2008 and FY 2009 in this report.

Program Funding and Leverage

The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client fees. The centers also receive grants and have generated small amounts of ancillary revenue that is related to their mission. Client fee income is leveraged from the base operating funding provided by state and federal funding, which has interconnected matching requirements. The following table summarizes the funding sources for the IRC program over the past three fiscal years.

IRC Program Funding Sources, 2008-2010

	FY2008	FY2009	FY2010
Client Revenues	$12,782,000	$13,018,000	$8,479,000
DCED-PA Funding	$15,199,000	$13,847,000	$6,854,000
NIST-MEP Funding	$5,285,000	$5,320,000	$5,374,000
Other Grants	$3,532,000	$2,568,000	$926,000
Other Sources	$633,000	$424,000	$515,000
Total Revenue	**$37,431,000**	**$35,177,000**	**$22,148,000**
State Leverage Ratio*	**1.5**	**1.5**	**2.2**
Client Leverage Ratio**	**0.84**	**0.94**	**1.24**
Client Share Core Revenue***	**38.4**	**40.4**	**40.9**

* State Leverage Ratio: Total Revenues-DCED Funding/DCED-PA Funding

** Client Leverage Ratio: Client Revenues/DCED-PA Funding

*** Client Revenue/(Client Revenue + DCED Funding + NIST-MEP Funding)

IRC funding from DCED dropped by about 9 percent, or $1,352,000 from FY 2008 to FY 2009. A much larger cut in program funding took place in the next fiscal year, when another $7.0 million was cut from the IRC's funding from DCED. The lost revenue over these two years totals $8.3 million, or 55 percent of FY 2008 revenue from the state.

The first measure of program impact is leverage. This measures additional funds raised due to the presence of state funds invested into the IRC program. Each dollar of state funding is associated with $1.50 in additional funds raised and earned in fiscal years 2008 and 2009. The leverage ratio reached 2.2 in FY 2010, which is anomalous and was triggered by the timing of the state's funding cuts. The leverage ratio increased from FY 2009 to FY 2010 because non-state revenues, especially NIST/MEP funds and client revenues, dropped more slowly than did the state revenues.

A major difference between the IRC program and other state and federal programs is that services must meet a market test. To continue to receive federal funding, the IRC program must reach impact targets and earn about two-thirds of its program revenues from fees charged for services delivered and state funding. The last line of the table that shows IRC funding sources reports on the client share of core program funding, which we define as funds from clients, DCED and the NIST/MEP.

Client revenues account for between 38 percent and 41 percent of core revenue. The share of client revenues in the IRC's core revenue increased during these two years of funding cuts, but this is also worrisome. As public sources of funds shrink, the IRCs will have to focus more intensely on projects with higher margins and on larger projects to cover their overhead costs. There is a danger that the centers will drift from their current focus on small to midsized manufacturing companies and supply chains dominated by these firms to larger clients.

The first table in this section demonstrates the association between DCED funding and the impact of services delivered to the state's manufacturing organizations. The steep decline in state funding from FY 2009 to FY 2010 was accompanied by a dramatic drop in client revenues. Client revenues declined 35 percent in the same year although federal funding remained relatively constant. Funding from other grants also declined by 64 percent. Such significant losses in funding would be presumed to affect IRC activities, but the impact in terms of economic outcomes cannot be assessed at this time.

Program Impact: Examining Financial Outcomes

Three sets of outcomes can be probed with data gathered for the financial impact analysis: impact of DCED funding of the IRC program on client sales, the efficiency of job creation and retention through the state's investment, and the economic impact of job creation and retention.

Sales

Funding sources were compared to the economic impact data from the NIST/MEP survey. As was noted earlier, a one-year lag time in impact was assumed, meaning that FY 2008 financial information was compared to FY 2009 economic impact data. The impact of DCED funding of the IRC program was measured through its impact on sales of client companies as reported in the NIST/MEP survey.

The data reveal that every $1 of DCED funding for the network of regional centers in fiscal year 2008 returned $51 in new and retained sales. In fiscal year 2009, the yield dropped to $46. The IRC's client companies reported that services delivered to them by the regional centers in fiscal year 2008 were responsible for an increase in sales of more than a quarter billion dollars and retained sales of another half-billion dollars. Sales impact associated with DCED funding of the IRC program in fiscal year 2009 dropped. While retained sales remained about the same ($531 million), reported new sales fell by more than half, dropping from $273 million to $102 million. Given that the economy began its recovery in 2009, it is difficult to associate this drop with the lingering effects of the recession. It is highly likely that the drop is related to the $1.3 million decline in DCED funding from FY 2008 to FY2009.

Efficiency in Job Creation and Retention From FY 2009 IRC Program Activity

An important measure of the effectiveness of any economic development program is to measure the cost per job created and retained. We examined job creation and retention data associated with IRC activity in fiscal year 2009 and calculated the cost per job retained and created. These results were then compared to guidelines for other programs and evaluative studies.

IRC activity in fiscal year 2009 affected more than 6,331 jobs in fiscal year 2009; clients reported 4,833 jobs retained and 1,498 new jobs created. The cost per job to the state of Pennsylvania was $2,187 in fiscal year 2009. This calculation is justified based on the assumption that DCED funding leverages the federal funds from NIST/MEP. However, combining federal and state funds in the calculation would bring the public cost per job to $3,027.

The question of how efficient the IRC program is at job creation and retention should be asked. An exhaustive review of the literature to determine how these results compare to other economic development programs or investments could not be conducted. This is because few programs are actually evaluated or subject to systematic program assessment or performance review. This means that the following comparisons are suggestive.

Professor Amy Glassmeir reviewed the cost per job created of expenditures made by the U.S. Economic Development Administration (EDA) in 1990 and 1993 in a report submitted to that agency in 2002.[11] The most relevant set of estimates were for projects managed by EDA's Philadelphia regional office. EDA's cost per job, after adjusting for inflation and restating them in 2010 dollars, in rural counties was $5,914; in small urban counties was $6,414; and in large urban counties, $6,784. When all sources of public funding were considered, the costs nearly doubled; the cost per job in rural counties was $14,890; in small urban counties was $11,484; and in large urban counties, $11,295.

Rutgers' Professor Robert Burchell led a team that conducted an evaluation of EDA's defense adjustment program. The program ran from 1992 to 1995 and averaged a cost per job (in 2010 dollars) of $8,052.[12]

Timothy Bartik and George Erickcek recently released an evaluation of Michigan's premier economic development program, the Michigan MEGA Tax Credit. This is a business tax credit program that was put in place rather than undertake business tax reform. Bartik and Erickcek found the net fiscal cost per job year to be $4,000.[13] MEGA provides tax credits to businesses with the credit tied to the personal income taxes paid by the employee holding the new or retained job. These credits are refundable against the state's business taxes and are awarded only to businesses that are considered to be part of the state's export base and done so at the discretion of the Michigan Economic Development Corporation. Most of the credits go to manufacturing companies; companies that export services to customers located outside of Michigan producers are also eligible. The credits have an annual value per job year of $2,188 and have an average life of 15.74 years. The present value cost at a 5 percent discount rate is $22,710.

[11] Glassmeir, Amy K. (2002). "Cost Per Job Associated with EDA Investments in Urban and Rural Areas." Available: http://www.eda.gov/PDF/PennStreport.pdf

[12] Burchell, Robert et al. *The EDA Defense Adjustment Program: Performance Evaluation* (Center for Urban Policy Research, Rutgers University).

[13] Bartik, Timothy, and Erickcek, George. (2010). Employment and Fiscal Effects of Michigan's MEGA. W.E. Upjohn Institute for Employment Research, 10-164. Available: http://research.upjohn.org/up_workingpapers/164/Tax Credit Program.

Karl Seidman reviewed the cost per job created or retained for state revolving loan funds in his 2005 economic development finance text.[14] Seidman writes that Revolving Loan Funds are "cost-effective" economic development programs as evidenced across multiple studies. After adjusting the cited cost-per-job numbers into 2010 current dollars, the costs ranged from $6,456 to $9,072 per job year.

Compared to all of these examinations, the cost per job created or retained due to IRC support for manufacturing services is substantially lower.

A second approach to exploring the IRC program's efficiency in job creation and retention is to examine guidelines on the cost per job that is expected as a performance standard for different economic development finance programs. The city of Allentown, Pennsylvania, maintains a useful and accessible list of economic development finance programs that includes the cost per job that is part of program eligibility guidelines.[15] The maximum cost per job created or retained: $15,000 for the Pennsylvania Minority Business Development Authority; $25,000 for Small Business First, Infrastructure Development Program, the Machinery and Equipment Fund; $35,000 for the Pennsylvania Industrial Development Authority; $100,000 for the U.S. Small Business Administration's 504 loan program for a manufacturing job. Again, the DCED's IRC program is much lower in cost because it does not involve purchases of plant or equipment or infrastructure spending. In fact, IRC program consulting activity is frequently associated with capital equipment purchases as companies introduce new products, improve the efficiency of their production processes, or introduce new Enterprise Resource Planning (ERP) systems − most often without subsidy.

The Addition to GSP Through Job Creation and Retention

An estimate of the economic impact of the jobs created or retained through the projects undertaken by the IRCs was calculated by using data on total factor productivity − GSP per job. This allowed us to monetize the value of jobs retained and created by estimating the GDP contribution of each job. There were three steps in this estimating process: (1) A list of companies generated by the NIST/MEP survey was categorized by industry, using their four-digit NAICS industry category, and geography, assigning them to an IRC service-provision region. This resulted in a list of the number of jobs created and retained by NAICS category for each of the IRC members' multicounty service area. (2) Regional average productivity for each NAICS industry was then calculated for each four-digit industry; this allowed for geographic variation in total factor productivity. (3) Estimated regional average productivity was then multiplied by the number of jobs created or retained. This provided an estimate of the addition to total GSP generated by the IRC program through job creation or retention.

As was noted earlier, IRC clients reported creating or retaining 6,331 manufacturing jobs due to services delivered in fiscal year 2009. The direct addition to GSP was $729 million, with the addition to GSP due to job retention accounting for $530.4 million and job creation adding $198.5 million in GSP. These additions occurred in the second half of 2009 and the first half of 2010. Based on fiscal year 2009 program income from DCED, this represents a return of $52 in GSP for each $1 of DCED funding.

[14] Seidman, Karl. (2005). *Economic Development Finance.* Sage Publications, pp. 225-226.
[15] Allentown Business Guide: http://www.allentownpa.gov/Businesses/BusinessFinancingIncentives/tabid/341/Default.aspx

These results indicate that the state of Pennsylvania's investments in the IRC program have large leverage effects, produce more than $40 in increased company sales for each dollar invested in the program, and are efficient in terms of the cost for each job retained or created. Another way of looking at the impact of the IRC program on the state's economy is to look at the more than half-billion dollar addition to the Commonwealth's GSP from jobs created and retained in both FY 2008 and 2009 – in the depths of the Great Recession.

The following graphic visually displays the impact of investment in the IRC program.

PA IRC NETWORK

SOURCES AND IMPACT OF FUNDS FOR FISCAL YEARS 2008 & 2009

SOURCES

SALES IMPACT

FISCAL YEAR	2008	2009
DCED-PA (STATE) (S)	$15,199,000	$13,847,000
CLIENT REVENUES (C)	$12,782,000	$13,018,000
NIST/MEP (FEDERAL) (F)	$5,285,000	$5,320,000
OTHER GRANTS (G)	$3,532,000	$2,568,000
OTHER INCOME (I)	$633,000	$424,000
	$15.2M IN-STATE FUNDS LEVERAGES $37.4M OF PUBLIC & PRIVATE INVESTMENT IN MFG.	$13.8M IN-STATE FUNDS LEVERAGES $35.2M OF PUBLIC & PRIVATE INVESTMENT IN MFG.
RETAINED SALES	$509,536,000	$531,885,000
INCREASED SALES	$272,685,000	$101,645,000
DIRECT ECONOMIC IMPACT	**$782,221,000**	**$633,530,000**
	$1 OF STATE INVESTMENT LEADS TO $51 IN NEW AND RETAINED SALES IN MFG.	$1 OF STATE INVESTMENT LEADS TO $46 IN NEW AND RETAINED SALES IN MFG.

Economic Impact Model

In addition to examining the direct financial impact of the IRCs on Pennsylvania's economy, the study team sought to quantify the economic impact of both the manufacturing sector and of the IRC program using economic impact analytical techniques. Economic impacts are measured in terms of the **value added, employment multipliers, labor (household) income, and state and local taxes paid** that is triggered by the performance improvements of client manufacturing companies.

For this study, the IRC program's economic impact was determined by analyzing two streams of revenue: (1) The direct, indirect and induced spending impacts triggered by new sales for IRC client companies. The input-output model calculated these with new sales forming the vector of final demand for the state. To be conservative in our estimates of program impact, reported retained sales were not included. This assumption should more than compensate for any substitution effects that took place. A substitution occurs when a sale by a manufacturer that was assisted by one of the IRCs came at the expense of another Pennsylvania manufacturer that was not assisted by the IRC program. (2) The indirect and induced spending impacts generated by the IRC program from the Hollings Manufacturing Extension Partnership (NIST/MEP) federal funding formed the second revenue stream. The federal funding of the IRC program was included because this represents external demand for Pennsylvania goods and services.

There is a conceptual challenge that needs to be overcome in calculating the impact of the federal funding. NIST/MEP funds are used along with DCED funds in providing assistance to manufacturing companies. To avoid the possibility of double counting, which would occur if the NIST/MEP funds were included along with the impact from the sales increase, only the indirect and induced spending impacts from the IRC program's federally funded activities were included in the impact calculations. In other words, the model captured the indirect effects of the IRC program on its own supply chain and of the spending of IRC employees and their contractors.

The 2008 IMPLAN (IMpact analysis for PLANning) state model for Pennsylvania was used to estimate both the impact of the manufacturing sector and of the IRC program. IMPLAN is an assessment software system that accounts for inter-industry purchasing and sales relationships within regions. This allowed us to examine how regional economies responded to IRC projects and programs that were introduced or changed. IMPLAN also enabled us to explore the multiplier, or "ripple effect, throughout regional economies. Although this was the latest available data, it should be noted that this model assumes relationships between industries as they were in 2008. For this study, our measurements for estimating the IRC program's economic impact were:

- **Value Added**: Specifically, value that is added (cost of goods sold less purchases of goods and services required in the production of the product). This is approximately equal to Gross Product.
- **Employment**: Specifically, average annual full- and part-time jobs created by the change in final demand.

- **Labor Income:** This includes **employee compensation** in the form of wages, salaries, other income, as well as employer and employee contributions to social insurance, and **proprietors' income**, which captures earnings of sole proprietorships and the self-employed.
- **Taxes**: Specifically, state and local taxes paid.

The impact of new sales by Pennsylvania's manufacturing companies aided by the IRC program was estimated by assigning reported new sales for each company that responded to the NIST/MEP survey to the IMPLAN sector that corresponded to the client company's NAICS code. The NIST/MEP funds that flow through the IRC program were treated as having the same economic impact as would occur in a management consulting company. This was done by assigning the spending to IMPLAN sector 374, which corresponds to NAICS 5416 (Administrative Management and General Management Consulting Services). The table below is taken directly from the IMPLAN model. According to IMPLAN, the Type I multiplier includes the economic impact of the direct and indirect spending triggered by final demand, whereas the SAM Multiplier is a more comprehensive measure, as it includes direct, indirect, and induced spending. In the more general economic impact literature, IMPLAN's SAM Multiplier is frequently referred to as a Type III multiplier. SAM is a three-letter acronym for Social Accounting Matrix.

The Impact of the Manufacturing Sector

As can be seen in the following table, manufacturing has the state's largest multiplier effect. This is true both when the direct and indirect effects are examined, as well as when induced effects from the spending of manufacturing employees and employees of companies in the manufacturing supply chain are included. When accounting for direct, indirect and induced effects, every $1 increase in manufacturing output leads to a total increase in value-added by all industries of $2.52. The $2.52 multiplier is made up of three components:

- 1 is the final demand for the product. This can be thought of as the first dollar spent that triggers rounds of orders that lie behind the multiplier process;
- 0.98 is the indirect purchasing that is triggered through the supply chain due to the product demand. This is calculated by subtracting 1.00 (the direct effect) from the Type 1 multiplier column in the table below leaving the indirect effect;
- 0.54 is the induced spending effect. This is calculated by subtracting the Type I multiplier from the SAM (or Type III) multiplier, and it reflects the consumer spending of the workforce in the manufacturing industry and its supply chain.
- This means that for every $1 of final demand for manufactured product, another $1.52 of Value Added or Gross State Product is generated among Pennsylvania's employers.

Construction and the information industry were the two Pennsylvania industries with multipliers that came closest to rivaling that of manufacturing, with both at roughly $2.26. Agriculture, transportation and warehousing, and arts, entertainment and recreation were the other industries with multiplier effects above $2.

Pennsylvania Value-Added Multipliers

Description	Type I Multiplier	Type SAM Multiplier
11 Agriculture, Forestry, Fish & Hunting	1.660054	2.149713
21 Mining	1.284994	1.581248
22 Utilities	1.217828	1.637231
23 Construction	1.549894	2.263028
31-33 Manufacturing	**1.982935**	**2.522285**
42 Wholesale Trade	1.314153	1.757506
44-45 Retail Trade	1.214726	1.731111
48-49 Transportation & Warehousing	1.518183	2.131597
51 Information	1.593462	2.258240
52 Finance & Insurance	1.230112	1.528027
53 Real Estate & Rental	1.165533	1.336412
54 Professional, Scientific & Technical Services	1.309041	1.847283
55 Management of Companies	1.349032	1.897440
56 Administrative & Waste Services	1.182001	1.770901
61 Educational Services	1.186880	1.783828
62 Health & Social Services	1.227172	1.791748
71 Arts, Entertainment & Recreation	1.406539	2.047142
72 Accommodation & Food Services	1.350438	1.787105
81 Other Services	1.294703	1.780334
92 Government & Non-NAICs	1.201244	1.878995

Note: Type I Multiplier = (Direct Effect + Indirect Effect)/(Direct Effect);
Type SAM Multiplier= (Direct Effect + Indirect Effect + Induced Effect)/(Direct Effect)
Source: 2010 Minnesota IMPLAN Group, Inc.

The next table shows that manufacturing also has the largest employment multiplier of all of Pennsylvania's industrial sectors. When accounting for direct, indirect and induced effects, every $1 million increase in final demand for manufactured products generates 2.9 jobs directly and indirectly in manufacturing (this is from the Type I multiplier listed) and an additional 1.3 jobs through the spending of employees of the manufacturers and the employees in their supply chain (subtracting the Type I multiplier from the SAM multiplier). That means a $1 million increase in final demand for manufactured products in Pennsylvania results in the creation of 4.2 jobs.

Mining, at 3.4, has the next-highest employment multiplier among Pennsylvania industries, followed by management of companies, at 2.8, and utilities, at 2.6. Manufacturing's multiplier effect is

more than double the employment generated by $1 million of final demand spent in construction; arts, entertainment and recreation; and the information industry.

Pennsylvania Employment Multipliers

Description	Type I Multiplier	Type SAM Multiplier
11 Agriculture, Forestry, Fish & Hunting	1.193798	1.333879
21 Mining	1.860447	3.382194
22 Utilities	1.519863	2.609664
23 Construction	1.40114	2.002056
31-33 Manufacturing	**2.867474**	**4.199856**
42 Wholesale Trade	1.45556	2.217969
44-45 Retail Trade	1.126495	1.497891
48-49 Transportation & Warehousing	1.581982	2.42442
51 Information	1.339607	1.814324
52 Finance & Insurance	1.463293	2.136118
53 Real Estate & Rental	1.241924	1.547766
54 Professional, Scientific & Technical Services	1.384526	2.153124
55 Management of Companies	1.60933	2.778391
56 Administrative & Waste Services	1.079261	1.324459
61 Educational Services	1.059417	1.27993
62 Health & Social Services	1.226248	1.8741
71 Arts, Entertainment & Recreation	1.099563	1.241554
72 Accommodation & Food Services	1.225271	1.536504
81 Other Services	1.188042	1.522053
92 Government & Non-NAICs	1.171426	1.785693

Source: 2010 Minnesota IMPLAN Group, Inc.

A critical component of the economic impact of any industry is its ability to generate not only work but income. The IMPLAN model allows for the calculation of Labor Income Multipliers, which are presented in the table below. The multipliers are the change in income throughout the economy that is associated with a $1 change in income in a particular industry. Income is defined as employee compensation, proprietor income, and other property income. The manufacturing sector in the table below serves as the example. Consistent with the previous tables, the Type I multiplier measures the direct and indirect economy-wide change in income, and the Type SAM multiplier measures the direct, indirect and induced economy-wide change in income associated with a $1 change in income in the manufacturing sector.

The manufacturing sector generates $3.60 in income economy-wide for every $1 change in income that comes directly from the manufacturing sector. The direct effect (change in income in the

manufacturing sector) is $1. The indirect multiplier is $1.74 (Type I multiplier of $2.74 less the $1 of direct income change). This means that incomes in the manufacturing supply chain increase by $1.74 for each $1 increase in manufacturing income. The increase in income from the induced spending of workers in manufacturing and its supply chain is $0.86.

Manufacturing's labor income multiplier effect of $3.60 is roughly double that of construction, information, and arts, entertainment and recreation. It more than doubles that of most other Pennsylvania industry sectors. Agriculture, forestry, fish and hunting is the state's only other industry with a labor income multiplier above $2, as can be seen in the following table. Manufacturing's multiplier is so extraordinarily high because of the length of its supply chain, which is reflected in its indirect income multiplier of $1.74.

Pennsylvania Labor Income Multipliers

Description	Type I Multiplier	Type SAM Multiplier
11 Agriculture, Forestry, Fish & Hunting	1.702796	2.249618
21 Mining	1.420063	1.875433
22 Utilities	1.274243	1.678262
23 Construction	1.431331	1.88489
31-33 Manufacturing	**2.738499**	**3.602419**
42 Wholesale Trade	1.350948	1.777115
44-45 Retail Trade	1.157527	1.522119
48-49 Transportation & Warehousing	1.418234	1.865793
51 Information	1.387287	1.824457
52 Finance & Insurance	1.38976	1.827924
53 Real Estate & Rental	1.411373	1.861489
54 Professional, Scientific & Technical Services	1.230079	1.619765
55 Management of Companies	1.306051	1.717509
56 Administrative & Waste Services	1.129653	1.485969
61 Educational Services	1.093812	1.438215
62 Health & Social Services	1.161408	1.528621
71 Arts, Entertainment & Recreation	1.312237	1.727584
72 Accommodation & Food Services	1.413708	1.85987
81 Other Services	1.265494	1.666835
92 Government & Non-NAICs	1.114285	1.464898

Source: 2010 Minnesota IMPLAN Group, Inc.

The Impact of the IRC

The following table lists the final demand from the two streams of revenue for each of the seven IRC regions that were incorporated into the IMPLAN model. As noted earlier, sales performance was determined by placing the sales data for each individual company that responded to the NIST/MEP survey into the IMPLAN sector corresponding to its NAICS code. Federal grants by NIST/MEP to the IRCs were assigned to IMPLAN Sector 374, which corresponds to NAICS 5416 (Administrative Management and General Management Consulting Services).

IMPLAN Data for the Increment in Final Demand by IRC Region

Regional IRC	Federal	Increased Sales
CC	$1,092,000	$24,988,740
DVIRC	$1,344,000	$18,569,642
IMC	$396,000	$3,413,800
MANTEC	$693,000	$25,723,000
MRC	$588,000	$11,773,000
NEPIRC	$504,000	$7,736,220
NWIRC	$703,000	$9,440,173
Total	**$5,320,000**	**$101,644,575**

Without a doubt, investment in the IRC program has sparked dynamic returns. The model estimated that more than 4,200 jobs were created in the state by the direct, indirect or induced result of increased sales in companies that used IRC services. As a result of increased sales, labor income in the state increased by nearly $236 million. The increased sales generated an increased demand in output (sales) for Pennsylvania products and services valued at almost $1.1 billion. Companies that used IRC services increased the value added by nearly $411 million as a result of increased sales.

Returns on Increased Company Sales Due to IRC Services

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	1,600	$84,385,238	$167,690,289	$601,608,269
Indirect Effect	1,346	$94,620,020	$142,168,596	$283,349,958
Induced Effect	1,285	$56,562,686	$100,909,986	$173,181,711
Total Effect	**4,232**	**$235,567,943**	**$410,768,870**	**$1,058,139,938**

As the following table indicates, the increase in sales and employment as a result of investment in the IRC program has, in turn, enriched state and local coffers. Companies that received IRC services paid an additional $31 million in state and local taxes in 2009. State and local governments collected nearly $17 million in business sales and property taxes and nearly $5 million in personal income tax.

State and Local Tax Impact of Increased Sales in Companies Served by IRCs

Description	Total
Dividends	$2,701,752
Social Ins. Tax: Employee Contribution	$80,167
Social Ins. Tax: Employer Contribution	$344,907
Indirect Bus. Tax: Sales Tax	$8,179,733
Indirect Bus. Tax: Property Tax	$8,628,660
Indirect Bus. Tax: Motor Vehicle Lic.	$179,479
Indirect Bus. Tax: Severance Tax	$0
Indirect Bus. Tax: Other Taxes	$2,524,171
Indirect Bus. Tax: S/L Non-Taxes	$566,407
Corporate Profits Tax	$1,804,537
Personal Tax: Income Tax	$4,849,002
Personal Tax: Non-Taxes (Fines- Fees)	$708,820
Personal Tax: Motor Vehicle License	$231,602
Personal Tax: Property Taxes	$112,066
Personal Tax: Other Tax (Fish/Hunt)	$109,290
Total State and Local Tax	**$31,020,593**

Four tables that detail the Pennsylvania industries that saw the greatest increases in added value due to direct and indirect effects stemming from increased sales among companies that received IRC services are located in the appendix to this report.

Indirect and induced benefits from federal investment of $5.3 million in 2009 to support operation of the IRCs resulted in increased demand for Pennsylvania products and services valued at nearly $6 million. (Direct benefits of these investment dollars from outside the state were calculated into the analysis of increased sales among companies served by the IRCs.) This investment in IRC operational activities led to an increase of $3.5 million in value added and the creation of 43 jobs within the Commonwealth. Labor income for the state grew by more than $2 million, as can be seen in the following table.

Return on Federal Investment in IRC Operations

Impact Type	Employment	Labor Income	Total Value Added	Output
Indirect Effect	16	$843,226	$1,336,658	$2,305,175
Induced Effect	27	$1,198,200	$2,138,473	$3,669,617
Total Effect	**43**	**$2,041,426**	**$3,475,131**	**$5,974,792**

Federal investment in IRC operations added nearly $465,000 in the form of personal income and business taxes to state and local governments.

State and Local Tax Impact
of Federal Investment in IRC Operations

Description	Total
Dividends	$27,508
Social Ins. Tax: Employee Contribution	$1,558
Social Ins. Tax: Employer Contribution	$6,702
Indirect Bus. Tax: Sales Tax	$114,809
Indirect Bus. Tax: Property Tax	$121,110
Indirect Bus. Tax: Motor Vehicle Lic.	$2,519
Indirect Bus. Tax: Severance Tax	$0
Indirect Bus. Tax: Other Taxes	$35,429
Indirect Bus. Tax: S/L Non-Taxes	$7,950
Corporate Profits Tax	$18,373
Personal Tax: Income Tax	$103,203
Personal Tax: Non-Taxes (Fines- Fees)	$15,086
Personal Tax: Motor Vehicle License	$4,929
Personal Tax: Property Taxes	$2,385
Personal Tax: Other Tax (Fish/Hunt)	$2,326
Total State and Local Tax	**$463,887**

Conclusion

In total, the impact of investment in the IRC program ripples throughout the Pennsylvania economy. In 2009, IRC operations and activities led to nearly $1.1 billion in increased output, more than $414 million in total value added and $238 million in labor income. Moreover, direct, indirect and induced effects from investment in the IRCs returned $31.5 million in state and local taxes.

Total Economic Impact to Pennsylvania of Investment in the IRC Program

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	1,600	$84,385,238	$167,690,289	$601,608,269
Indirect Effect	1,362	$95,463,246	$143,505,254	$285,655,133
Induced Effect	1,313	$57,760,885	$103,048,459	$176,851,328
Total Effect	**4,275**	**$237,609,369**	**$414,244,001**	**$1,064,114,730**

PUBLIC POLICY ANALYSIS

One focus group participant succinctly put forth a strategy for public policy to help manufacturing and business in general in Pennsylvania: "Government should make it easy to do business in Pennsylvania. Reasonable red tape and taxes. Support bringing business back domestically from overseas as much as possible. Encourage investment in Pennsylvania – low taxes, good business environment promotion."

This comment points to the top-of-mind concerns for Pennsylvania's new gubernatorial administration and highlights issues critical to a healthy business environment, particularly among the Commonwealth's manufacturing sector. Governor Corbett has committed his administration to regulatory, tax and tort reform, which is in alignment with comments of manufacturing leaders in focus groups held across the state as part of this research. No less important are two other policy areas, workforce development and Marcellus Shale development, which arose from the focus group discussions and a survey of successful manufacturers in the state. This section will detail manufacturers' input in these key policy areas and offer recommendations for change.

Tax Reform

Tax reform was not a lengthy topic of conversation during the focus groups, but the little said spoke volumes about what manufacturers consider an over burdensome tax climate in Pennsylvania.

- *"It's not a friendly environment for manufacturers in Pennsylvania. The tax situation is not friendly. The [past] governor has said focus more on service than manufacturing.*

- *"Businesses don't hire employees for tax credits; they hire employees for demand for goods and services. We have to focus on manipulating the tax code. I make decisions about what I need to do for business, not based on tax code. The government needs to create an environment that increases demand; otherwise it's just a waste."*

The limited discussion of the state's tax structure had the effect of conveying the obvious: Tax reform has been talked about repeatedly among political and business leaders. Reforming the tax structure is important to help Pennsylvania compete, but there are other factors, as well. Survey results and comments were more succinct. They focused on the state's high tax rates (its corporate rate, especially) and the complexity of the tax code (compliance and navigation). Of 57 written survey responses outside of the prepared survey questions, 24 comments were made about the tax rate or the tax code. When asked what kept them up at night, many respondents answered taxes. Of those who wrote simply one word or one phrase, taxes in the Commonwealth was the dominant response.

Pennsylvania, along with most states in the region, has a reputation for high taxes that suppress economic activity, especially for the manufacturing sector. The new administration can take steps to address threats to economic growth that arise from both tax reality and perception. These include:

- **Reducing the corporate net income tax.** At a flat rate of 9.99 percent, it is currently the second-highest rate in the country.

- **Increasing the R&D tax credit.** Many focus group participants indicated that they were unable to access the credit designed to encourage business investment because of offsetting tax liabilities.

- **Reducing or eliminating taxes on capital investment back into the business.**

- **Moving toward a lower rate and a broader base.** Manufacturers are job and wealth generators that the rest of the consuming and service sectors must rely on in order to survive. The Commonwealth would be wise not to overburden the producing sector that drives the rest of the economy.

If given a choice between a business tax code that is flatter, broader and easier to comply with or one with higher rates offset by complicated tax incentives, the manufacturing leaders would pick flat, broad and easy. The leaders who responded to the survey and participated in focus groups represented small and midsized manufacturers, which were the stable part of Pennsylvania's manufacturing employment base from 2006 to 2008. They indicated it was time to return to a set of incentives that encouraged investment in their businesses: In particular, they had a strong desire to use retained earnings as a source of internal finance, citing the difficulties that overly leveraged firms had during the Great Recession.

Firms selected to participate in the focus groups were chosen because they were viewed as being among the state's “best of the best.” These firms finance their product development internally and viewed current research and development tax credits as not directed at their firms. Tax credits are useful only if a profit is made, and selling them is viewed as being more complicated than an equivalent grant of funds or other incentive. Additionally, the focus group participants indicated that product development activities are typically extensions of and improvements on current product platforms. These successful manufacturers have tended to follow their customers closely in order to sustain and grow their market share. Their development processes have involved working closely with suppliers and customers based on trust and long-term business interest. Technology typically has been pulled into products with the help of suppliers, rather than having technology push out new classes and types of products.

The manufacturers also spoke earnestly about not taxing their plant and equipment. They saw it as a tax against the future and against their firms’ survival.

Like Pennsylvania, neighboring Ohio has suffered much during the recession and in the years leading up to it. Yet, Ohio may soon see a resurgence in its manufacturing base due to a phased-in major business tax overhaul. Heavily supported and driven by the state’s manufacturing sector, the reform has resulted in:

- No tax on inventory or corporate income.

- No tax on investments in machinery and equipment.

- No tax on export product sold.

- A flat tax of $150 for companies with sales between $150,000 and $1 million.

- Significant reduction of the state income tax.

Ohio is learning that there are two groups opposed to a broad, flat tax. The first are very large companies that benefit from various incentive programs and tax loss carry-forwards and that are unlikely to have paid taxes in years. The second group is composed of companies in the service industry with primarily in-state customers. The argument made in Ohio was that the future of in-state service providers depends on the state's economic base; therefore, shifting the business tax burden by lowering the rate radically and broadening its base was justified.

One Pennsylvania manufacturer provided this bottom-line comment: "Manufacturing is key to job creation and money generation. If you tax the hell out of it, we lose our motivation and go away. Leave us alone, let us grow our business, employ people, and the economy will grow ... and so will tax revenue."

Business Tax Reform Alone Is Not Enough

Public policy analysts and economists love to think about their ability to influence the world through the manipulation of a few big public policy levers. In the case of Pennsylvania, the thought may be that lawmakers will have done enough if they fix the business tax code and then step aside to let the market work to return the state to prosperity. Unfortunately, pulling on that one big policy lever will not be enough. Contrary to expectations of those who look no further than at the smooth, quick operation of the theoretical economists' invisible hand, manufacturing capacity, supply chain, knowledge and products will not be sitting patiently on a shelf somewhere to be rapidly redeployed. The path to prosperity has been permanently altered, and the manufacturing commons will need to be recreated.[16]

Many of Pennsylvania's manufacturers have cut so much to survive this recession that they now lack the capability to manage their businesses properly. Many have divested their product development capacity. Others have abandoned their practices of lean manufacturing and continuous improvement. As production comes back, they will have to rethink their production processes and sourcing. Yes, over a decade, the market will work toward a solution. But the cost of such a laissez-faire approach will be a slower-than-need-be pace of recovery and an unnecessary loss of firms. The speed of the rebound among Pennsylvania's manufacturers will be dictated by how quickly widespread enterprise transformation takes place and how rapidly new firms arise to fill gaps created by the death of companies that could not adapt. Here, the IRC Network is positioned to accelerate positive and necessary transition.

Our research and conversations with Pennsylvania's manufacturers reveal a clear ability to compete when firms engage in enterprise transformation. Such transformation:

- Is built on the foundation of a strong objective strategic plan;

[16] Pisano, G., & Shih, W. (2009, July-August). "Restoring American Competitiveness," *Harvard Business Review*.

- Eliminates waste, improves quality, and frees up resources by fully deploying lean manufacturing techniques throughout the enterprise (in the back office and on the shop floor);
- Measures what is important and establishes a culture of continuous improvement;
- Empowers the core workforce and frees senior management to work on their businesses;
- Engages in product development, incorporating new technologies, pursuing market niches to battle commoditization, and enhancing sales and marketing efforts.

This is a recipe that is easy to recite, challenging to implement, and hard to stick with unless it is a core part of company operations. We have witnessed that the best-of-the-best can structure their operations to contain costs that reside in the middle of their balance sheets, while allowing company leadership the time and resources to implement strategies to grow the top line. To succeed in today's global market, manufacturers cannot only focus on cost containment or on growth; the imperative is to do both.

The focus group sessions indicated several areas for programmatic support of manufacturing. These include:

- Targeted workforce development efforts designed to increase the number of potential workers with middle skills critical to manufacturing.
- An integrated suite of services that builds on a foundation of strategy and management practices that use continuous improvement and lean tools to promote cultural change.
- A one-stop source for help with product development and marketing.
- Assistance with information technology evaluation and acquisition, particularly regarding the costly, critical choice of an enterprise resource planning (ERP) system. This should also include assistance in turning data collected through ERP systems into opportunity for product and process transformation.
- Help with harnessing the potential of online networking.

The seven IRCs are active in all of these areas critical to enterprise transformation and competitive advantage.

Regulatory & Tort Reform

Similar to tax reform, the topics of regulatory and tort reform did not generate great discussion during the focus groups. However, the issues were not completely avoided, as the following comments indicate:

- *"I believe to my core that it is incredibly important to this state and nation that we continue to be manufacturers or we won't be innovators. Don't impede. Don't overregulate us. Let us do our work."*

- *"My biggest concern is what is going to happen to employees with all the new health care regulations."*

However, like tax reform, regulatory and tort issues were raised in the survey results with greater frequency. Regulatory concerns among respondents fluctuated between federal- and state-level regulatory issues, whereas tort and associated legal and insurance costs were listed as major impediments to business, with half of all survey respondents rating them as 4 or 5 on a scale of 1 to 5.

Workforce

In the focus groups, the most pressing worry of the manufacturing leaders was workforce. This is a surprising result coming at the tail end of the Great Recession and in the early stages of an anemic recovery. Among focus group participants surveyed, 94 percent rated "human-capital acquisition, development and retention" as important to their company's success over the next five years; 60 percent described it as highly important. In particular, these top performers fretted over skills, attitude and interest. Workforce issues constrained their ability to grow. They pointed to a deficit of workers with skills critical to manufacturing activities. “We can’t find machinists, welders, hands-on guys who used to be the backbone of this country,” said a Philadelphia-area manufacturer. “We have the opportunity to grow. But we can’t find the people.”

Only 18 percent of focus group participants surveyed considered cost of entry-level labor to be a problem, but 50 percent or more said availability and skill level were. For semi-skilled jobs, 25 percent of survey respondents considered cost of labor to be a problem, while more than 50 percent said availability and skill level were. Half or more respondents cited technical labor costs, availability and skill levels as problems, with a quarter describing availability and skill level as "major" problems.

Another participant served by the DVIRC echoed the difficulty in finding workers with the right “middle” skills. “If we’re hiring engineers, engineers will be lined up down the block. But if we’re looking for welders or fitters, we may find three candidates, and they’ll all be 50 or older.” One frustration among these manufacturers is government-supported workforce centers steering people with skills away from the industry: “A few years ago, we were looking to hire people, and a company laid off a bunch of machinists after shutting down,” said another Philadelphia-area manufacturer. “Those guys were told there was no future in manufacturing and they should look at health care.” A participant in the Williamsport focus group shared a similar story of workers with in-demand manufacturing skills being steered away from the industry. Her local plant was forced to wring enough costs out of production to keep her parent company from moving operations to a lower-cost country. That meant letting a number of people go. “One of our tool-and-die guys who got laid off, he couldn’t go to school to further his tool-and-die skills because he couldn’t get tuition credits. It wasn’t seen as a sustainable job. So he went into the health-care industry instead. That’s not what he wanted to do. That’s one reason why we’re missing those skills.”

Although they decried the lack of focus on and training for skills critical to manufacturing, they worried even more about work ethic and attitude. Finding good workers is limiting their ability to seize on opportunities, they said. “In the tool-and-die business, we need a particular skill set. Now we find that people with the skill set don’t have the mental aptitude we need,” said a York-area manufacturer. “They’re too entrenched in old industrial norms. There’s a pervasive attitude that [they] will build no die

before it's time. It's an arts and crafts mentality. We've taken to hiring based on attitude and then we'll train."

"We had one position open up; 100 applied and we didn't hire one," said a Bethlehem-area manufacturer. "We're extremely picky. We go through a screening process about the attitude piece. The position we were looking for was higher skill. When we find people with the right attitude, we hire them. We don't start with skill and work backward."

A Pittsburgh-area manufacturer agreed: "We're going to be trying to hire 25 to 30 percent more people in the next year. At least half don't pass the drug test. That's going to be a huge problem for us. We can try to be more efficient, but it will be a detriment to our growth if we don't find them."

The manufacturers in the MANTEC region applauded the efforts of their local workforce agency. As the research team sifted through the responses from the manufacturers and combined their comments with the data on middle-skill jobs, a picture of needed change in the workforce system came into view. The workforce development system need to evolve from its dual-customer mission so that the employer becomes the dominant customer. The person who is referred to the employer needs to be genuinely work-ready. It is likely the government will have to find ways to cooperate − or, if necessary, compete − with temporary staffing agencies, which many focus group participants said they are turning to for help in filling entry-level jobs.

Insights provided from the occupational data point to a new form of apprentice program that could move workers in Gateway occupations up a rung on the career ladder to middle-skill, middle-income jobs. But to get started on such a career ladder, the person must first be work-ready. Work-ready means that a person has a strong work ethic, is able to pass a drug test, is able to work in diverse settings, has a secondary school diploma, and is literate and numerate. Specifically, numerate refers to having the ability to measure and to complete Algebra 1 and shop geometry. A work-ready person needs to be able to work in diverse groups as a team member without excessive supervision. And, for many jobs, work-readiness carries the expectation that a person is fit enough to stand for 8 hours and lift 40 pounds.

The labor market is beginning to treat high school graduates as it treats dropouts, meaning they are constrained to low-wage, high-turnover work unless they can access a path up the career ladder by leveraging experience and training. A set of lesser-skilled workers are still necessary to support manufacturing activity, but these workers will not be considered for jobs higher up the career ladder unless they meet the standards of literacy, numeracy, and work ethic required to be part of the company's employment core. Even workers who meet these basic standards must accept that repeated retraining is a requirement for succeeding in today's globally competitive environment. In other words, modern manufacturing can no longer be viewed as America's anti-poverty program. Today's manufacturers need workers with the skills, attitude, and adaptability to compete in a rapidly changing marketplace.

The data on middle-skill jobs indicate that those workers who do best in today's market are those who have graduated from high school and either have completed an industry-standard, skill-

certified training program or have received substantial on-the-job training. A modern apprentice program will do both, coupling formal training with substantial structured on-the-job experience. This underscores a role for the IRCs as intermediaries between the workplace and Pennsylvania's educational system. The IRCs are experienced at providing training and brokering services in customized or semi-customized settings. Manufacturers would be well-served if the IRCs could help increase the supply of workers with needed skills by coupling industry-standard training with an internship or apprentice-like experience.

Marcellus Shale Development and Pennsylvania's Manufacturers

When asked "*What are the 1 to 3 emerging industries, products, business functions or technologies that you think are good bets for moving Pennsylvania's economy forward during the next decade?"* survey respondents overwhelmingly referenced the coming impact of shale gas and its related supply chain. Twelve of 50 respondents specifically commented on natural gas, gas drilling and Marcellus gas. Most of them listed it as their only response. Adding in comments that included some reference to energy or alternative energy captured 76 percent of responses to the question.

Clearly, the impact of the shale gas revolution that is taking hold in North America – centered in the Commonwealth – is of great importance to Pennsylvania's manufacturing sector. Combined with taxes, these two issues alone solicited the most one-word or one-phrase responses to questions surrounding public policy and future growth industries. What was interesting was the pattern of responses. Nearly all of the respondents participating in Williamsport and Bethlehem focus groups were very aware of the possibilities inherent in extracting natural gas. There was awareness of the industry's potential among participants at other focus groups, but it was not as keen. Pennsylvania's manufacturers are interested in the industry for a number of reasons. A natural resource like Marcellus shale is unmovable, and Pennsylvania encompasses the portion of the region known as "the fairway." As one Pennsylvania manufacturer succinctly noted: "We're sitting on top of it." There is optimism about a dependable, clean-burning fuel source that will be well-priced and that, from the perspective of the energy user, will provide operating security.

Equally large in the eyes of manufacturers is the possibility of joining the supply chain of the well drillers. If drilling goes forward, there will be demand for pipe, controls, and machinery. Small and midsized manufacturers want assurance that they will have the ability to bid for work and not confront closed supply chains that are brought into the state.

However, manufacturers also have concerns about the Marcellus development and its impact on the labor market. Marcellus development poses a threat to low-skill manufacturing in the shale region. Anecdotal evidence already suggests upward pressure on labor prices, particularly among semi-skilled workers. Manufacturers expect that this market pressure will intensify as drilling accelerates and companies look for drivers and field workers.

When development of the shale region begins in earnest, informed manufacturers anticipate that the development will be intense for a relatively short time period, say a decade. They want to be

positioned so that they can survive the burst of labor market pressure and be part of the state's economic base once the development wave has passed.

Sensible, forward-looking public policy could go a long way in accelerating the adjustment of Pennsylvania's manufacturing base and protecting the next generation of goods producers. The IRC program is ready to continue its stewardship responsibility.

REGIONAL DIFFERENCES

The impact of manufacturing in Pennsylvania on the economy differs from region to region. The mix of driver industries that powers each region also differs from place to place. The industry mix that exists in the state's two urban areas of Philadelphia and Pittsburgh is not the same as the manufacturing that takes place in the more rural regions surrounding Erie or Wilkes-Barre. Political leaders and government programs often expect and plan for differences between urban and rural activities. However, there are distinct differences in terms of industrial activity and competitive effect within each region. Philadelphia and Pittsburgh are similar in their population density, but they have distinct advantages and face individual challenges in terms of their industrial mix and economic environment. The same could be said for Bethlehem, Williamsport, York and the remaining regions of the state. In other words, any policies or programs aimed at supporting and improving manufacturing in Pennsylvania must understand the effect such policies would have not just at the state level, but at the regional level, as well. State efforts to improve manufacturing also must take into account that each individual IRC faces different challenges and opportunities because of the particular needs of the industrial mix they are charged with supporting.

The following table shows change in manufacturing GSP for each IRC region. As can be seen, a 10-year comparison tells a challenging story of growth for all seven regions. Between 1998 and 2008, manufacturing GSP for all regions shrank. Narrowing the analysis to the years from 2003 to 2008 shows that four of the seven IRC regions had begun to see positive growth in manufacturing GSP, with the communities served by the Northwest IRC leading the way at 2 percent. It's worth pointing out that although the region served by the NWIRC has experienced negative growth for the decade (-1.3%), it has counterbalanced that loss with impressive gains in the past few years. Three regions – those served by the Delaware Valley IRC (DVIRC), the Manufacturers Resource Center (MRC) and the IMC – continued to show negative growth even after manufacturing in other parts of the state appeared to have turned a corner.

Despite the contraction, the area served by the DVIRC, which includes Philadelphia, is by far the state's largest manufacturing region, accounting for $28.2 billion in GDP in 2008. The two next-biggest contributors are the regions served by Catalyst Connection, which includes the state's other population center of Pittsburgh, and MANTEC, which includes the state capital and governmental hub of Harrisburg. Manufacturers in the area served by Catalyst Connection contributed nearly $14 billion to Pennsylvania's GSP in 2008, an increase of 1.9 percent over its 2005 gross product. Manufacturers in the area served by MANTEC contributed more than $13.5 billion in GSP, an increase of nearly 1 percent over its 2005 gross product.

Manufacturing Performance by IRC Region

Regional IRC	2008 Manufacturing GSP ($Million)	05-08 CAGR	03-08 CAGR	98-08 CAGR
DVIRC	$28,168	-0.5%	-4.3%	-2.2%
CC	$13,976	1.9%	0.3%	-0.9%
MANTEC	$13,539	0.8%	0.7%	-1.3%
MRC	$9,079	-3.0%	-2.9%	-2.3%
NWIRC	$7,050	1.7%	2.0%	-1.3%
NEPIRC	$5,388	0.4%	-0.7%	-1.0%
IMC	$4,246	-0.4%	-1.0%	-2.2%

Source: Moody's Economy.com
Note: CAGR represents Compound Annual Growth Rate.

Catalyst Connection

As noted earlier, Catalyst Connection serves the region surrounding Pittsburgh. Since the 2004 study, Manufacturing Pennsylvania's Future, the service area has been realigned to consist of the following 12 counties:

- Allegheny
- Armstrong
- Beaver
- Butler
- Cambria
- Fayette
- Greene
- Indiana
- Lawrence
- Somerset
- Washington
- Westmoreland

The following table shows the regional GSP and growth rate by industry for the counties served by Catalyst Connection. As can be seen, the first nine sectors mirror the state's mix of largest GDP contributors. However, in the region anchored by Pittsburgh, the three largest sectors in terms of regional GSP are more evenly represented. As with the state overall, manufacturing tops the list in terms of industry GSP, accounting for 11.3 percent, or nearly $14 billion, of regional GSP. However, it is followed closely by Real Estate and Rental and Leasing, at 11 percent, and Health Care and Social Assistance, at 10.4 percent. Manufacturing, as with all but five of the 20 industry sectors listed, showed growth, when comparing 2005 GSP to that of 2008. Despite the effects of recession, which took hold in December 2007, manufacturing in the area served by Catalyst Connection expanded. Manufacturing's three-year change in annual growth rate of 1.9 percent may seem modest compared to the sizzling 15.4 percent for Management of Companies and Enterprises and even the 4.8 percent for Professional, Scientific and Technical Services. However, the growth among Pittsburgh-area manufacturers is the highest three-year change for manufacturing in all seven regions of Pennsylvania.

GSP and Growth Rate by Industry for Region Served by Catalyst Connection

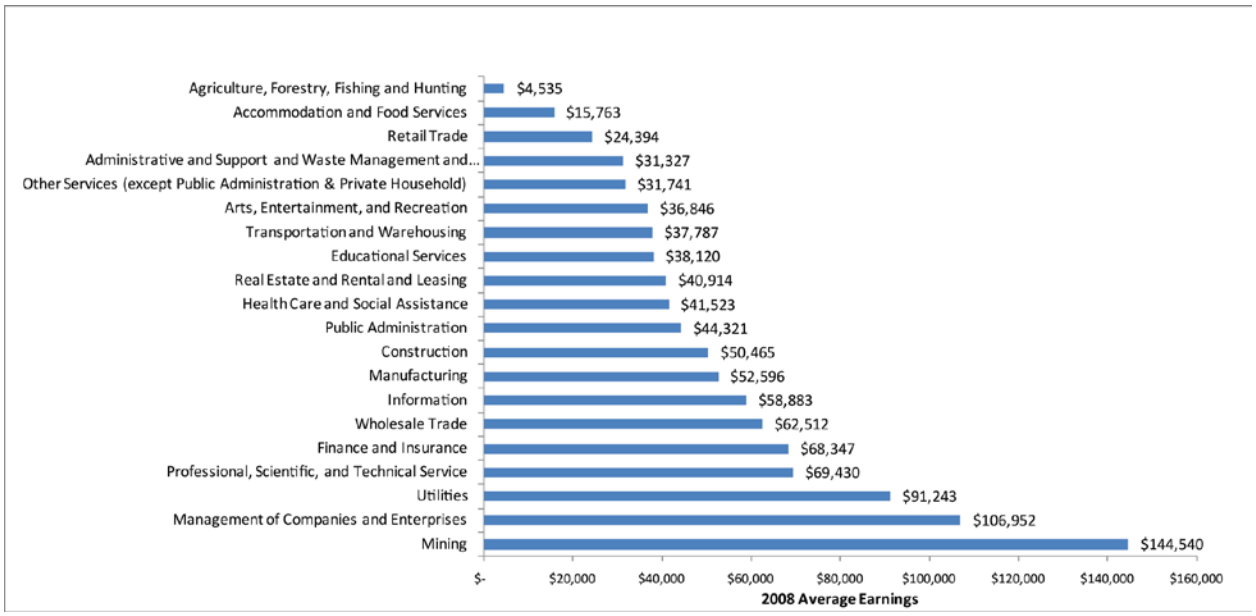
Industry	2008 Employment	2008 GSP ($M)	05-08 CAGR	03-08 CAGR	98-08 CAGR	Industry Gross Product as a % of Regional GSP
Manufacturing	**114,249**	**$13,976**	**1.9%**	**0.3%**	**-0.9%**	**11.3%**
Real Estate and Rental and Leasing	14,887	$13,570	2.1%	0.7%	1.2%	11.0%
Health Care and Social Assistance	208,958	$12,852	2.8%	2.8%	3.2%	10.4%
Public Administration	155,500	$10,407	-0.3%	-0.3%	0.3%	8.4%
Professional, Scientific, and Technical Service	75,959	$9,585	4.8%	3.5%	2.6%	7.7%
Finance and Insurance	60,371	$8,911	0.1%	1.1%	1.9%	7.2%
Retail Trade	149,848	$7,493	-1.4%	-1.9%	-0.8%	6.0%
Wholesale Trade	54,869	$7,334	1.4%	2.8%	2.1%	5.9%
Construction	66,674	$5,314	-1.1%	-0.1%	1.3%	4.3%
Utilities	7,725	$5,295	4.3%	6.7%	5.8%	4.3%
Management of Companies and Enterprises	35,009	$5,093	15.4%	13.3%	5.8%	4.1%
Information	23,168	$4,523	-0.9%	1.8%	2.4%	3.7%
Transportation and Warehousing	44,345	$3,511	-6.9%	-5.1%	-2.9%	2.8%
Administrative and Support and Waste Management and Remediation Services	62,841	$3,313	1.2%	3.7%	2.1%	2.7%
Other Services (except Public Administration & Private Household)	60,568	$3,173	0.3%	1.2%	1.1%	2.6%
Accommodation and Food Services	102681	$2,817	2.3%	1.5%	1.5%	2.3%
Mining	5,606	$2,609	4.3%	7.6%	4.3%	2.1%
Educational Services	53,930	$2,508	1.6%	1.2%	3.4%	2.0%
Arts, Entertainment, and Recreation	19,361	$1,231	4.9%	1.7%	3.2%	1.0%
Agriculture, Forestry, Fishing and Hunting	15,274	$345	1.8%	2.6%	0.9%	0.3%
	1,331,823	$123,860	1.64%	1.62%	1.45%	
Source: Moody's Economy.com						
Note: CAGR represents Compound Annual Growth Rate.						

The structure of the regional economy has clearly shifted toward the non-manufacturing sector: The presence of Health Care and Social Assistance increased, moving into third place for regional GDP and eclipsing all other sectors in terms of employment with nearly 209,000 workers. Professional, Scientific and Technical Services moved into the fifth spot, accounting for 7.7 percent of regional GDP and employing more than 60,000 workers. Although not reflected in the numbers, manufacturing may be helping to fuel this growth in Professional, Scientific and Technical Services. The increasing sophistication of advanced manufacturing drives demand for scientific and professional services to support it. Manufacturing continues to be a major employer in the region, accounting for 8.6 percent of the local labor market. However, its overall employment, which stood at 114,249 by 2008, had fallen to fourth, behind Health Care, Public Administration and Retail Trade.

Those workers engaged in manufacturing had average earnings of $52,596 in 2008, higher than that of 12 of the 20 regional industries examined. Although higher than for many larger and more rapidly growing industries in the region, it should be noted that average annual manufacturing earnings declined slightly when accounting for inflation ($52,596 compared to a projected $55,108). However, as noted earlier, increases in earnings among two sectors closely related to manufacturing may be masking some of the wage growth among manufacturing activity. Management of Companies and Enterprises and Professional, Scientific and Technical Services saw their average earnings increase significantly. This requires a bit of understanding regarding NAICS (North American Industrial Classification Systems) reporting. Under NAICS, industries are classified based on which activity accounts for 50 percent of the value coming out of an establishment. Outsourcing some lower-wage manufacturing activities could

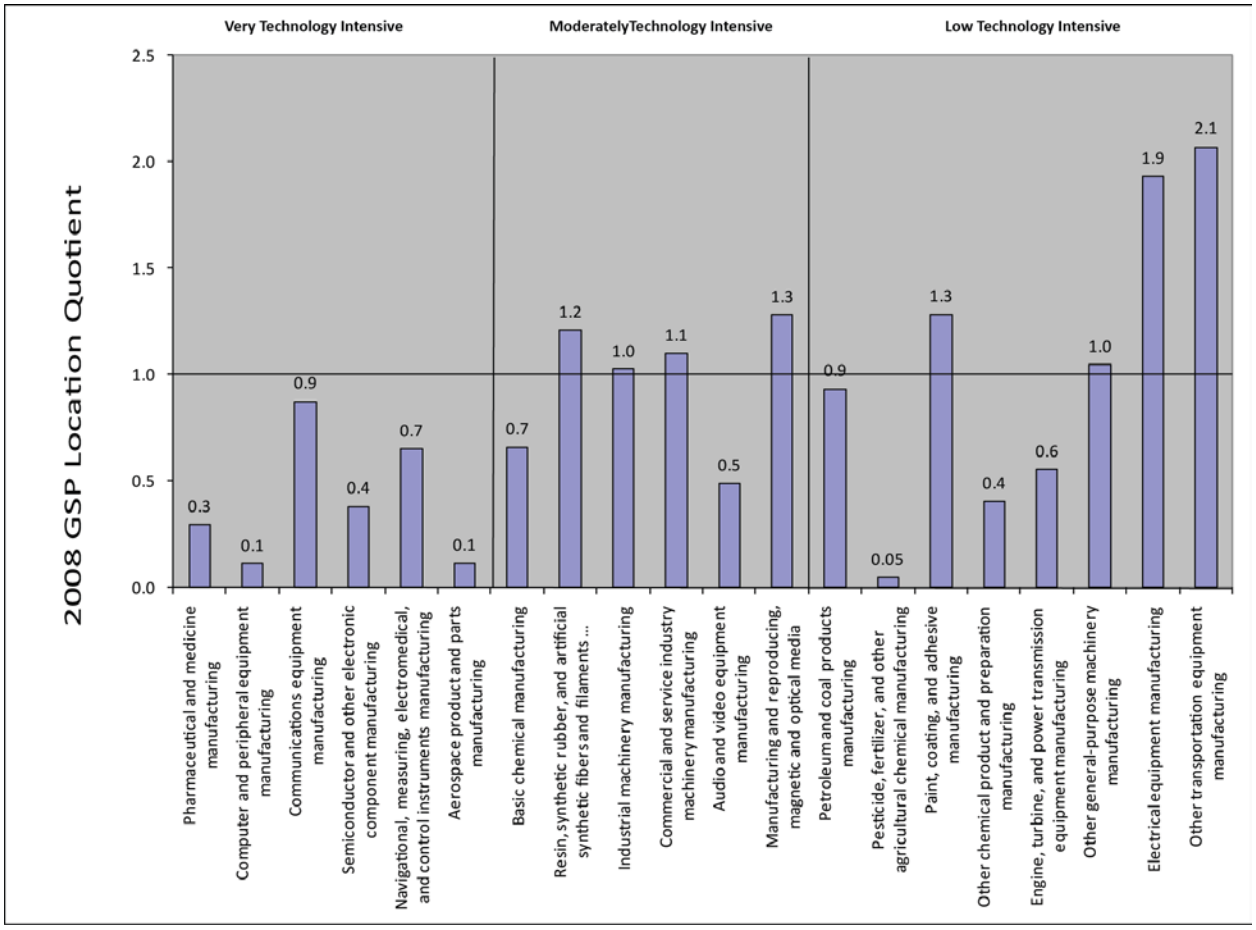
result in longtime manufacturers being reclassified as Management of Companies and Enterprises, or spinning off research and design activities to a separate establishment would result in those typically higher wage jobs being classified as Professional, Scientific and Technical Services when they previously would have been included in the employment numbers (and wage calculations) for Manufacturing.

Earnings by Industry for Region Served by Catalyst Connection



Three of the seven manufacturing industries in which the area surrounding Pittsburgh employs a greater share of workers than the national average are low in technology intensity. As can be seen in the following figure, the region employs more than twice the national percentage of workers engaged in Other Transportation Equipment Manufacturing and nearly twice the national share engaged in Electrical Equipment Manufacturing. The region also has a greater share of workers in Painting, Coating and Adhesives Manufacturing. The region captures or exceeds the national share of employment in the more moderately technology-intensive fields of Industrial Machinery Manufacturing; Commercial and Service Industry Machinery Manufacturing; Resin, Synthetic Rubber, and Artificial Synthetics Manufacturing; and Manufacturing and Reproducing Magnetic and Optical Media. The region is below the national average share of employment in industries that are considered highly reliant on technology. It comes close with Communications Equipment Manufacturing, but other highly technology-intense industries are underrepresented in the region.

Technology Intensity Among Industries in Region Served by Catalyst Connection



As can be seen in the following table, the region served by Catalyst Connection trails the state overall, peer states and the nation in highly technology intensive manufacturing. The Pittsburgh area does not have any highly concentrated industry classified as very technology-intensive. However, the area exceeds the state and peer averages for service activities that are very reliant on technology. Among moderately technology-intensive industries, two have relatively strong presence in the region served by Catalyst Connection:

- Resin, Synthetic Rubber and Artificially Synthetic Fibers (LQ=1.2)
- Manufacturing and Reproducing, Magnetic and Optical Media (LQ=1.3)

Although the region slightly exceeds the national and peer averages for low technology intensive manufacturing activities, the area served by Catalyst Connection far exceeds the average share of low technology service activities in the state, among peer states and in the nation overall. Three manufacturing industries requiring low technology intensity have strong presence in the region:

- Other Transportation Equipment Manufacturing (LQ=2.1)
- Electrical Equipment Manufacturing (LQ=1.9)
- Paint, Coating, and Adhesive Manufacturing (LQ=1.3)

It should be noted that NAICS codes have been redefined and Hecker's definition has been changed since the 2004 Pennsylvania industry study, making it difficult to examine changes over time in the technology intensity of each regional industry mix. Since the previous study, total employment in technology-intensive industries increased, reaching 11.1 percent and surpassing the average for Pennsylvania (10.5%) and the regional peers (8.6%).

Comparing Employment in Technology-Intensive Industries

	CC	Pennsylvania	Regional Peers*	United States
Total Technology-Intensive Employment in Private Sector	11.1%	10.5%	8.6%	11.6%
Very Technology Intensive				
Very Technology Intensive Manufacturing	0.7%	1.1%	1.1%	1.5%
Very Technology Intensive Pipeline & Telecommunication	0.0%	0.0%	0.0%	0.1%
Very Technology Intensive Service	2.8%	2.6%	2.2%	2.8%
Moderate Technology Intensive				
Moderate Technology Intensive Manufacturing	0.5%	0.5%	0.3%	0.4%
Moderate Technology Intensive Others	1.6%	1.7%	1.5%	2.7%
Moderate Technology Intensive Service	1.2%	1.2%	0.9%	1.2%
Low Technology Intensive				
Low Technology Intensive Manufacturing	0.7%	0.7%	0.5%	0.6%
Low Technology Intensive Pipeline & Telecommunication	0.7%	0.7%	0.6%	0.7%
Low Technology Intensive Service	2.8%	2.1%	1.4%	1.6%
*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV				

Source: Moody's Economy.com

Regional Driver Industries

The following table details the 21 identified driver industries for the region of Pennsylvania served by Catalyst Connection. Despite the significant challenges to manufacturing over the past decade, manufacturers make up a third of the region's driver industries. Yet, manufacturing's clout has clearly diminished. Only metalworking machinery and glass products remain from the 10 manufacturing industries identified as drivers and emerging drives for the region in the 2004 study. In terms of 2008 GSP, the $2.4 billion generated by the top-performing manufacturing driver, iron and steel mills and ferroalloy, is eclipsed by five other driver industries. Three of the seven regional manufacturing drivers experienced negative growth from 1998 to 2008.

Driver Industries for the Region Served by Catalyst Connection
(ranked by 2008 GSP)

NAICS	Industry Name	2008 GSP($M)	2005-08 GSP CAGR	2003-08 GSP CAGR	98-08 GSP CAGR	2008 GSP Location Quotient	2002-08 Change in LQ
GVL	Local Government	$6,520	-0.8%	-0.2%	0.1%	0.81	-0.06
5311	Lessors of Residential Buildings and Dwellings	$5,311	5.8%	4.3%	0.7%	1.04	0.07
5511	Management of Companies and Enterprises	$5,093	15.4%	13.3%	5.8%	2.04	0.83
5313	Real Estate Property Managers	$4,872	4.4%	0.3%	2.1%	0.89	-0.09
2211	Electric Power Generation, Transmission and Distribution	$4,025	5.5%	7.0%	6.9%	2.01	0.28
3311	Iron and Steel Mills and Ferroalloy Manufacturing	$2,416	12.1%	14.5%	6.0%	14.43	3.96
5312	Offices of Real Estate Agents and Brokers	$2,309	-8.2%	-3.7%	0.2%	0.60	-0.16
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$507	2.4%	15.8%	6.7%	6.55	2.10
3335	Metalworking Machinery Manufacturing	$484	-4.5%	-2.3%	-5.4%	3.15	-0.22
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$418	2.8%	11.1%	7.6%	4.60	1.38
6219	Ambulance Services	$395	-0.4%	0.0%	6.0%	2.79	-0.77
3272	Glass and Glass Product Manufacturing	$313	-10.4%	-9.7%	-8.0%	3.20	-1.17
4854	School and Employee Bus Transportation	$202	-2.9%	3.1%	3.4%	3.15	0.31
3365	Railroad Rolling Stock Manufacturing	$146	16.0%	5.8%	1.7%	5.96	-0.65
6222	Psychiatric and Substance Abuse Hospitals	$133	-7.7%	-4.4%	-1.9%	3.18	-1.59
3271	Pottery, Ceramics, and Plumbing Fixture Manufacturing	$128	-16.8%	-12.2%	-7.9%	2.70	-1.64
5179	Other Telecommunications	$89	4.9%	1.4%	-11.0%	0.21	0.01
6112	Junior Colleges	$42	16.1%	5.1%	-0.2%	3.37	-0.75
4855	Charter Bus Industry	$39	-4.4%	1.1%	-2.9%	2.88	0.22
7132	Casinos (except Casino Hotels)	$31	58.9%	30.8%	6.2%	0.30	0.20
4245	Grain and Field Bean Merchant Wholesalers	$6	0.9%	9.7%	28.3%	0.10	0.08

Source: Moody's Economy.com

The following table shows the clustering of driver industries for the region served by Catalyst Connection. This clearly shows that real estate and associated activities are more of an economic engine driving the region than manufacturing. Real estate is a growing cluster, driven by real estate management and the management of companies. However, manufacturing remains a critical part of the economic base, with industry still heavily concentrated in the Pittsburgh area. Education and health-care industries reflect the region's population structure, although education is an export industry for the region. These industries experienced modest fluctuation in GSP and employment, and they maintain a strong local presence. Casinos have shown strong growth since 2003, and grain wholesalers gained significant concentration throughout the whole decade of study.

Driver Industries by Group for the Region Served by Catalyst Connection

NAICS	Industry Name	2008 GSP ($M)	2005-08 GSP CAGR	2003-08 GSP CAGR	98-08 GSP CAGR	2008 GSP Location Quotient	2002-08 change in LQ
	Real Estate and Management						
5311	Lessors of Residential Buildings and Dwellings	$5,311	5.8%	4.3%	0.7%	1.04	0.07
5511	Management of Companies and Enterprises	$5,093	15.4%	13.3%	5.8%	2.04	0.83
5313	Real Estate Property Managers	$4,872	4.4%	0.3%	2.1%	0.89	-0.09
2211	Electric Power Generation, Transmission and Distribution	$4,025	5.5%	7.0%	6.9%	2.01	0.28
5312	Offices of Real Estate Agents and Brokers	$2,309	-8.2%	-3.7%	0.2%	0.60	-0.16
5179	Other Telecommunications	$89	4.9%	1.4%	-11.0%	0.21	0.01
	Manufacturing						
3311	Iron and Steel Mills and Ferroalloy Manufacturing	$2,416	12.1%	14.5%	6.0%	14.43	3.96
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$507	2.4%	15.8%	6.7%	6.55	2.10
3335	Metalworking Machinery Manufacturing	$484	-4.5%	-2.3%	-5.4%	3.15	-0.22
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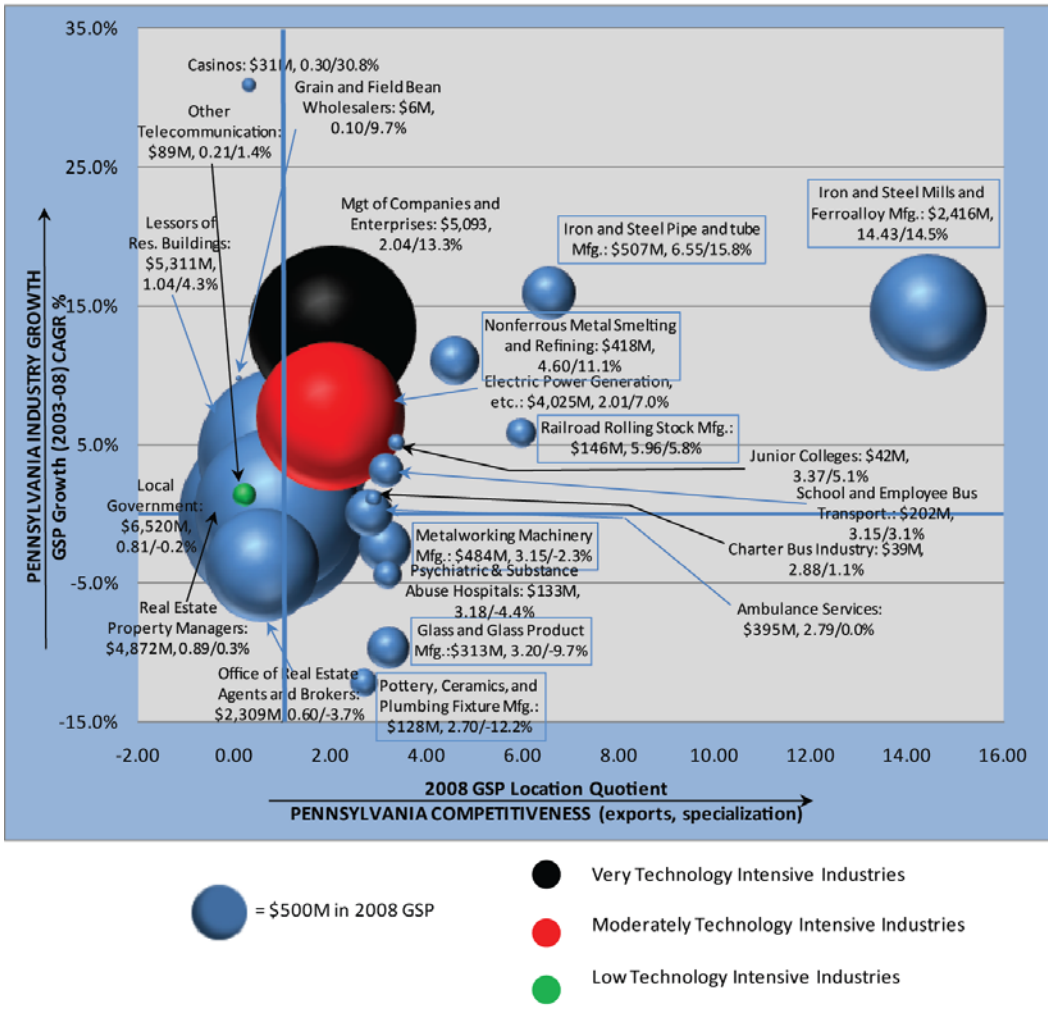
3272	Glass and Glass Product Manufacturing	$313	-10.4%	-9.7%	-8.0%	3.20	-1.17
3365	Railroad Rolling Stock Manufacturing	$146	16.0%	5.8%	1.7%	5.96	-0.65
3271	Pottery, Ceramics, and Plumbing Fixture Manufacturing	$128	-16.8%	-12.2%	-7.9%	2.70	-1.64
	Education and Health Care						
GVL	Local Government	$6,520	-0.8%	-0.2%	0.1%	0.81	-0.06
6219	Ambulance Services	$395	-0.4%	0.0%	6.0%	2.79	-0.77
4854	School and Employee Bus Transportation	$202	-2.9%	3.1%	3.4%	3.15	0.31
6222	Psychiatric and Substance Abuse Hospitals	$133	-7.7%	-4.4%	-1.9%	3.18	-1.59
6112	Junior Colleges	$42	16.1%	5.1%	-0.2%	3.37	-0.75
4855	Charter Bus Industry	$39	-4.4%	1.1%	-2.9%	2.88	0.22
	Other Industries						
7132	Casinos (except Casino Hotels)	$31	58.9%	30.8%	6.2%	0.30	0.20
4245	Grain and Field Bean Merchant Wholesalers	$6	0.9%	9.7%	28.3%	0.10	0.08

Source: Moody's Economy.com

Of the 21 regional drivers, only three are industries making intensive use of technology. Only one – management of companies and enterprises – is considered to have very high technology intensity. The industry has strong presence in the region, with a GSP LQ of 2.04 in 2008, and experienced a healthy compound average growth rate of 13.3 percent from 2003 to 2008. Electric power generation is a moderately technology-intensive industry in the region that grew 7 percent annually between 2003 and 2008 and maintained a strong GSP LQ of 2.01.

Technology Intensity of Driver Industries

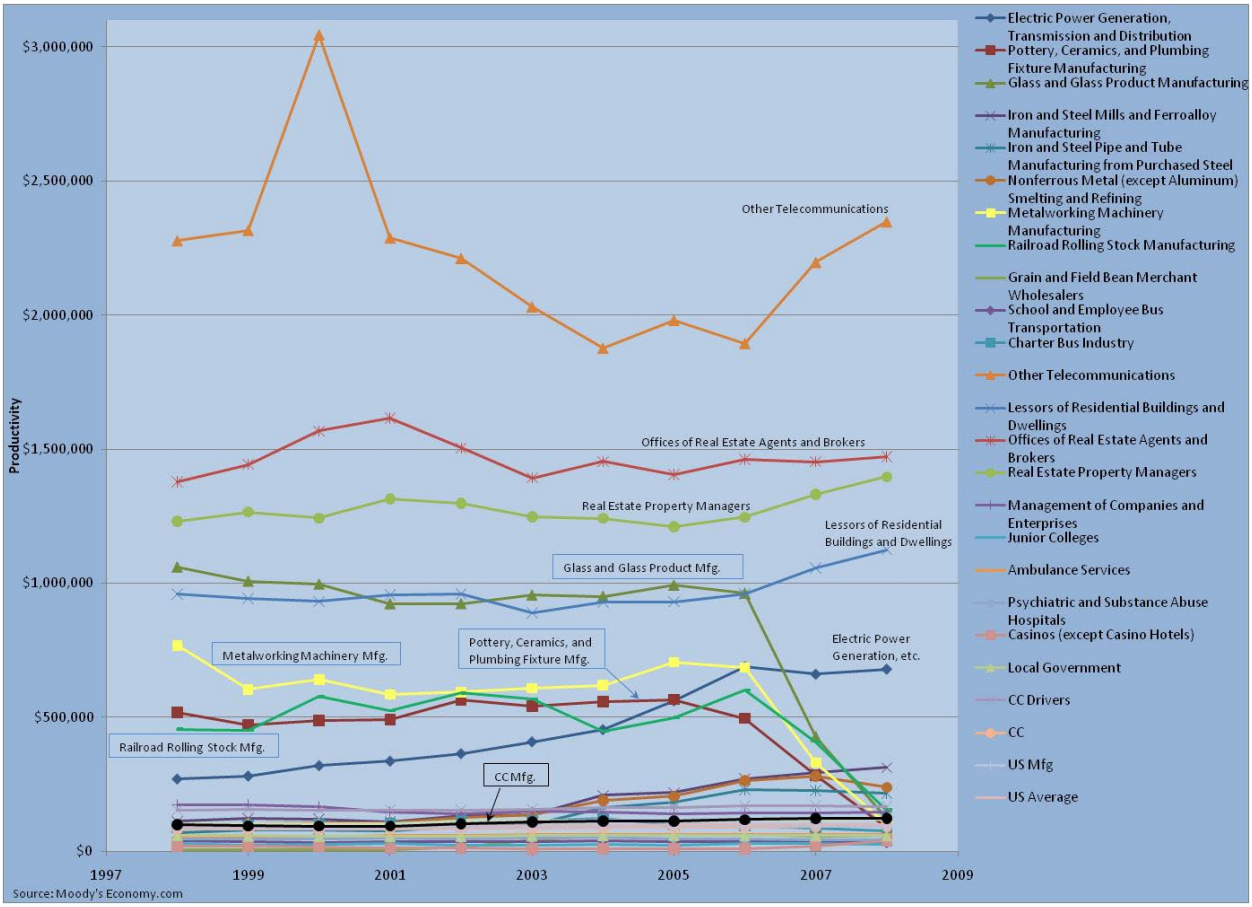


Other telecommunication, the region's only low-intensity technology industry, grew 4.9 percent annually, on average, from 2005 to 2008. Although its GSP LQ is low for the region, the industry has very high and growing productivity in terms of GSP per employee. The following figure shows productivity over time for each of the region's driver industries. As can be seen, despite falling well off its peak in 2000, productivity for the Other Telecommunication industry far exceeded that of the other driver industries. By the end of the decade studied, its productivity was once again growing substantially.

Among the region's drivers, Real Estate and Management industries have demonstrated high productivity. These productivity rates remained stable over much of the decade and began to grow in the final years of the study period. Electric power generation industry, which clustered with real estate and management due to the similar dynamic of its productivity, grew by 151 percent from 1998 to 2008. Four manufacturing drivers – glass and glass product; pottery, ceramic, and plumbing fixture; metalworking machinery; and railroad rolling stock – maintained high productivity from 1998 to 2006

before experiencing rapid declines over the next two years. Glass and glass product manufacturing experienced the greatest decline in productivity, with GSP falling 88 percent from 2005 to 2008.

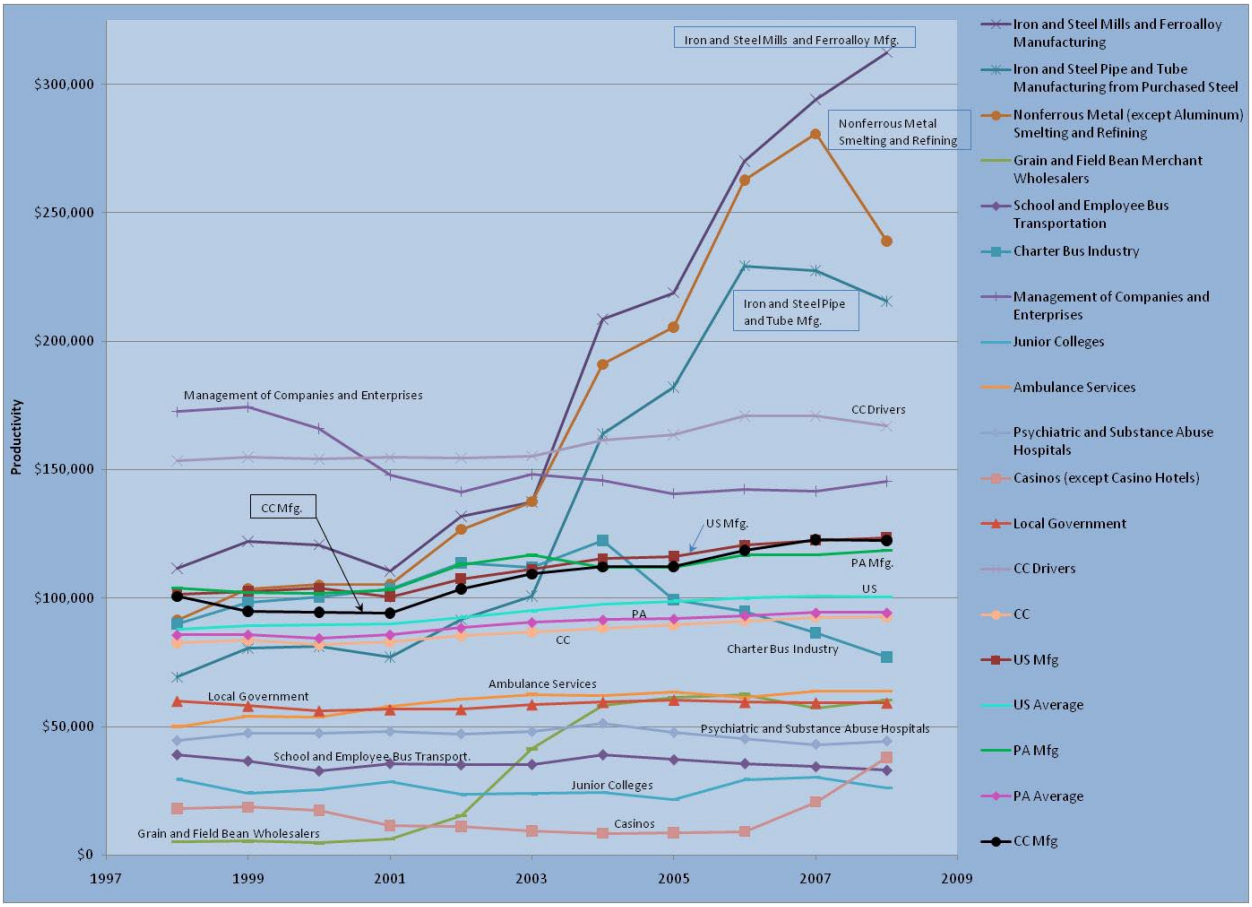
Productivity by Regional Driver Industry



Note: Productivity = GSP per Employee.

The following graph excludes high-productivity industries – NAICS 2211, 3271, 3272, 3335, 3365, 5179, 5311, 5312, and 5313 – to better examine how productivity changed over the study period for the region's other drivers. The graph shows how these lower-productivity drivers compared to the region as a whole, the nation and U.S. manufacturing specifically. As can be seen, three metal manufacturing industries – Iron and Steel Mills and Ferroalloy, Nonferrous Metal Smelting and Refining, and Iron and Steel Pipe and Tube – experienced productivity growth beginning in 2001. This growth was accompanied by losses of employment and strong GSP growth. By the end of the study period, Nonferrous Metals and Iron and Steel Pipe and Tube Manufacturing had begun to see declines in productivity. Drivers in the education and health-care cluster demonstrated lower productivity compared to the other drivers, but they experienced stable, albeit modest, productivity growth over the decade studied.

Lower-Productivity Regional Drivers



Among the 21 driver industries in the region served by Catalyst Connection, 12 had productivity levels that exceeded the national average in 2008. Nine matched or exceeded the U.S. average annual growth rate for the decade studied. Three regional manufacturing drivers – Iron and Steel Mills and Ferroalloy Manufacturing; Nonferrous Metal (except Aluminum) Smelting and Refining; and Iron and Steel Pipe and Tube Manufacturing from Purchased Steel – enjoyed 2008 productivity levels that were above the national average for manufacturing in 2008.

Average Annual Change in Productivity by Regional Driver

NAICS	Industry Name	1998	2008	1998-2008 Productivity CAGR
5179	Other Telecommunications	$2,278,179	$2,348,927	0.3%
5312	Offices of Real Estate Agents and Brokers	$1,377,529	$1,472,667	0.7%
5313	Real Estate Property Managers	$1,230,047	$1,396,744	1.3%
5311	Lessors of Residential Buildings and Dwellings	$958,764	$1,125,001	1.6%
2211	Electric Power Generation, Transmission and Distribution	$270,402	$680,063	9.7%
3311	Iron and Steel Mills and Ferroalloy Manufacturing	$111,631	$312,461	10.8%
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$91,474	$239,054	10.1%
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$69,246	$215,647	12.0%
3365	Railroad Rolling Stock Manufacturing	$455,553	$154,304	-10.3%
5511	Management of Companies and Enterprises	$172,522	$145,486	-1.7%
3272	Glass and Glass Product Manufacturing	$1,060,451	$121,885	-19.5%
3335	Metalworking Machinery Manufacturing	$767,707	$102,788	-18.2%
3271	Pottery, Ceramics, and Plumbing Fixture Manufacturing	$517,329	$90,029	-16.0%
4855	Charter Bus Industry	$89,929	$77,149	-1.5%
6219	Ambulance Services	$49,989	$63,895	2.5%
4245	Grain and Field Bean Merchant Wholesalers	$5,209	$60,358	27.8%
GVL	Local Government	$59,947	$59,260	-0.1%
6222	Psychiatric and Substance Abuse Hospitals	$44,443	$44,281	0.0%
7132	Casinos (except Casino Hotels)	$18,054	$37,902	7.7%
4854	School and Employee Bus Transportation	$39,025	$33,053	-1.6%
6112	Junior Colleges	$29,409	$26,205	-1.1%
U.S. Average		$87,891	$100,495	1.3%
U.S. Manufacturing		$101,530	$123,614	2.0%
PA Average		$85,648	$94,381	1.0%
PA Manufacturing		$104,038	$118,485	1.3%
All Catalyst Connection		$82,744	$92,784	1.2%
Catalyst Connection Drivers		$153,505	$166,929	0.8%
Catalyst Connection Region Mfg. Average		$100,611	$122,335	2.0%

Source: Moody's Economy.com

Impact and Return From Catalyst Connection

For this analysis, three years of IRC financial data was analyzed by region (FY2008, FY2009, and FY2010). All sources of income were identified. The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client service income. The client fee income is leveraged by the state and federal funding, which tends to have interconnected matching requirements.

To determine the economic impact of IRC activities, MEP survey data was analyzed by region. As part of the survey, manufacturing clients were asked to quantify new and retained sales and new and retained jobs attributable to the work of the IRCs. Funding sources were compared to the economic impact data from the survey. A one-year lag time in impact was assumed, meaning that, for example, FY2008 financial information was compared to FY2009 economic impact data. Two ratios were calculated to determine the economic impact of $1 of funding.

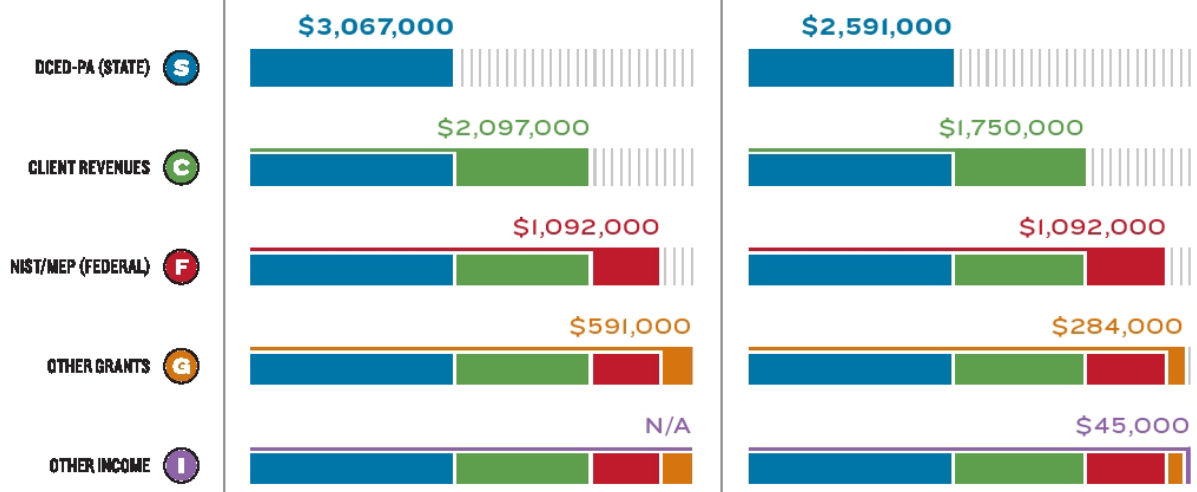
Analysis of IRC financial data reveals that every $1 of state investment in Catalyst Connection in 2009 yielded $73 in new and retained sales in the manufacturing sector, as can be seen in the following graphic. The impact of investment in the center for fiscal year 2009 was nearly $190 million in new and retained sales in manufacturing and 1,275 new and retained jobs for the region. For that year, state cost per job created or retained in the region served by Catalyst Connection was $2,032.

CATALYST CONNECTION

SOURCES AND IMPACT OF FUNDS FOR FISCAL YEARS 2008 & 2009

SOURCES

SALES IMPACT



	FY 2008	FY 2009
RETAINED SALES	$144,877,000	$164,309,000
INCREASED SALES	$33,007,000	$24,989,000
DIRECT ECONOMIC IMPACT	**$177,884,000**	**$189,298,000**
	$1 OF STATE INVESTMENT LEADS TO $58 IN NEW AND RETAINED SALES IN MFG.	$1 OF STATE INVESTMENT LEADS TO $73 IN NEW AND RETAINED SALES IN MFG.

Northwest Pennsylvania Industrial Resource Center

The NWIRC serves the region anchored by Erie. It serves the following 13 counties:

- Cameron
- Clarion
- Clearfield
- Crawford
- Elk
- Erie
- Forest
- McKean
- Mercer
- Jefferson
- Potter
- Venango
- Warren

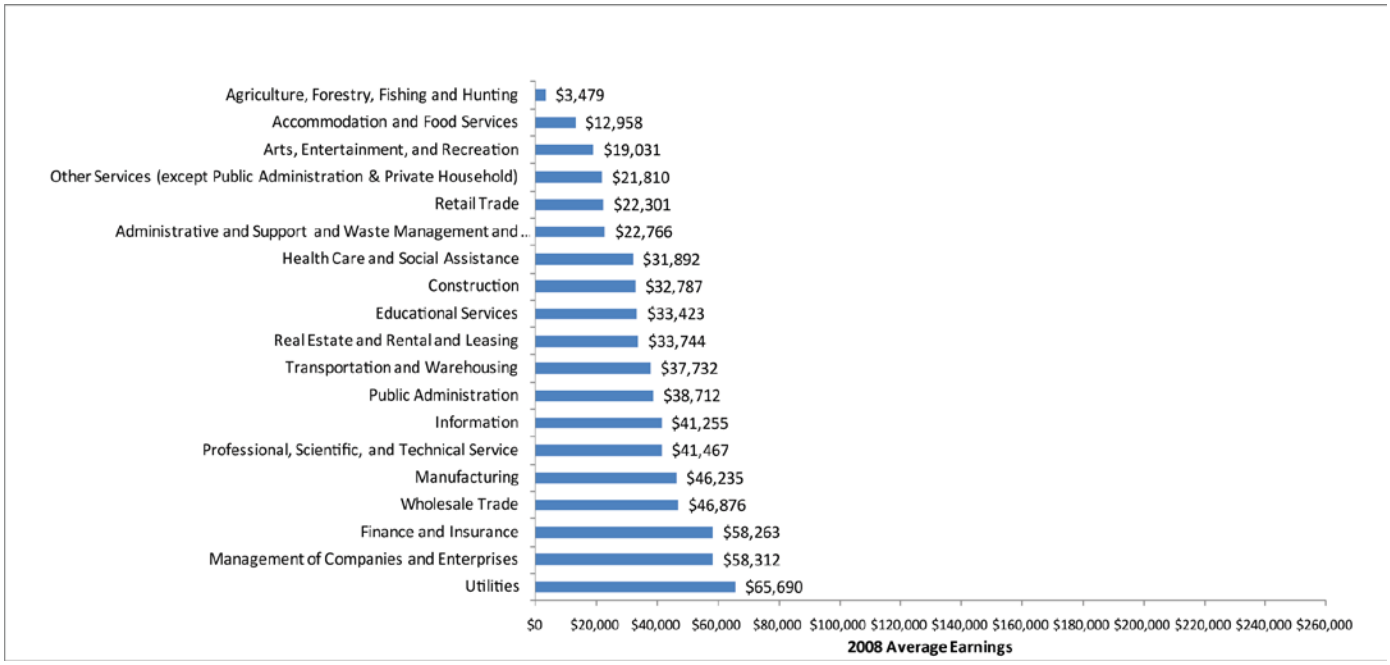
Manufacturing remains the top industry in northwestern Pennsylvania, providing more than $7 billion in annual GSP. As can be seen in the following table, manufacturing accounts for more than a quarter of the region's total GSP and more than twice the GSP of the region's next- largest sector, Health Care and Social Assistance. Manufacturing also constitutes the largest employment sector in the regional economy, providing 70,931 jobs in 2008. The compound average growth rate from 2003 to 2008 was 2 percent. However, over the 10-year study period, the sector has contracted at an average annual rate of 1.3 percent.

GSP and Growth Rate by Industry for Region Served by NWIRC

Industries	Employment 2008	GSP 2008 ($M)	05-08 CAGR	03-08 CAGR	98-08 CAGR	Industry GSP as a % of Regional GSP
Manufacturing	**70,931**	**$7,050**	**1.7%**	**2.0%**	**-1.3%**	**27.3%**
Health Care and Social Assistance	65,225	$3,087	1.6%	1.8%	3.0%	11.9%
Public Administration	50,582	$2,926	0.2%	0.4%	0.5%	11.3%
Retail Trade	42,474	$1,960	-0.8%	-0.4%	0.4%	7.6%
Real Estate and Rental and Leasing	2,599	$1,484	4.3%	1.1%	0.8%	5.7%
Finance and Insurance	10,228	$1,320	2.2%	2.2%	3.2%	5.1%
Wholesale Trade	9,689	$981	0.4%	1.3%	1.2%	3.8%
Transportation and Warehousing	11,983	$972	2.6%	4.3%	3.0%	3.8%
Utilities	1,823	$909	13.1%	8.7%	2.6%	3.5%
Mining	834	$738	8.0%	14.3%	12.6%	2.9%
Construction	12,805	$670	-5.5%	-2.6%	-1.2%	2.6%
Information	4,532	$664	-9.0%	-4.8%	-1.4%	2.6%
Other Services (except Public Administration & Private Household)	16,702	$608	1.4%	1.0%	1.0%	2.4%
Accommodation and Food Services	26,592	$602	1.8%	1.6%	0.8%	2.3%
Professional, Scientific, and Technical Service	7,138	$544	2.8%	1.5%	3.6%	2.1%
Administrative and Support and Waste Management and Remediation Services	13,087	$509	1.7%	3.5%	3.5%	2.0%
Educational Services	7,118	$293	2.0%	1.7%	3.0%	1.1%
Management of Companies and Enterprises	2,923	$234	0.6%	3.2%	1.8%	0.9%
Agriculture, Forestry, Fishing and Hunting	9,619	$168	1.0%	0.1%	-1.6%	0.7%
Arts, Entertainment, and Recreation	4,271	$149	7.0%	5.1%	4.3%	0.6%
	371,155	$25,868	1.42%	1.69%	0.78%	
Source: Moody's Economy.com						
Note: CAGR represents Compound Annual Growth Rate.						

Manufacturing in the region maintained high average earnings ($46,253) in 2008. As the region's largest employer, manufacturing helps to sustain the population's good standard of living. Only four sectors pay higher earnings, on average, in the region than manufacturing: Wholesale Trade, Finance and Insurance, Management of Companies and Enterprises, and Utilities. It should be noted that mining was omitted from the following graph due to incorrect data estimated by Moody's Economy.com.

Earnings by Industry for Region Served by NWIRC



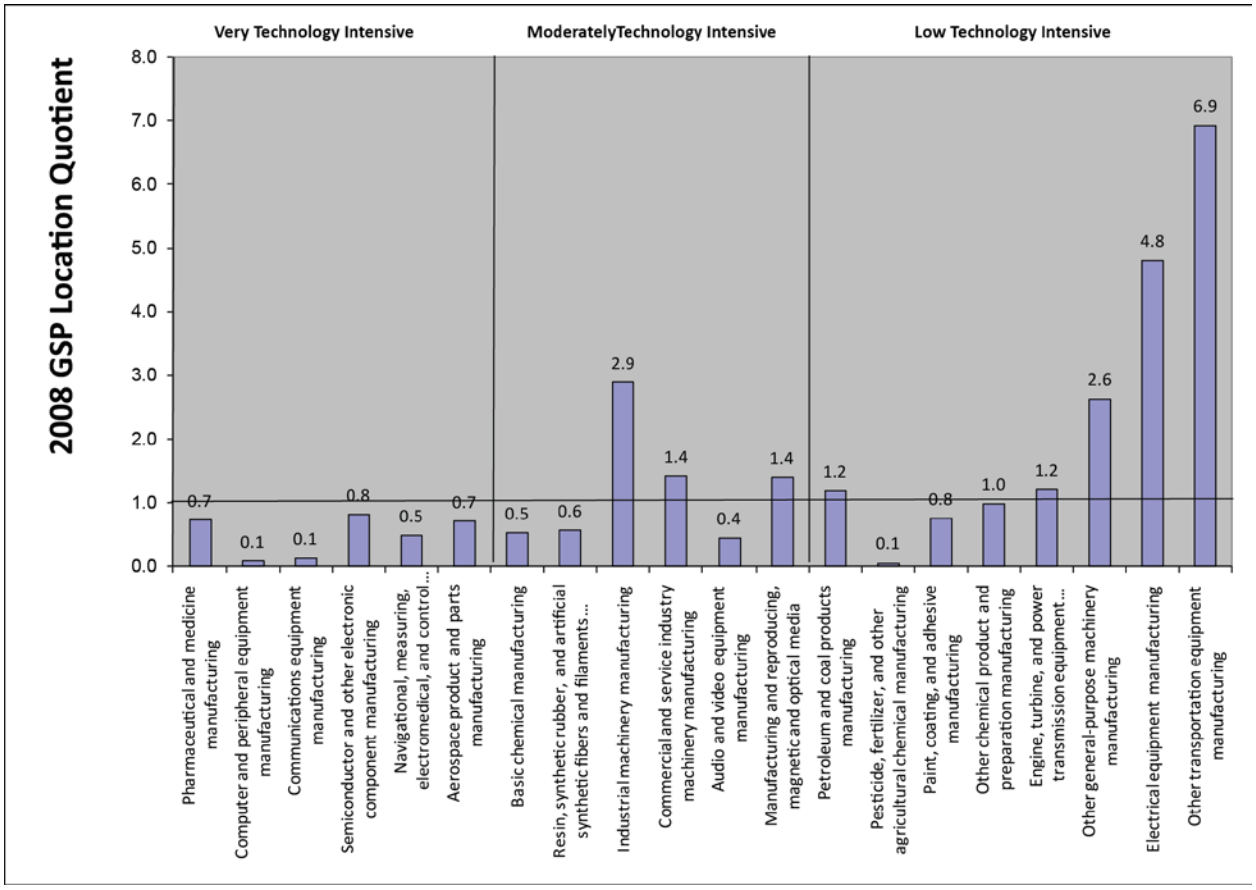
Manufacturers in the region served by the NWIRC specialize in industries that have low to moderate technology intensity. Low technology-intensive industries with high regional presence are:

- Other Transportation Equipment Manufacturing (LQ=6.9)
- Electrical Equipment Manufacturing (LQ=4.8)
- Other General-Purpose Machinery Manufacturing (LQ=2.6)
- Engine, Turbine, and Power Machinery Equipment Manufacturing (LQ=1.2)
- Petroleum and Coal Products Manufacturing (LQ=1.2)

Manufacturers in industries with moderate technology intensity and strong regional presence include:

- Industrial Machinery Manufacturing (LQ=2.9)
- Commercial and Service Industry Machinery Manufacturing (LQ=1.4)
- Manufacturing and Reproducing , Magnetic and Optical Media (LQ=1.4)

Technology Intensity Among Industries in Region Served by NWIRC



The strong presence of manufacturing industries with low to moderate technology intensity allows the region to enjoy an overall strong position. As the following table shows, the region served by the NWIRC is on par with Pennsylvania's regional peers in terms of employment in technology-intensive industries (8.6%). Employment in moderate- and low-technology intense manufacturing industries exceeds not only the average for the state and its regional peers, but for the nation, as well. Even though the region has no high-intensity industries in its economic base, employment in very technologically intense manufacturing activities exceeds that of the state and its regional peers (1.3% vs. 1.1%).

Comparing Employment in Technology-Intensive Industries

	NWIRC	Pennsylvania	Regional Peers*	United States
Total Technology-Intensive Employment in Private Sector	8.6%	10.5%	8.6%	11.6%
Very Technology Intensive				
Very Technology Intensive Manufacturing	1.3%	1.1%	1.1%	1.5%
Very Technology Intensive Pipeline & Telecommunication	0.0%	0.0%	0.0%	0.1%
Very Technology Intensive Service	0.6%	2.6%	2.2%	2.8%
Moderate Technology Intensive				
Moderate Technology Intensive Manufacturing	0.6%	0.5%	0.3%	0.4%
Moderate Technology Intensive Others	2.9%	1.7%	1.5%	2.7%
Moderate Technology Intensive Service	0.3%	1.2%	0.9%	1.2%
Low Technology Intensive				
Low Technology Intensive Manufacturing	1.3%	0.7%	0.5%	0.6%
Low Technology Intensive Pipeline & Telecommunication	0.6%	0.7%	0.6%	0.7%
Low Technology Intensive Service	0.9%	2.1%	1.4%	1.6%

*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV

Source: Moody's Economy.com

Regional Driver Industries

Northwestern Pennsylvania's legacy of metal and metal products is reflected in the composition of its four driver industries:

- Forging and Stamping and Iron and Steel Pipe and Tube Manufacturing provide the underpinnings for the regional economy, with an employment concentration more than 12 times the national average and a GSP location quotient that exceeds 20. Combined, these two drivers accounted for more than $800 million of the region's GSP in 2008.

- Railroad Rolling Stock Manufacturing employs a significant portion of the regional workforce and claims a high share of the national industry. The regional location quotient is extremely high and growing. Between 2003 and 2008, GSP for the region's Railroad Rolling Stock Manufacturing industry expanded at an average annual rate of 10.4 percent, totaling $636 by the end of the five-year span.

- The Casino industry is rapidly growing in the region, increasing its share, earnings and GSP compared to the national average. However, GSP from the burgeoning Casino industry is eclipsed by that of the region's traditional manufacturing drivers.

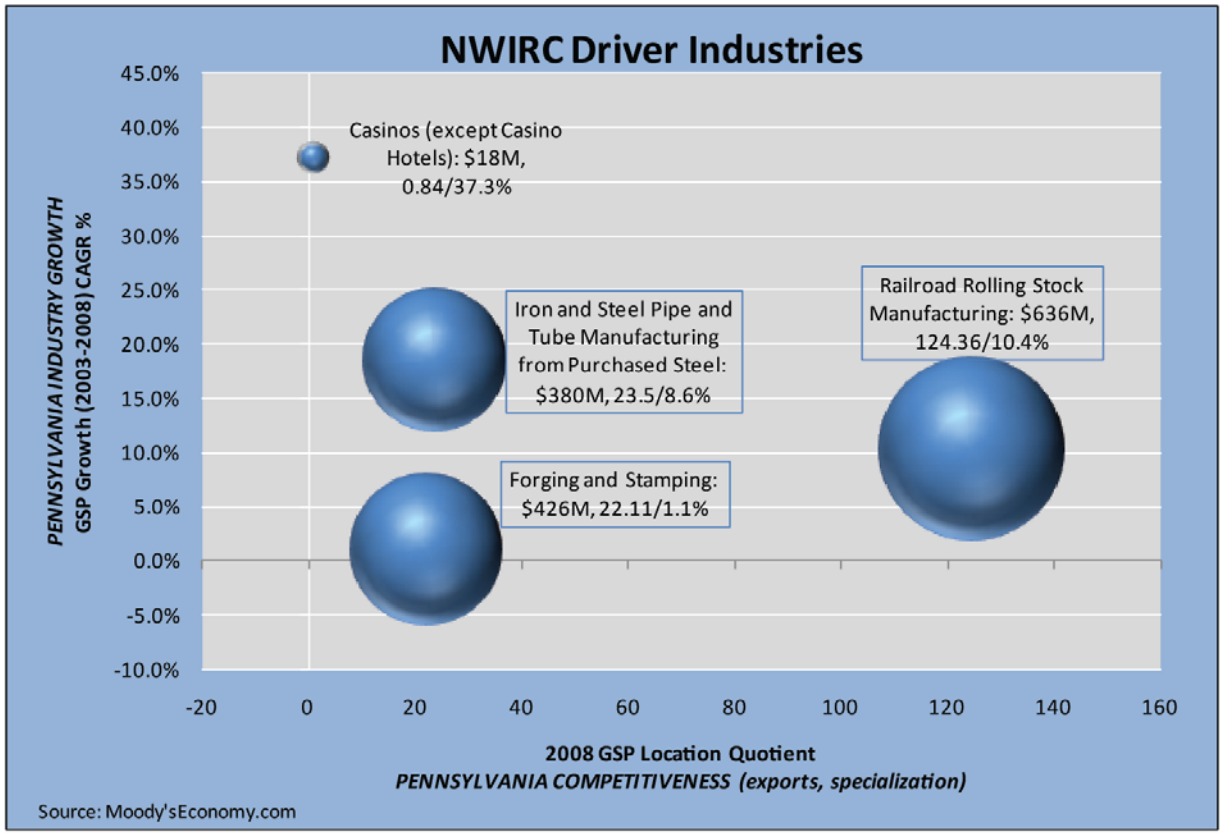
Driver Industries for the Region Served by NWIRC
(ranked by 2008 GSP)

NAICS	Industry Name	2008 GSP ($M)	2005-08 GSP CAGR	2003-08 GSP CAGR	1998-2008 GSP CAGR	2008 GSP Location Quotient	2002-2008 Change in LQ
3365	Railroad Rolling Stock Manufacturing	$636	8.0%	10.4%	1.9%	124.36	27.05
3321	Forging and Stamping	$426	-0.1%	1.1%	-3.2%	22.11	-1.44
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$380	14.0%	18.6%	9.5%	23.50	6.47
7132	Casinos (except Casino Hotels)	$18	70.6%	37.3%	13.4%	0.84	0.65

Source: Moody's Economy.com

As can be seen in the following figure, none of the four regional drivers is considered a technology-intensive industry.

Technology Intensity of Regional Driver Industries



Manufacturing industries are boxed.

= $200M in 2008 GSP

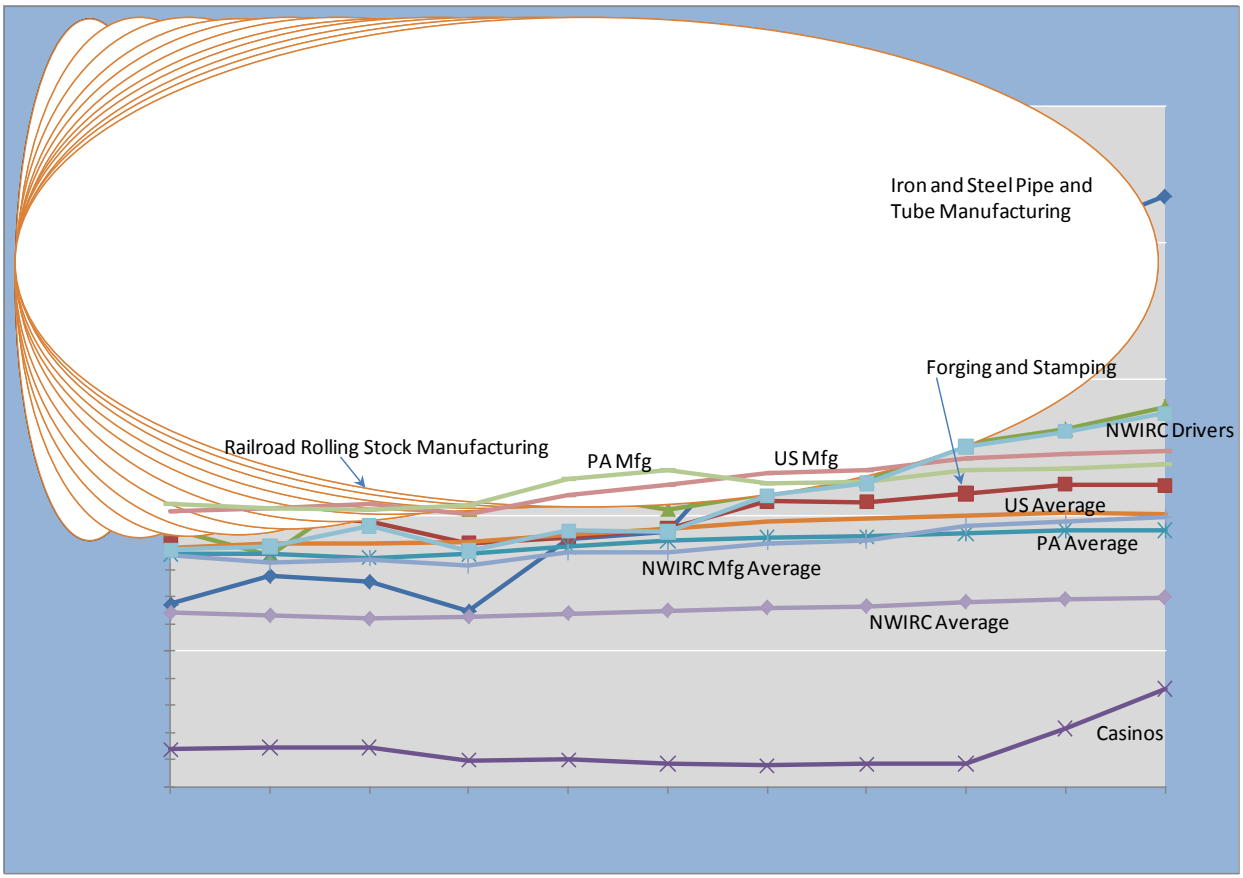
Very Technology Intensive Industries

Moderately Technology Intensive Industries

Low Technology Intensive Industries

All three manufacturing drivers in the region have very high productivity. In 2008, productivity for the region's Iron and Steel Pipe and Tube Manufacturing industry, which amounted to GSP of $217,162 per employee, more than doubled the national average of $100,495. Productivity for Railroad Rolling Stock Manufacturing, at $139,774, and Forging and Stamping, at $110,978, exceeded the national average for all industries, but Forging and Stamping did not keep pace with the average U.S. manufacturing productivity of $123,614.

Productivity by Regional Driver Industry



All four driver industries have enjoyed 10-year growth rates in productivity that exceed the state and national averages. Although GSP per employee for the Casino industry, which stood at $36,080 in 2008, fell far below the national and state averages, the industry has experienced double-digit growth since slot machines were legalized in Pennsylvania in 2004. Productivity in Iron and Steel Pipe and Tube Manufacturing also enjoyed double-digit growth from 1998 to 2008. Productivity growth for Railroad Rolling Stock Manufacturing also exceeded the average growth over the decade for manufacturing in the state and nation.

Average Annual Change in Productivity by Regional Driver

NAICS	Industry Name	1998	2008	1998-2008 CAGR
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$67,214	$217,162	1.9%
3321	Forging and Stamping	$91,959	$110,978	-3.2%
3365	Railroad Rolling Stock Manufacturing	$94,816	$139,774	9.5%
7132	Casinos (except Casino Hotels)	$13,827	$36,080	13.4%
U.S. Average		$87,891	$100,495	2.1%
PA Average		$85,648	$94,381	1.5%
NWIRC Region Mfg. Average		$85,050	$99,395	-1.3%

Impact and Return from NWIRC

For this analysis, three years of IRC financial data was analyzed by region (FY2008, FY2009, and FY2010). All sources of income were identified. The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client service income. The client fee income is leveraged by the state and federal funding, which tends to have interconnected matching requirements.

To determine the economic impact of IRC activities, MEP survey data was analyzed by region. As part of the survey, manufacturing clients were asked to quantify new and retained sales and new and retained jobs attributable to the work of the IRCs. Funding sources were compared to the economic impact data from the survey. A one-year lag time in impact was assumed, meaning that, for example, FY2008 financial information was compared to FY2009 economic impact data. Two ratios were calculated to determine the economic impact of $1 of funding.

Analysis of IRC financial data reveals that every $1 of state investment in the NWIRC in 2008 yielded $63 in new and retained sales in the manufacturing sector. As can be seen in the following graphic, direct economic impact was down dramatically in 2009, following a significant reduction in state funding. The impact of investment in the NWIRC for fiscal year 2008 was more than $115 million in new and retained sales in manufacturing and 1,080 new and retained jobs. State cost per job created or retained in the region served by the NWIRC in 2008 was $1,679.

NWIRC

SOURCES AND IMPACT OF FUNDS FOR FISCAL YEARS 2008 & 2009

SOURCES

SALES IMPACT

	FY 2008	FY 2009
SOURCES	$1.8M IN-STATE FUNDS LEVERAGES $4.4 OF PUBLIC & PRIVATE INVESTMENT IN MFG.	$1.7M IN-STATE FUNDS LEVERAGES $4.IM OF PUBLIC & PRIVATE INVESTMENT IN MFG.
DCED-PA (STATE) (S)	$1,813,000	$1,683,000
CLIENT REVENUES (C)	$1,222,000	$1,142,000
NIST/MEP (FEDERAL) (F)	$698,000	$703,000
OTHER GRANTS (G)	$490,000	$474,000
OTHER INCOME (I)	$139,000	$76,000
RETAINED SALES	$49,866,000	$45,753,000
INCREASED SALES	$65,157,000	$9,440,000
DIRECT ECONOMIC IMPACT	**$115,023,000**	**$55,193,000**
	$1 OF STATE INVESTMENT LEADS TO $63 IN NEW AND RETAINED SALES IN MFG.	$1 OF STATE INVESTMENT LEADS TO $33 IN NEW AND RETAINED SALES IN MFG.

MANTEC

Located in York, MANTEC serves nine counties of south-central Pennsylvania. They are:

- Adams
- Cumberland
- Dauphin
- Fulton
- Franklin
- Lebanon
- Lancaster
- Perry
- York

The following table shows the GSP and growth rate by industry for the region served by MANTEC. As can be seen, manufacturing continues to power south-central Pennsylvania. Manufacturing is the largest sector in the regional economy, employing more than 132,000 workers, generating $13.5 billion in 2008 annual GSP, and accounting for about 18 percent of the region's total GSP. The fact that Pennsylvania's state capital of Harrisburg is located within the region served by MANTEC accounts for Public Administration being the area's second-largest employer, with more than 126,000. Despite similar employment levels, Public Administration is dwarfed by Manufacturing in terms of GSP. With 2008 GSP of $8.9 billion, Public Administration accounted for 11.8 percent of the region's GSP. The Health Care and Social Assistance industry was the region's third-largest employer, with nearly 115,000 workers, and accounted for 8.9 percent of its total GSP.

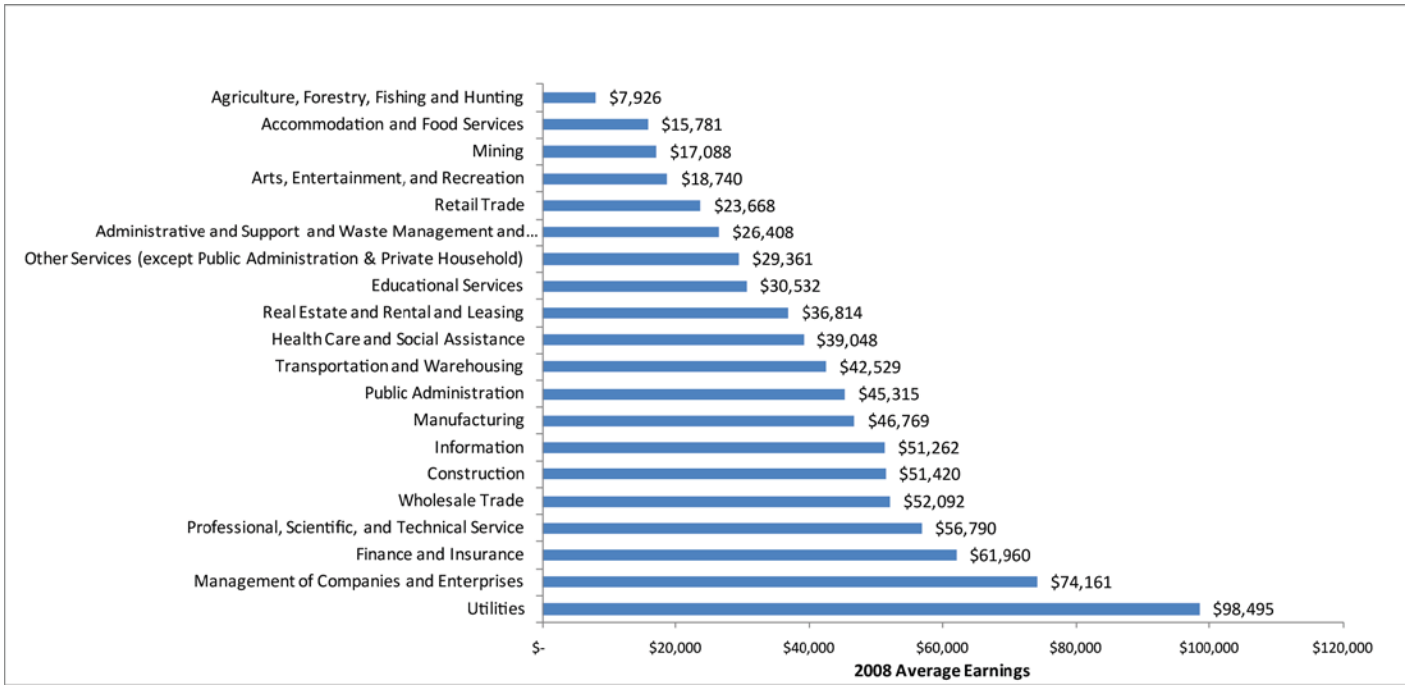
Although manufacturing GSP in the region declined by an average annual rate of 1.3 percent over the entire 10-year period analyzed, the industry sector appears to have turned the corner on decline, showing growth of 0.7 percent from 2003 to 2008.

GSP and Growth Rate by Industry for Region Served by MANTEC

Industry	Employment 2008	GSP 2008 ($M)	05-08 CAGR	03-08 CAGR	98-08 CAGR	Industry GSP as a % of Regional GSP
Manufacturing	**132,441**	**$13,539**	**0.8%**	**0.7%**	**-1.3%**	**18.0%**
Public Administration	126,424	$8,861	0.8%	1.1%	1.3%	11.8%
Health Care and Social Assistance	114,582	$6,721	3.3%	3.1%	4.2%	8.9%
Real Estate and Rental and Leasing	8,107	$6,231	3.1%	1.8%	1.6%	8.3%
Retail Trade	102,874	$5,090	-0.8%	-0.7%	0.5%	6.8%
Finance and Insurance	35,677	$4,828	2.4%	1.2%	1.8%	6.4%
Wholesale Trade	41,353	$4,698	0.1%	1.7%	2.1%	6.2%
Transportation and Warehousing	48,823	$4,151	1.5%	4.6%	3.5%	5.5%
Construction	45,520	$3,770	-5.6%	-0.2%	1.6%	5.0%
Professional, Scientific, and Technical Service	32,671	$3,437	3.1%	2.9%	3.8%	4.6%
Information	14,550	$2,390	2.6%	3.2%	2.9%	3.2%
Utilities	2,802	$2,115	12.2%	3.4%	1.9%	2.8%
Other Services (except Public Administration & Private Household)	41,592	$2,054	0.5%	1.3%	1.7%	2.7%
Accommodation and Food Services	65,609	$1,872	1.3%	1.8%	1.9%	2.5%
Administrative and Support and Waste Management and Remediation Services	40,234	$1,829	4.0%	8.7%	4.2%	2.4%
Management of Companies and Enterprises	14,236	$1,465	-8.7%	-0.9%	2.6%	1.9%
Agriculture, Forestry, Fishing and Hunting	21,634	$872	-0.2%	1.8%	1.3%	1.2%
Educational Services	18,132	$688	3.4%	3.5%	4.5%	0.9%
Arts, Entertainment, and Recreation	14,680	$507	5.9%	4.0%	5.0%	0.7%
Mining	4,432	$211	-0.1%	0.2%	0.0%	0.3%
	926,373	$75,328	1.1%	1.7%	1.5%	
Source: Moody'sEconomy.com						
Note: CAGR represents Compound Annual Growth Rate.						

Although Manufacturing has large presence in the region, its earnings are average relative to other sectors. Average manufacturing earnings in the region have remained virtually unchanged since 2003. As can be seen, Manufacturing earnings fall well below those for typically well-paying technical and professional services such as Utilities; Management of Companies and Enterprises; Finance and Insurance; Professional, Scientific and Technical Services; and Information, but, at $46,769, they also lag average earnings for Construction. Manufacturing earnings in south-central Pennsylvania are also significantly lower than manufacturing earnings in other parts of the state. For example, in the region surrounding Pittsburgh, manufacturing workers earned, on average, $52,596 in 2008. The labor cost advantage can explain the relative strength of the industry in this region.

Earnings by Industry for Region Served by MANTEC

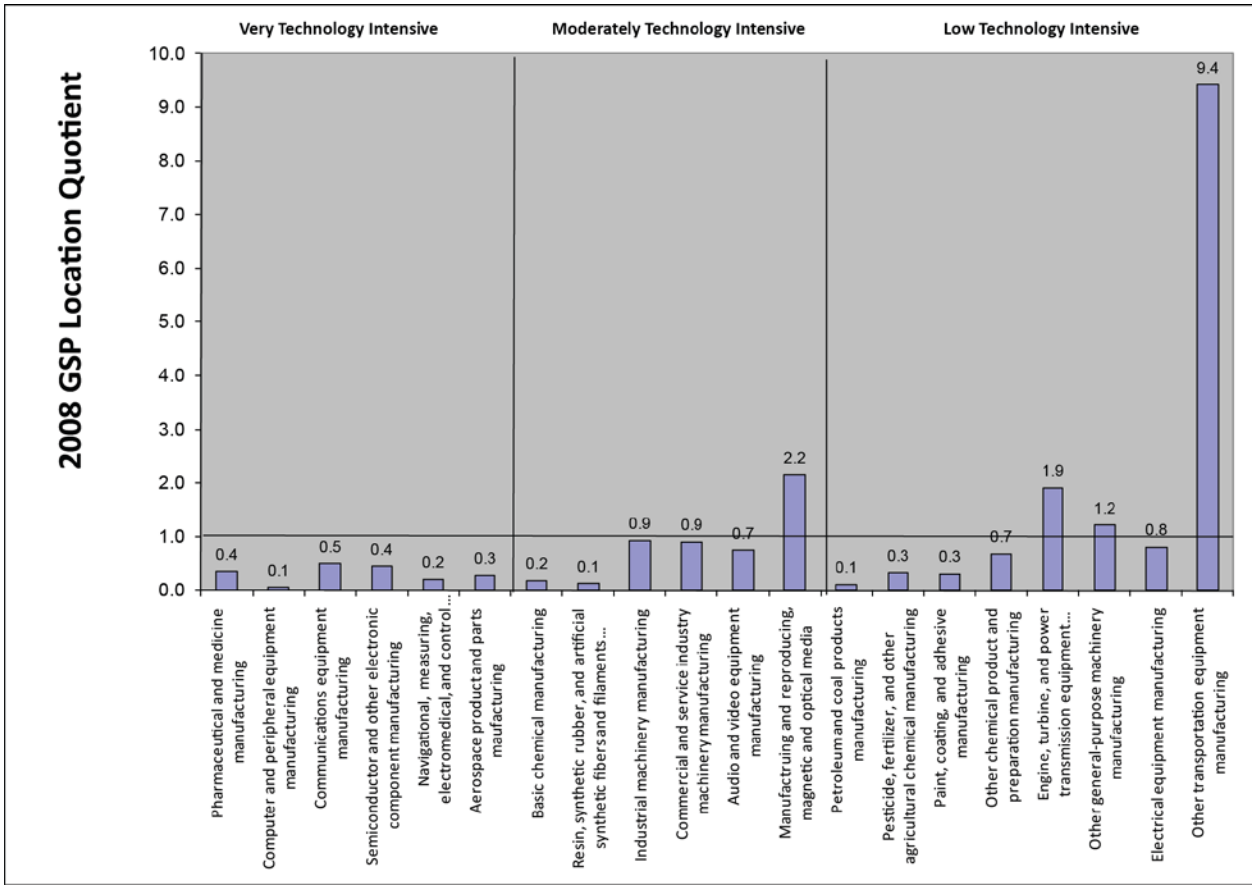


The region served by MANTEC has scarce presence of technology-intensive industries. As can be seen in the following figure, technology industries with the highest location quotients in the region tend to be low intensity ones. Other Transportation Equipment Manufacturing has strong presence in the region, with a location quotient of 9.4. Two other manufacturing industries with low technology intensity contribute to the region's economic base. They are:

- Engine, Turbine, and Power Transmission Equipment Manufacturing (LQ=1.9)
- Other General-Purpose Machinery Manufacturing (LQ=1.2)

Among industries with moderate technology intensity, only Manufacturing and Reproducing Magnetic and Optics Media, with a location quotient of 2.2, can be counted among the region's economic base. More than likely, this industry captures companies from the region's former Audio and Video Equipment Manufacturing sector and sustain its export base. Large declines in Pennsylvania's Pharmaceuticals industry, which were discussed earlier in this report, have affected the south-central part of the state. This very technology intense industry has lost its competitive advantage in the area and no longer can be counted among the region's economic base.

Technology Intensity Among Industries in Region Served by MANTEC



The modest presence of technology-intensive manufacturing in south-central Pennsylvania is reflected in regional employment levels being significantly lower than state and national averages for such industries. Only 9 percent of workers in the region served by MANTEC are employed in technology-intensive industries. That compares to 10.5 percent for the state and 11.6 percent for the nation as a whole. The disparity is particularly stark in manufacturing that is considered very technology intensive, where the national employment level is more than double the region's. Among low technology intensive industries, the region served by MANTEC exceeds average employment levels for the nation as a whole and for the peer states used as benchmarks for this study. The region also exceeds employment averages in industries with moderate technology intensity for benchmark peers.

Comparing Employment in Technology-Intensive Industries

	MANTEC	Pennsylvania	Regional Peers*	United States
Total Technology Intensive Employment in Private Sector	9.0%	10.5%	8.6%	11.6%
Very Technology Intensive				
Very Technology Intensive Manufacturing	0.7%	1.1%	1.1%	1.5%
Very Technology Intensive Pipeline & Telecommunication	0.0%	0.0%	0.0%	0.1%
Very Technology Intensive Service	1.7%	2.6%	2.2%	2.8%
Moderate Technology Intensive				
Moderate Technology Intensive Manufacturing	0.4%	0.5%	0.3%	0.4%
Moderate Technology Intensive Others	2.5%	1.7%	1.5%	2.7%
Moderate Technology Intensive Service	0.7%	1.2%	0.9%	1.2%
Low Technology Intensive				
Low Technology Intensive Manufacturing	0.7%	0.7%	0.5%	0.6%
Low Technology Intensive Pipeline & Telecommunication	0.5%	0.7%	0.6%	0.7%
Low Technology Intensive Service	1.7%	2.1%	1.4%	1.6%
*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV				

Source: Moody's Economy.com

Regional Driver Industries

MANTEC has a healthy number of manufacturing industries among the region's 21 identified driver industries. These industries represent metal, food, paper, and motor vehicle and transportation equipment manufacturing. Although five of the 14 manufacturing drivers experienced losses in GSP for the 10-year period studied, it appears that many managed to turn around. Only two continued to shrink from 2005 to 2008. Those were Printing, which saw an average annual decline for the three-year period of 2.6 percent, and Forging and Stamping, which shrank at a rate of 2.1 percent. Conversely, Nonferrous Metal (Except Aluminum) Smelting and Refining expanded at a vigorous three-year annual rate of 19.4 percent, and Other Transportation Equipment Manufacturing grew at a robust 13.6 percent.

Transportation, warehousing and wholesale activities related to the automotive industry constitute another driver group that is differentiated by its large and growing GSP. The region's large education and government services sectors are clustered in another group. These industries reflect the presence of state government in the region and south-central Pennsylvania's aging population.

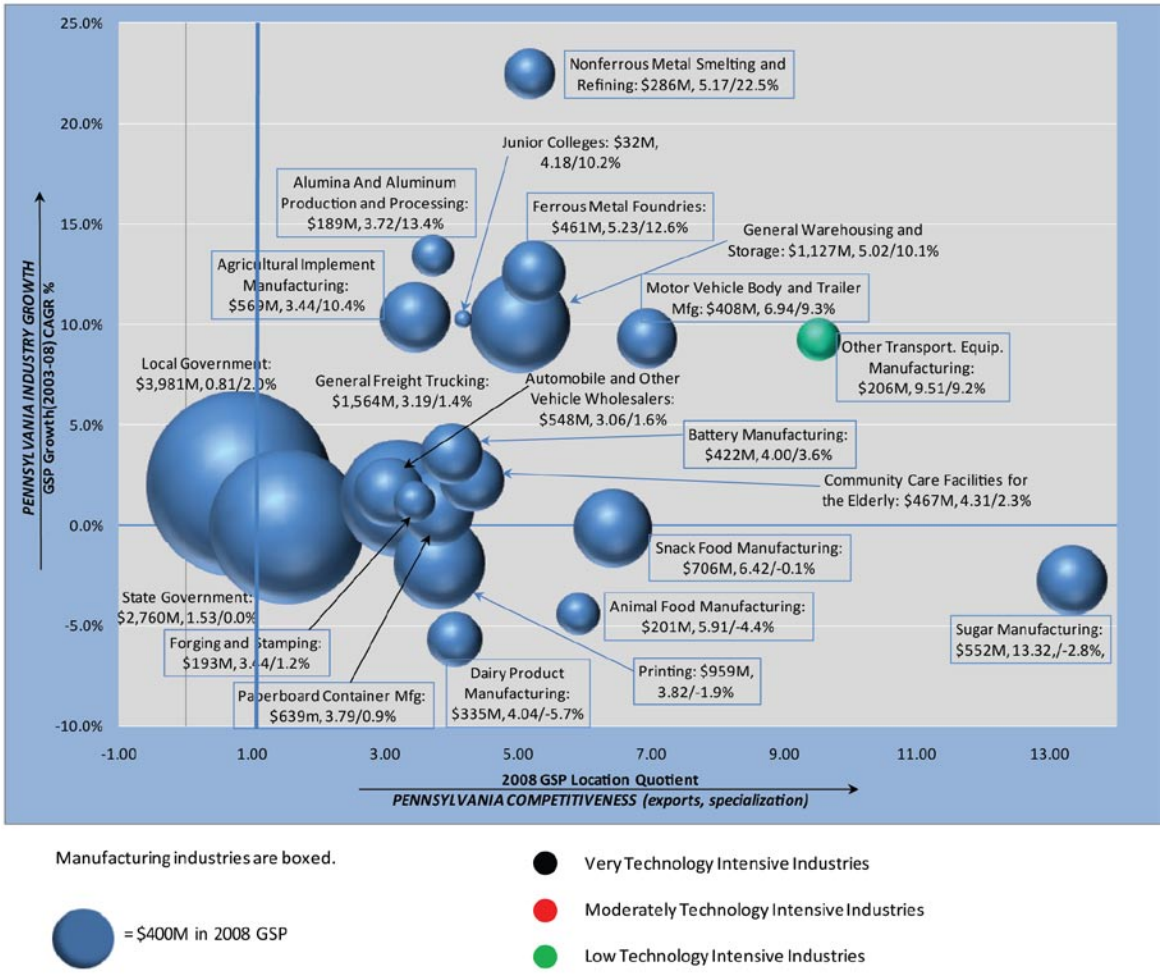
Driver Industries for the Region Served by MANTEC
(grouped by clusters)

NAICS	Industry Name	2008 GSP ($M)	2005-08 GSP CAGR	2003-08 GSP CAGR	1998-2008 GSP CAGR	2008 GSP Location Quotient	2002-2008 Change in LQ
	Manufacturing						
3231	Printing	$959	-2.6%	-1.9%	-2.1%	3.82	0.05
3119	Snack Food Manufacturing	$706	3.6%	-0.1%	1.2%	6.42	0.14
3222	Paperboard Container Manufacturing	$639	0.9%	0.9%	1.9%	3.79	0.41
3331	Agricultural Implement Manufacturing	$569	2.2%	10.4%	-2.2%	3.44	-0.06
3113	Sugar Manufacturing	$552	2.3%	-2.8%	-1.3%	13.32	0.13
3315	Ferrous Metal Foundries	$461	4.0%	12.6%	5.3%	5.23	0.54
3359	Battery Manufacturing	$422	7.1%	3.6%	-1.4%	4.00	0.31
3362	Motor Vehicle Body and Trailer Manufacturing	$408	5.7%	9.3%	6.5%	6.94	0.70
3115	Dairy Product (except Frozen) Manufacturing	$335	2.3%	-5.7%	0.1%	4.04	-0.07
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$286	19.4%	22.5%	9.5%	5.17	1.20
3369	Other Transportation Equipment Manufacturing	$206	13.6%	9.2%	9.3%	9.51	0.83
3111	Animal Food Manufacturing	$201	6.2%	-4.4%	0.4%	5.91	-0.19
3321	Forging and Stamping	$193	-2.1%	1.2%	-0.5%	3.44	0.01
3313	Alumina and Aluminum Production and Processing	$189	2.8%	13.4%	10.7%	3.72	0.65
	Transportation and Logistics						
4841	General Freight Trucking, Local	$1,564	0.9%	1.4%	1.2%	3.19	0.00
4931	General Warehousing and Storage	$1,127	1.9%	10.1%	7.8%	5.02	0.33
4231	Automobile and Other Motor Vehicle Merchant Wholesalers	$548	1.4%	1.6%	2.7%	3.06	0.20
	Education, Health Care and Government Services						
GVL	Local Government	$3,981	1.3%	2.0%	1.9%	0.81	0.05
GVS	State Government	$2,760	-0.1%	0.0%	0.8%	1.53	-0.04
6233	Community Care Facilities for the Elderly	$467	2.0%	2.3%	11.2%	4.31	0.81
6112	Junior Colleges	$32	16.1%	10.2%	3.5%	4.18	0.53

Source: Moody's Economy.com

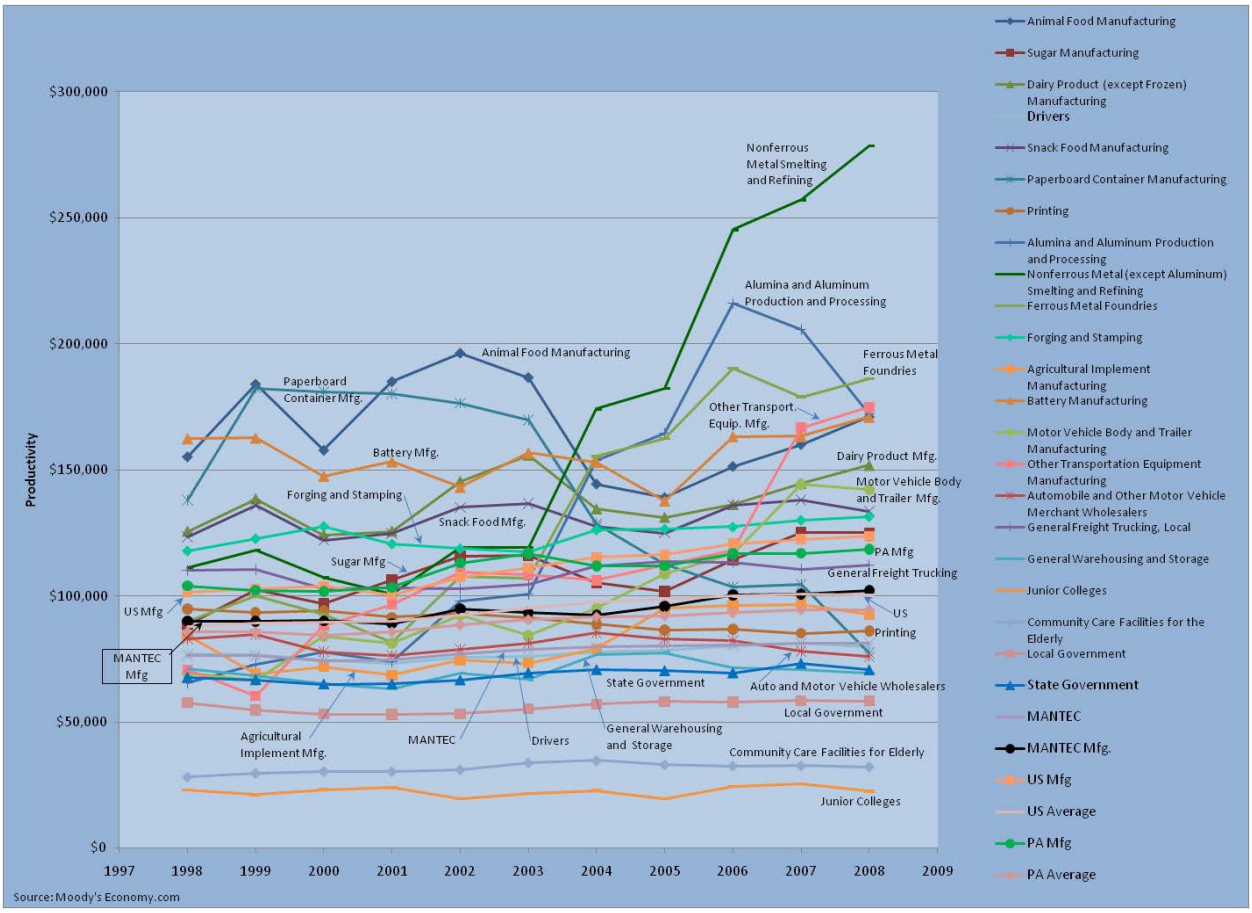
As can be seen in the following figure, Other Transportation Equipment Manufacturing is the only regional driver considered a technology-intense industry, and it falls into the category of low intensity. This industry and six others – Nonferrous Metal Smelting and Refining, Ferrous Metal Foundries, Alumina and Aluminum Production and Processing, Agricultural Implement Manufacturing, Motor Vehicle Body and Trailer Manufacturing, and Battery Manufacturing – represent the part of the region's manufacturing base that grew from 2003 to 2008.

Technology Intensity of Driver Industries



Nonferrous Metal Smelting and Refining has the highest productivity among the region's drivers and it is growing. Productivity in this industry more than doubled from $111,106 GSP per employee in 1998 to $278,481 in 2008. The industry shed jobs over the study period, but, by 2008, it had nearly regained its 1998 employment base. This dynamic productivity growth was also experienced by the Ferrous Metal Foundries industry, which has been rising since 2001. While the industry experienced employment losses over the 10-year period studied, productivity grew from $89,837 in 1998 to $186,289 in 2008.

Productivity by Regional Driver Industry



Six of the region's manufacturing driver industries experienced 10-year compound growth rates for productivity that exceeded the national average for manufacturing of 2.0 percent. In addition to the two metal manufacturing industries noted earlier, Other Transportation Equipment Manufacturing and Alumina and Aluminum Production and Processing enjoyed high average rates of growth, at 9.5 percent and 10.1 percent, respectively. Motor Vehicle Body and Trailer Manufacturing also grew at an impressive average annual rate of 7.4 percent from 1998 to 2008, and Sugar Manufacturing expanded by 3.5 percent each year, on average.

The region's transportation and logistics cluster of drivers did not experience growth over the 10-year period, but the industries largely maintained their productivity levels for the period studied. The region's education, health-care and government services cluster also did not see much growth in productivity over the decade, but it did expand its employment.

Average Annual Change in Productivity by Regional Driver

NAICS	Industry Name	1998	2008	1998-2008 Productivity CAGR
	Manufacturing			
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$111,106	$278,481	9.6%
3315	Ferrous Metal Foundries	$89,837	$186,219	7.6%
3369	Other Transportation Equipment Manufacturing	$70,727	$174,937	9.5%
3313	Alumina and Aluminum Production and Processing	$65,553	$172,042	10.1%
3111	Animal Food Manufacturing	$155,171	$171,001	1.0%
3359	Battery Manufacturing	$162,503	$171,000	0.5%
3115	Dairy Product (except Frozen) Manufacturing	$125,540	$151,848	1.9%
3362	Motor Vehicle Body and Trailer Manufacturing	$69,394	$142,243	7.4%
3119	Snack Food Manufacturing	$123,496	$133,682	0.8%
3321	Forging and Stamping	$117,967	$131,592	1.1%
3113	Sugar Manufacturing	$88,652	$124,992	3.5%
3331	Agricultural Implement Manufacturing	$84,428	$92,830	1.0%
3231	Printing	$94,772	$86,036	-1.0%
3222	Paperboard Container Manufacturing	$138,104	$77,401	-5.6%
	Transportation and Logistics			
4841	General Freight Trucking, Local	$110,158	$112,235	0.2%
4231	Automobile and Other Motor Vehicle Merchant Wholesalers	$83,015	$75,849	-0.9%
4931	General Warehousing and Storage	$71,159	$69,239	-0.3%
	Education, Health Care and Government Services			
GVS	State Government	$67,807	$70,681	0.4%
GVL	Local Government	$57,676	$58,350	0.1%
6233	Community Care Facilities for the Elderly	$28,075	$32,195	1.4%
6112	Junior Colleges	$22,909	$22,524	-0.2%
U.S. Average		$87,891	$100,495	1.3%
U.S. Manufacturing		$101,530	$123,614	2.0%
PA Average		$85,648	$94,381	1.0%
PA Manufacturing		$104,038	$118,485	1.3%
All MANTEC		$76,318	$81,162	0.6%
MANTEC Drivers		$77,048	$79,920	0.4%
MANTEC Region Mfg. Average		$90,118	$102,229	1.3%

Source: Moody's Economy.com

Impact and Return from MANTEC

For this analysis, three years of IRC financial data was analyzed by region (FY2008, FY2009, and FY2010). All sources of income were identified. The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client service income. The client fee income is leveraged by the state and federal funding, which tends to have interconnected matching requirements.

To determine the economic impact of IRC activities, MEP survey data was analyzed by region. As part of the survey, manufacturing clients were asked to quantify new and retained sales and new and retained jobs attributable to the work of the IRCs. Funding sources were compared to the economic impact data from the survey. A one-year lag time in impact was assumed, meaning that, for example, FY2008 financial information was compared to FY2009 economic impact data. Two ratios were calculated to determine the economic impact of $1 of funding.

Analysis of IRC financial data reveals that every $1 of state investment in MANTEC in 2009 yielded $48 in new and retained sales in the manufacturing sector, as can be seen in the following graphic. The impact of investment in MANTEC for fiscal year 2009 was more than $93 million in new and retained sales in manufacturing and 815 new and retained jobs. State cost per job created or retained in the region served by MANTEC was $2,362 in 2009.

MANTEC

SOURCES AND IMPACT OF FUNDS FOR FISCAL YEARS 2008 & 2009

FISCAL YEAR	2008	2009
SOURCES		
DCED-PA (STATE) (S)	$2,075,000	$1,925,000
CLIENT REVENUES (C)	$2,615,000	$2,798,000
NIST/MEP (FEDERAL) (F)	$728,000	$693,000
OTHER GRANTS (G)	$384,000	$189,000
OTHER INCOME (I)	$69,000	$46,000
	$2.1M IN-STATE FUNDS LEVERAGES $5.9M OF PUBLIC & PRIVATE INVESTMENT IN MFG.	$1.9M IN-STATE FUNDS LEVERAGES $5.7M OF PUBLIC & PRIVATE INVESTMENT IN MFG.
SALES IMPACT		
RETAINED SALES	$42,939,000	$67,448,000
INCREASED SALES	$24,580,000	$25,723,000
DIRECT ECONOMIC IMPACT	**$67,519,000**	**$93,171,000**
	$1 OF STATE INVESTMENT LEADS TO $33 IN NEW AND RETAINED SALES IN MFG.	$1 OF STATE INVESTMENT LEADS TO $48 IN NEW AND RETAINED SALES IN MFG.

IMC

Located in Williamsport, the IMC serves 12 counties of central Pennsylvania. They are:

- Bedford
- Blair
- Centre
- Clinton
- Huntingdon
- Juniata
- Lycoming
- Mifflin
- Montour
- Northumberland
- Snyder
- Union

Since the 2004 manufacturing study, IMC's service region has been expanded to include Bedford County.

In the region served by the IMC, Manufacturing claims the top spot in terms of GSP, but just barely. Between 1998 and 2008, the region's Manufacturing GSP shrank at an average annual rate of 2.2 percent, while Public Administration grew by 1.4 percent yearly. Manufacturing's 2008 gross product of $4.2 billion accounted for 18 percent of the region's GSP, followed closely by Public Administration's $4.1 billion. As an employer, Public Administration's nearly 70,000 jobs in the region eclipses the 48,195 positions in manufacturing. In fact, Manufacturing has slipped to the No. 3 spot in terms of regional employment due to steep job losses in the industry. The 2004 study cited Manufacturing employment for the then-11-county region served by the IMC as 66,087. Manufacturing employment in the region now ranks below Health Care and Social Assistance, which has grown to a workforce of nearly 50,000. Although Health Care and Social Assistance accounts for a significantly smaller share of regional GSP than the other two industries, its GSP has been growing at a robust average annual pace of 3.7 percent over the decade studied.

GSP and Growth Rate by Industry for Region Served by the IMC

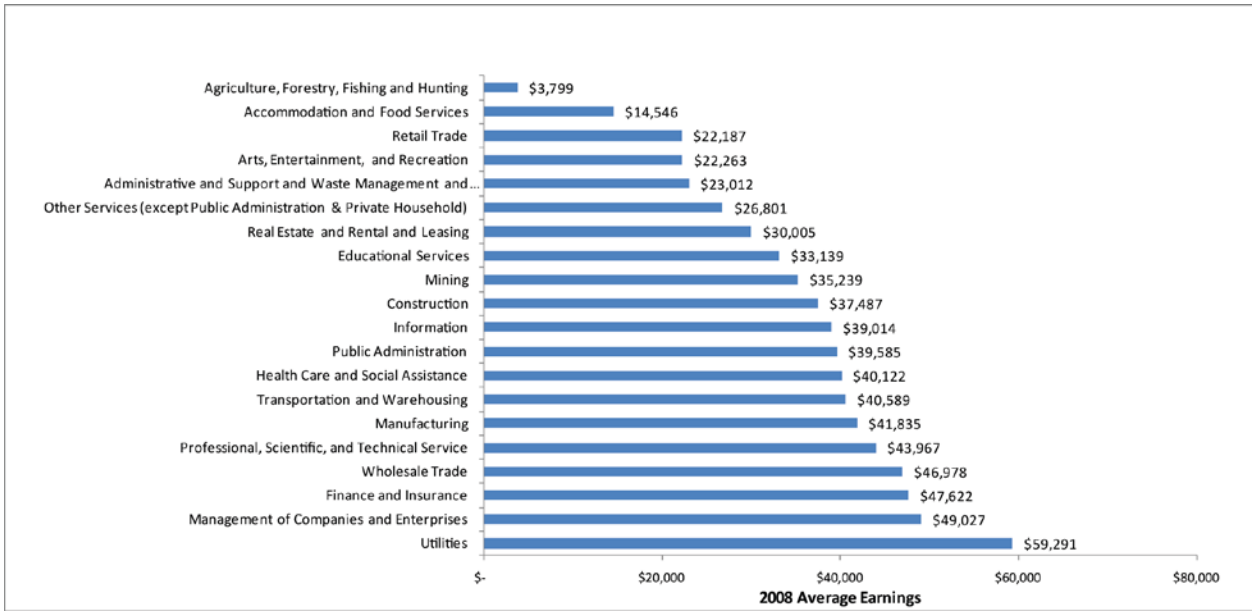
Industry	Employment 2008	GSP 2008 ($M)	05-08 CAGR	03-08 CAGR	98-08 CAGR	Industry GSP As a % of Regional GSP
Manufacturing	**48,195**	**$4,246**	**-0.4%**	**-1.0%**	**-2.2%**	**18.0%**
Public Administration	69,504	$4,105	0.9%	1.3%	1.4%	17.4%
Health Care and Social Assistance	49,681	$2,969	3.5%	3.9%	3.7%	12.6%
Retail Trade	39,567	$1,818	0.0%	-0.2%	0.2%	7.7%
Real Estate and Rental and Leasing	2,787	$1,777	3.6%	3.1%	2.4%	7.5%
Transportation and Warehousing	13,566	$1,162	2.5%	4.2%	3.7%	4.9%
Wholesale Trade	11,272	$1,145	1.8%	2.3%	3.2%	4.9%
Construction	16,542	$990	-4.3%	0.6%	2.2%	4.2%
Professional, Scientific, and Technical Service	10,948	$882	3.7%	5.1%	5.0%	3.7%
Finance and Insurance	8,345	$872	-0.6%	-1.7%	0.9%	3.7%
Accommodation and Food Services	25,488	$656	3.7%	2.6%	1.7%	2.8%
Information	4,687	$585	-2.5%	1.3%	1.6%	2.5%
Other Services (except Public Administration & Private Household)	11,652	$521	1.2%	1.3%	0.8%	2.2%
Utilities	1,098	$494	3.2%	6.0%	1.0%	2.1%
Administrative and Support and Waste Management and Remediation Services	9,286	$368	2.3%	3.2%	3.3%	1.6%
Management of Companies and Enterprises	4,565	$307	0.0%	-0.3%	4.1%	1.3%
Agriculture, Forestry, Fishing and Hunting	11,650	$223	-0.2%	2.3%	2.1%	0.9%
Educational Services	5,217	$212	1.7%	2.6%	0.0%	0.9%
Arts, Entertainment, and Recreation	3,375	$135	-1.3%	0.6%	2.4%	0.6%
Mining	918	$101	3.6%	3.4%	5.8%	0.4%
	348,343	$23,569	1.1%	1.5%	1.2%	

Source: Moody's Economy.com

Note: CAGR represents Compound Annual Growth Rate.

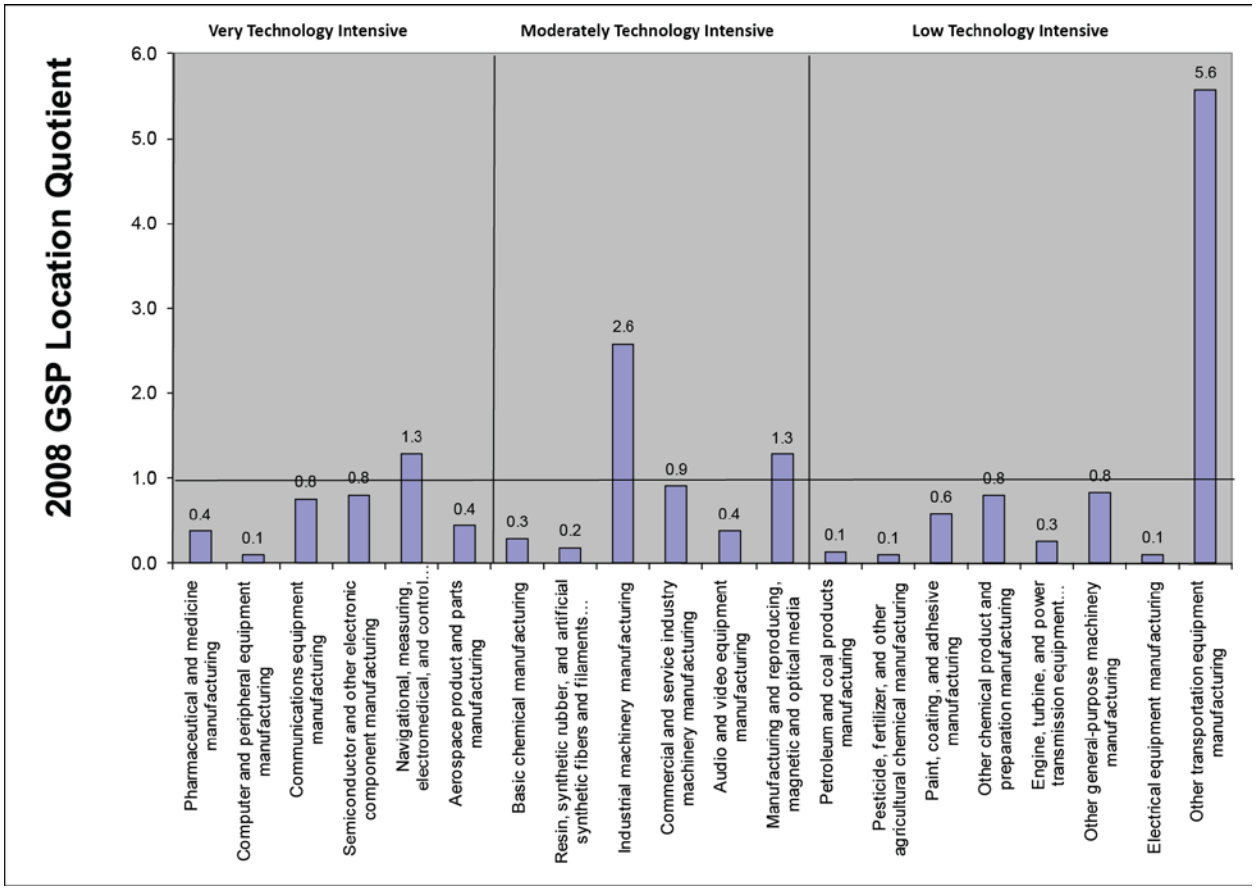
Manufacturing in the region has experienced a significant increase in average earnings. In 2008, the average manufacturing wage reached $41,835, sixth-highest among regional industries. In the 2004 study, manufacturing earnings ranked No. 14 in the then-11-county region. The dramatic change in relative wage leads us to speculate that, as part of the massive employment losses, the sector shed lower skill jobs at the lower end of the pay scale. As is true in other Pennsylvania regions, top earnings are in the fields of Wholesale Trade, Finance, Management of Companies and Enterprises, and Utilities.

Earnings by Industry for Region Served by the IMC



The region served by the IMC has modest specialization in technology-intensive industries. Big losses in Pharmaceuticals across the entire state contributed to the region losing competitive advantage in the industry. This loss was also accompanied by a decrease in the location quotient of a related industry, Basic Chemical Manufacturing. Shifts in the structure of the economy left Navigational, Measuring, Electromedical, and Control Instruments Manufacturing as the only regionally competitive industry among very technology intensive industries. The region improved its competitive advantage in Industrial Machinery Manufacturing, increasing its GSP location quotient to 2.6. The region's group of industries with moderate technology intensity industries includes Commercial and Service Industry Machinery Manufacturing, which has a location quotient (0.9) near the national average. This industry likely clusters with Industrial Machinery Manufacturing. Manufacturing and Reproducing Magnetic and Optical Media is another regionally competitive industry among those with moderate technology intensity, as can be seen in the following figure.

Technology Intensity Among Industries in Region Served by IMC



A strong regional presence in Other Transportation Equipment Manufacturing (LQ = 5.6) among industries with low technology intensity does not translate into competitive advantage because of very modest regional employment in the industry. Despite significant declines in competitiveness, the region has maintained higher employment levels in industries with high technology intensity than is seen throughout the state and among regional peers (1.3% compared to 1.1%). However, the region significantly lags average employment levels in high-intensity service industries. Among industries with moderate technology intensity, the region served by the IMC has employment levels that are similar to the nation overall, but significantly higher than for the state and regional peers.

Comparing Employment in Technology-Intensive Industries

	IMC	Pennsylvania	Regional Peers*	United States
Total Technology Intensive Employment in Private Sector	9.5%	10.5%	8.6%	11.6%
Very Technology Intensive				
Very Technology Intensive Manufacturing	1.3%	1.1%	1.1%	1.5%
Very Technology Intensive Pipeline & Telecommunication	0.0%	0.0%	0.0%	0.1%
Very Technology Intensive Service	1.4%	2.6%	2.2%	2.8%
Moderate Technology Intensive				
Moderate Technology Intensive Manufacturing	0.5%	0.5%	0.3%	0.4%
Moderate Technology Intensive Others	3.5%	1.7%	1.5%	2.7%
Moderate Technology Intensive Service	0.5%	1.2%	0.9%	1.2%
Low Technology Intensive				
Low Technology Intensive Manufacturing	0.4%	0.7%	0.5%	0.6%
Low Technology Intensive Pipeline & Telecommunication	0.5%	0.7%	0.6%	0.7%
Low Technology Intensive Service	1.4%	2.1%	1.4%	1.6%

*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV

Source: Moody's Economy.com

Regional Driver Industries

The region served by the IMC has a strong manufacturing economic base. Out of 17 identified driver industries for the region, 14 are in manufacturing. Manufacturing in the region served by the IMC is grouped into two economic clusters, as can be seen in the following table. The first cluster represents mature paper, food, glass and other manufacturing, which is an older and declining economic base for the region. The second cluster of metal manufacturing industries includes smaller industries with high and growing productivity and increasing share of national GSP. Telecommunication is a very small industry with extremely high productivity (a finding that may be due in part to imperfect data estimations). The government, education, and health-care cluster reflects the region's large employment base and the presence of Penn State University, Penn College and other educational institutions.

Driver Industries for the Region Served by the IMC

NAICS	Industry Name	2008 GSP ($M)	2005-08 GSP CAGR	2003-08 GSP CAGR	1998-2008 GSP CAGR	2008 GSP Location Quotient	2002-08 Change in LQ
	Mature Declining Manufacturing Economic Base						
3222	Paperboard Container Manufacturing	$359	-10.2%	-3.8%	-2.4%	6.80	1.27
3371	Wood Kitchen Cabinet and Countertop Manufacturing	$223	-12.8%	-5.7%	-1.3%	6.90	0.34
3219	Millwork	$214	-17.0%	-7.0%	-1.5%	8.11	-0.11
3221	Pulp Mills	$178	12.0%	5.7%	2.1%	5.46	2.33
3114	Frozen Food Manufacturing	$138	-2.2%	-9.8%	-10.0%	4.69	-0.21
3272	Glass and Glass Product Manufacturing	$95	12.0%	22.8%	11.0%	5.14	-3.00
3212	Veneer, Plywood, and Engineered Wood Product Manufacturing	$71	-0.3%	9.5%	7.3%	6.71	0.31
3211	Sawmills and Wood Preservation	$53	-6.1%	-6.0%	-0.5%	4.90	0.46
3369	Other Transportation Equipment Manufacturing	$38	-18.9%	-15.4%	-6.2%	5.63	1.63
3379	Mattress Manufacturing	$32	3.0%	3.6%	2.6%	6.22	-2.71
	Metal Manufacturing						
3311	Iron and Steel Mills and Ferroalloy Manufacturing	$164	3.6%	0.2%	-1.1%	5.14	2.98
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$99	11.2%	22.7%	10.4%	5.70	2.43
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$61	5.8%	4.5%	4.1%	4.11	2.38
3313	Alumina and Aluminum Production and Processing	$61	12.8%	16.3%	6.3%	3.85	1.19
	Telecommunication						
5179	Other Telecommunications	$47	-10.8%	-11.6%	-5.3%	0.59	-0.82
	Government, Education and Health Care						
GVL	Local Government	$1,522	0.4%	1.0%	0.9%	0.99	0.00
6221	General Medical and Surgical Hospitals	$886	8.8%	1.5%	-1.6%	1.90	0.12

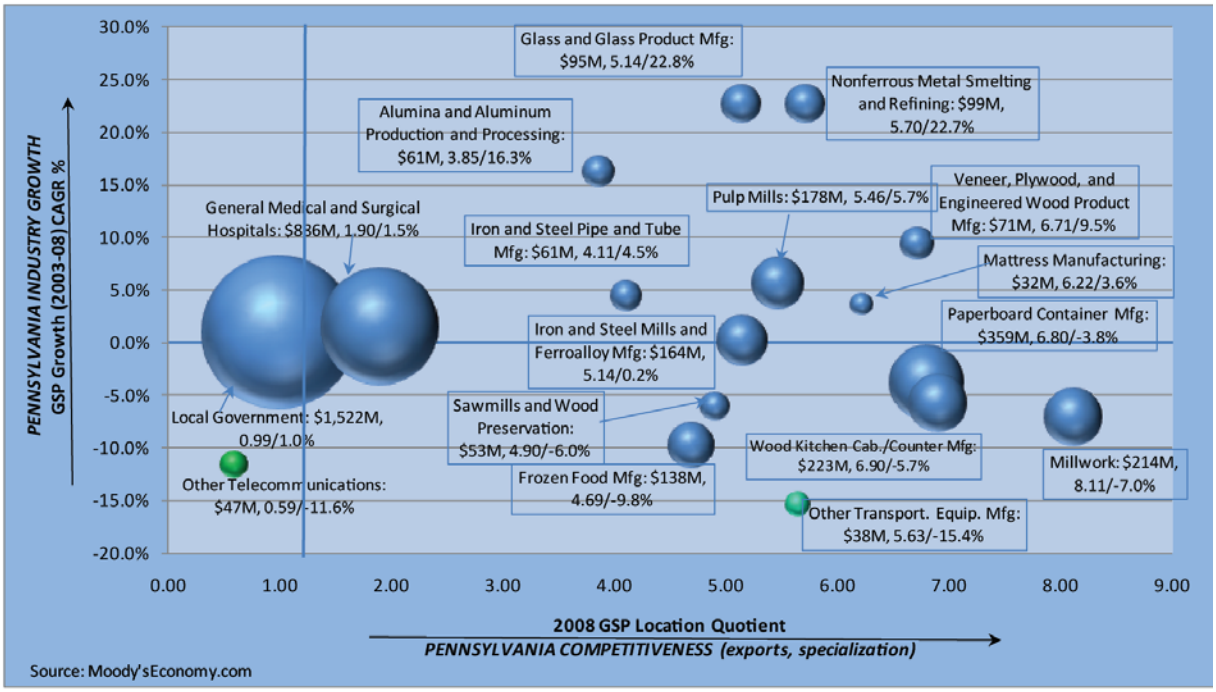
Source: Moody's Economy.com

As can be seen in the following figure, all industries of the metal-making cluster are located in the top right quadrant, which indicates growing economic base industries with growing sales. A few more industries from the cluster of mature manufacturing are also growing and are high specialization in the region. Among those are industries in the glass, paper and wood sectors. Specifically, these mature but growing regional drivers are:

- Glass and Glass Product Manufacturing
- Pulp Mills
- Veneer, Plywood, and Engineered Wood Product Manufacturing

Only two of the region's 17 economic drivers – Other Transportation Equipment Manufacturing and Other Telecommunications – are in technology-intensive industries. Both of these regional industries experienced declines in GSP, and Other Telecommunications also saw declines in competitiveness, from 2003 to 2008.

Technology Intensity of Driver Industries

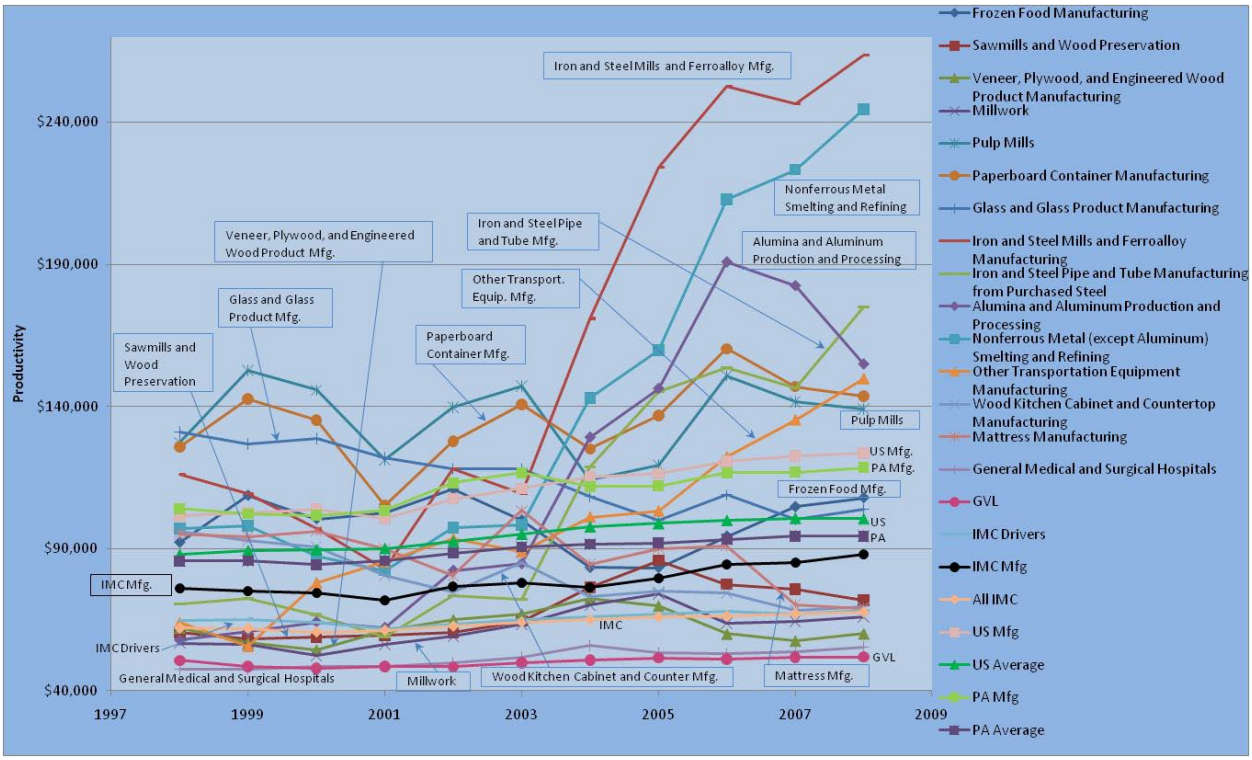


The following figure shows the productivity for the regional drivers. Besides Other Telecommunications, which was excluded from the figure due to its outlier position, industries in the metal-manufacturing cluster top the list in terms of regional productivity. Productivity in this cluster increased at an impressive pace between 1998 and 2008. Average annual growth in GSP per employee for these industries ranged from 8.5 percent to 10.4 percent over the 10-year period. As can be seen in the following figure, Iron and Steel Mills and Ferroalloy Manufacturing grew productivity over the decade to more than $263,000 in GSP per employee. Nonferrous Metal (Except Aluminum) Smelting and Refining was not far behind, achieving productivity levels of more than $244,000.

Other Transportation Equipment Manufacturing experienced a similar change in average rate of growth, boosting productivity by 8.9 percent annually. Among the regional drivers, four – all of them manufacturing industries – posted productivity levels that were lower in 2008 than in 1998. These were:

- Glass and Glass Product Manufacturing
- Wood Kitchen Cabinet and Countertop Manufacturing
- Mattress Manufacturing
- Veneer, Plywood and Engineered Wood Product Manufacturing

Productivity by Regional Driver Industry



In total, seven regional driver manufacturing industries exceeded not only the state average for manufacturing productivity but the U.S. manufacturing average, as well. Two more regional manufacturing drivers exceeded the state ($94,381) and national ($100,495) averages for overall productivity.

Average Annual Change in Productivity by Regional Driver

NAICS	Industry Name	1998	2008	1998-2008 Productivity CAGR
5179	Other Telecommunications	$1,154,441	$1,962,082	5.4%
3311	Iron and Steel Mills and Ferroalloy Manufacturing	$116,141	$263,473	8.5%
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$96,985	$244,492	9.7%
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$70,430	$175,004	9.5%
3313	Alumina and Aluminum Production and Processing	$57,777	$154,842	10.4%
3369	Other Transportation Equipment Manufacturing	$63,976	$149,671	8.9%
3222	Paperboard Container Manufacturing	$125,908	$143,598	1.3%
3221	Pulp Mills	$127,283	$138,977	0.9%
3114	Frozen Food Manufacturing	$92,153	$107,827	1.6%
3272	Glass and Glass Product Manufacturing	$131,011	$103,740	-2.3%
3211	Sawmills and Wood Preservation	$60,588	$71,815	1.7%
3371	Wood Kitchen Cabinet and Countertop Manufacturing	$96,125	$69,441	-3.2%
3379	Mattress Manufacturing	$95,059	$68,948	-3.2%
3219	Millwork	$56,755	$66,073	1.5%
3212	Veneer, Plywood, and Engineered Wood Product Manufacturing	$62,161	$60,120	-0.3%
6221	General Medical and Surgical Hospitals	$47,581	$55,223	1.5%
GVL	Local Government	$50,651	$51,894	0.2%
U.S. Average		$87,891	$100,495	1.3%
U.S. Manufacturing		$101,530	$123,614	2.0%
PA Average		$85,648	$94,381	1.0%
PA Manufacturing		$104,038	$118,485	1.3%
ALL IMC		$61,980	$67,528	0.9%
IMC Drivers		$64,677	$68,142	0.5%
IMC Region Mfg. Average		$76,112	$88,125	1.5%
Source: Moody's Economy.com				

Impact and Return From the IMC

For this analysis, three years of IRC financial data was analyzed by region (FY2008, FY2009, and FY2010). All sources of income were identified. The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client service income. The client fee income is leveraged by the state and federal funding, which tends to have interconnected matching requirements.

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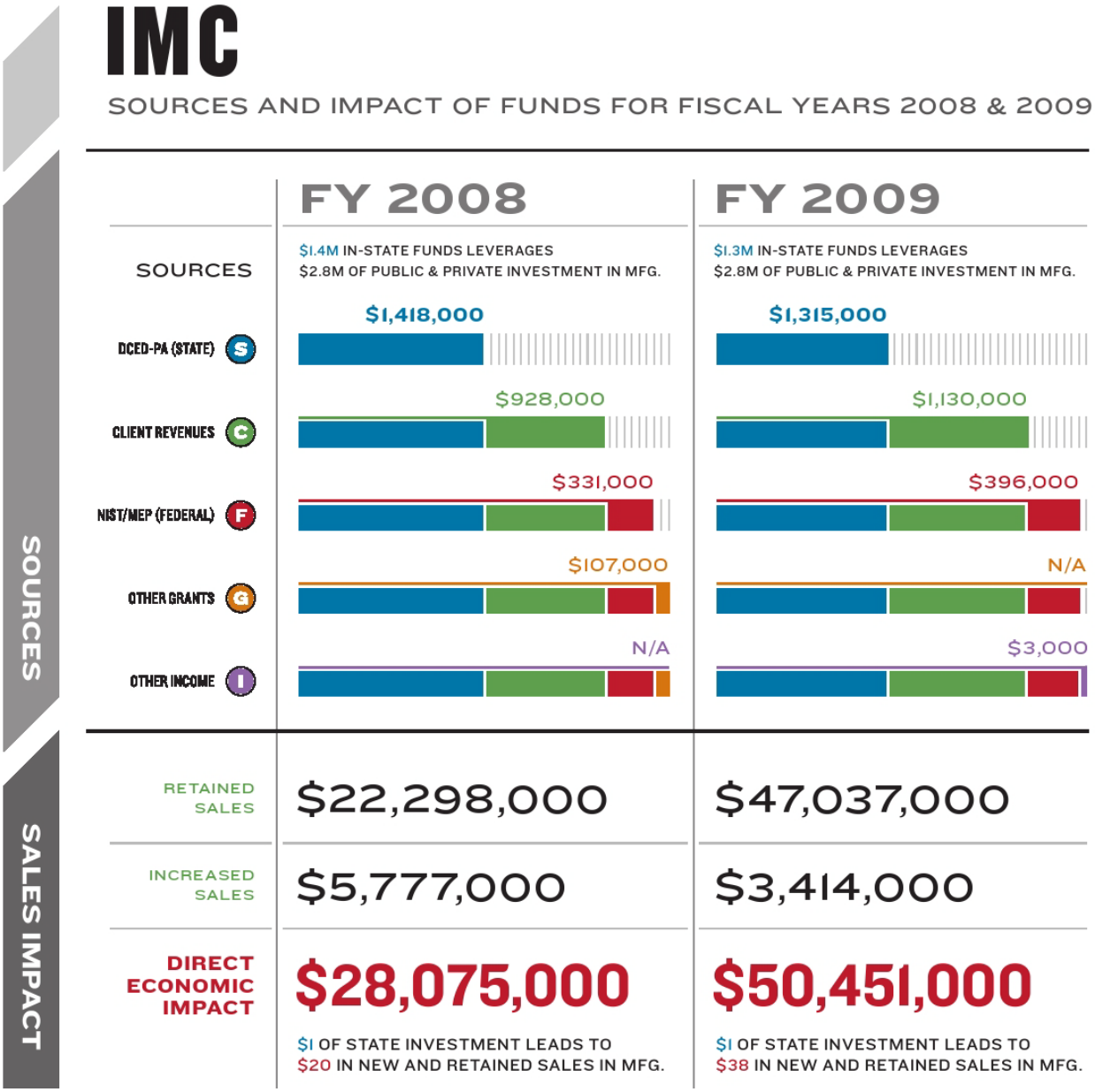
Analysis of IRC financial data reveals that every $1 of state investment in the IMC in 2009 yielded $38 in new and retained sales in the manufacturing sector, as can be seen in the following graphic. The impact of investment in the IMC for fiscal year 2009 was more than $50 million in new and retained sales in manufacturing and 509 new and retained jobs. State cost per job created and retained in the region served by the IMC was $2,583 in 2009.



Manufacturers Resource Center (MRC)

Located in Bethlehem, the MRC serves five Pennsylvania counties:

- Berks
- Carbon
- Lehigh
- Northampton
- Schuylkill

Manufacturing maintains its position as the No. 1 industry in terms of GSP in the region served by the MRC, accounting for roughly 20 percent of the region's total annual GSP. However, Manufacturing has fallen to being the region's second-largest employment sector. Since the 2004 study, the industry's total employment has been surpassed by Health Care and Social Assistance, which employed more than 80,000 workers in 2008. That compares to the more than 76,000 workers who were engaged in manufacturing activities in the region the same year.

Although the region's Manufacturing GSP of more than $9 billion in 2008 dwarfed the $5 billion generated by the Health Care and Social Assistance industry, Manufacturing has been declining in the region. From 1998 to 2008, Manufacturing in the region shrank by an average annual rate of 2.3 percent. Even more troubling, that average annual decline was greater for the final three years of the decade studied. This indicates that, unlike manufacturing in other parts of the state, manufacturing in the five-county region had failed to turn the tide on decline.

Management of Companies and Enterprises experienced remarkable growth in the region served by the MRC since the 2004 study. As can be seen in the following table, the industry increased its GSP in the region at an average annual rate of 12 percent from 1998 to 2008 and it more than doubled its employment. Its GSP growth for the last three years of the study period was even higher, at almost 15 percent.

In addition to regional growth in the company headquarters industry, Professional, Science, and Technical Services grew at an average annual rate of 3 percent from 1998 to 2008, increasing its GSP by an even more impressive 5.4 percent annually for the final three years of the study. Another related industry, Administrative and Support and Waste Remediation Services, also saw GSP growth of 3.4 percent annually, on average, from 1998 to 2008.

Two additional sectors of the regional economy expanded at a healthy pace over the decade studied. The Wholesale Trade industry increased its GSP by an average annual rate of 4.1 percent over the 10-year period, and Transportation and Warehousing grew at 4.5 percent. Each of the two industries employed more than 20,000 workers in the region in 2008, indicating strength in logistics.

The protracted decline in manufacturing and the sustained growth in service industries indicate that restructuring in the regional economy continues.

GSP and Growth Rate by Industry for Region Served by MRC

Industry	Employment 2008	GSP 2008 ($M)	05-08 CAGR	03-08 CAGR	98-08 CAGR	Industry GSP As a % of Regional GSP
Manufacturing	**76,158**	**$9,079**	**-3.0%**	**-2.9%**	**-2.3%**	**19.8%**
Health Care and Social Assistance	80,048	$5,038	4.1%	4.1%	4.9%	11.0%
Public Administration	67,922	$3,983	1.4%	1.9%	1.7%	8.7%
Real Estate and Rental and Leasing	5,002	$3,430	5.3%	2.5%	1.6%	7.5%
Retail Trade	61,322	$3,086	-1.4%	-0.4%	1.0%	6.7%
Wholesale Trade	21,496	$2,963	4.3%	5.4%	4.1%	6.5%
Finance and Insurance	19,535	$2,413	-1.8%	-1.6%	0.2%	5.3%
Management of Companies and Enterprises	14,266	$2,151	14.9%	10.9%	12.0%	4.7%
Professional, Scientific, and Technical Service	19,733	$2,137	5.4%	4.6%	3.0%	4.7%
Construction	21,693	$2,015	-5.2%	0.0%	2.5%	4.4%
Transportation and Warehousing	22,241	$1,909	5.0%	6.0%	4.5%	4.2%
Administrative and Support and Waste Management and Remediation Services	28,251	$1,418	3.0%	3.5%	3.4%	3.1%
Information	9,075	$1,409	-2.1%	2.6%	-1.1%	3.1%
Utilities	1,877	$1,323	5.9%	-7.4%	-6.0%	2.9%
Other Services (except Public Administration & Private Household)	23,260	$1,126	-0.9%	0.0%	0.4%	2.5%
Accommodation and Food Services	36,844	$1,005	2.9%	1.9%	2.0%	2.2%
Educational Services	13,383	$514	-0.1%	1.1%	2.7%	1.1%
Agriculture, Forestry, Fishing and Hunting	6,343	$441	3.1%	4.3%	1.4%	1.0%
Arts, Entertainment, and Recreation	8,101	$265	-3.3%	-1.3%	1.5%	0.6%
Mining	3,064	$228	5.8%	5.4%	2.7%	0.5%
	539,614	$45,932	1.3%	1.1%	1.1%	

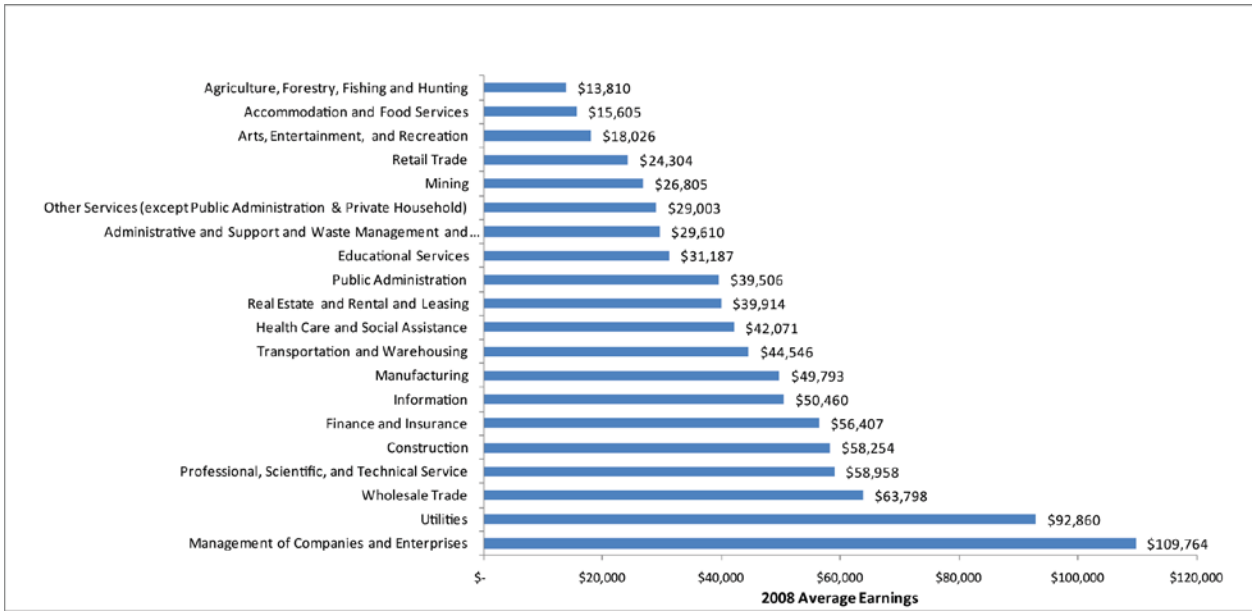
Source: Moody's Economy.com

Note: CAGR represents Compound Annual Growth Rate.

Manufacturing paid an average annual wage of $49,793 in 2008. Accounting for inflation, average earnings in manufacturing had not risen in the years since the 2004 study. The industry also did not change its position in terms of earnings. Compared to other industries in the region, manufacturing paid the eighth-highest wage. However, the annual average wage in the region increased over the decade studied due to the continued employment growth in industries paying higher earnings. These high-paying regional industries that saw growth – and their 2008 average earnings – included:

- Management of Companies and Enterprises – $109,764
- Utilities – $92,860
- Wholesale Trade – $63,798
- Professional, Scientific, and Technical Services – $58,958

Earnings by Industry for Region Served by MRC



Despite a decline in the Pharmaceutical and Medicine Manufacturing industry, Basic Chemical Manufacturing maintained a competitive regional position, with a GSP location quotient of 1.9. This industry's moderate technology intensity supports two other regional industries with low technology intensity: Paint, Coating, and Adhesive Manufacturing (LQ = 1.6) and Other Chemical Product and Preparation Manufacturing (LQ = 1.6).

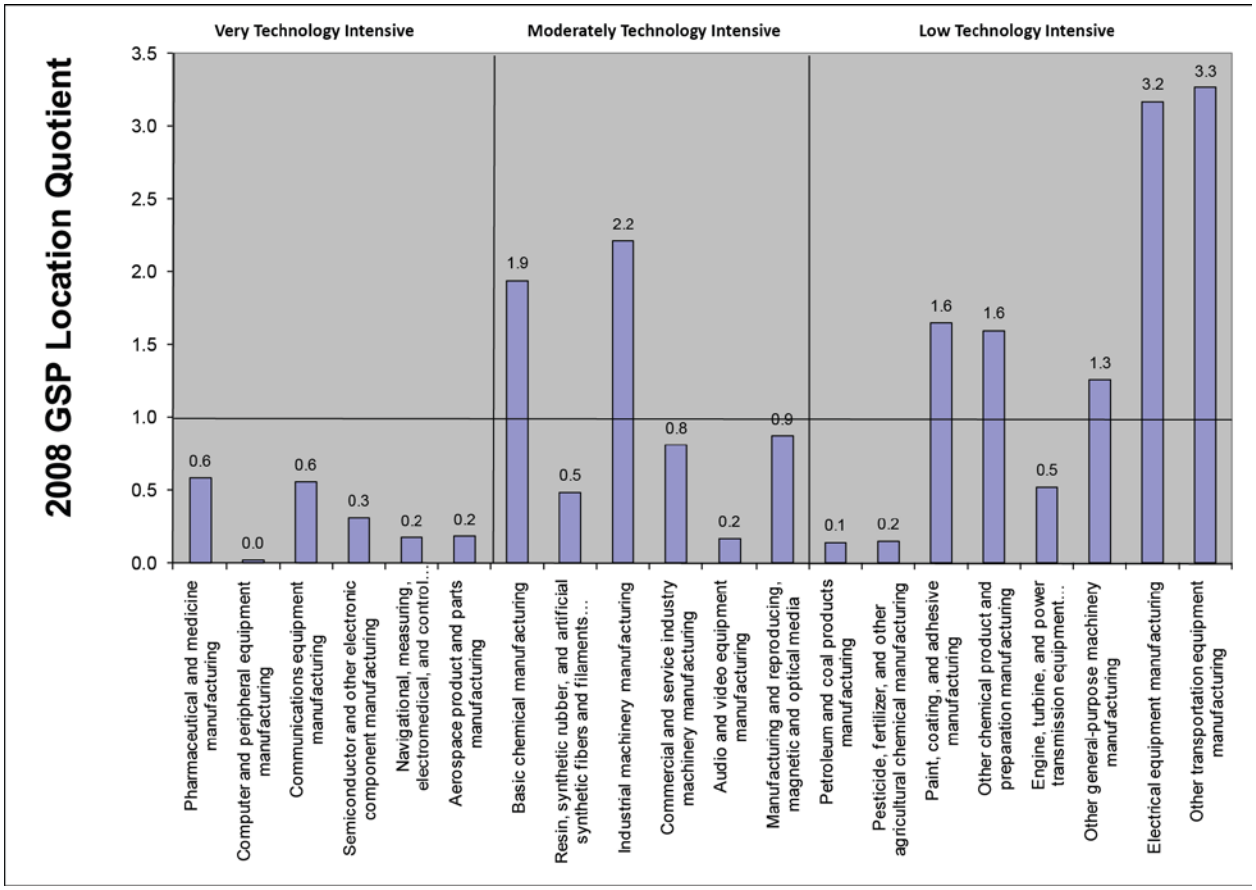
Industrial Machinery Manufacturing is another base industry in the region (LQ = 2.2) that has moderate technology intensity. A related industry, Commercial and Service Industry Machinery Manufacturing, saw its location quotient dip slightly in 2008 to 0.8.

The region served by the MRC also has strong presence of manufacturing industries with low technology intensity. In addition to the two chemical-related industries, three equipment and machinery manufacturing industries have competitive advantage in the region:

- Other Transportation Equipment Manufacturing (LQ=3.3)
- Electrical Equipment Manufacturing (LQ=3.2)
- Other General-Purpose Machinery Manufacturing (LQ=1.3)

These five industries had high and growing GSP location quotients in 2008, compared to 2002.

Technology Intensity Among Industries in Region Served by the MRC



Strong presence of industries with moderate and low technology intensity gives the region a higher share of manufacturing employment in these groups than seen in the state and nation overall. As can be seen in the following table, the region also surpasses all benchmark states in the share of employment engaged in service industries with low technology intensity. However, weaker presence in very high technology intensive industries and in non-manufacturing industries with moderate technology intensity means that the region lags the Pennsylvania, the nation and peer states in terms of total employment in technology-intensive industries. Only 8.4 percent of workers in the region served by the MRC are thus employed, compared to 10.5 percent for the state overall and 11.6 percent for the nation.

Comparing Employment in Technology-Intensive Industries

	MRC	Pennsylvania	Regional Peers*	United States
Total Technology Intensive Employment in Private Sector	8.4%	10.5%	8.6%	11.6%
Very Technology Intensive				
Very Technology Intensive Manufacturing	0.6%	1.1%	1.1%	1.5%
Very Technology Intensive Pipeline & Telecommunication	0.0%	0.0%	0.0%	0.1%
Very Technology Intensive Service	1.8%	2.6%	2.2%	2.8%
Moderate Technology Intensive				
Moderate Technology Intensive Manufacturing	0.7%	0.5%	0.3%	0.4%
Moderate Technology Intensive Others	0.3%	1.7%	1.5%	2.7%
Moderate Technology Intensive Service	0.8%	1.2%	0.9%	1.2%
Low Technology Intensive				
Low Technology Intensive Manufacturing	0.9%	0.7%	0.5%	0.6%
Low Technology Intensive Pipeline & Telecommunication	0.6%	0.7%	0.6%	0.7%
Low Technology Intensive Service	2.7%	2.1%	1.4%	1.6%
*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV				

Source: Moody's Economy.com

Regional Driver Industries

The region served by the MRC has an economy driven by four clusters encompassing 10 industries. The large, rapidly growing, high-productivity, high-wage Management of Companies industry drives the service cluster. In 2008, Offices of Physicians and General Medical and Surgical Hospitals had very large GSP and an extremely high share of the regional employment base, high and growing productivity and earnings, and a high share of total regional earnings.

The metal-manufacturing cluster had smaller employment in 2008 but enjoyed very productivity, which had more than doubled since 2002. All four industries in this cluster had a high and rapidly growing share of national industry presence, very high and growing GSP, and high and growing earnings relative to the industries' average pay nationwide. The industries' employment location quotients were also high and growing.

The other manufacturing cluster includes two industries – Sugar Manufacturing and Battery Manufacturing. These two industries had extremely high and growing GSP location quotient in 2008 and very high location quotient for employment.

Open-End Investment Funds is a regional driver with small employment but very high GSP, which makes the industry's productivity extremely high. The industry also has rapidly growing productivity and earnings relative to the industry nationwide and has low, but fast-growing location quotient in terms of GSP and employment.

Driver Industries for the Region Served by MRC

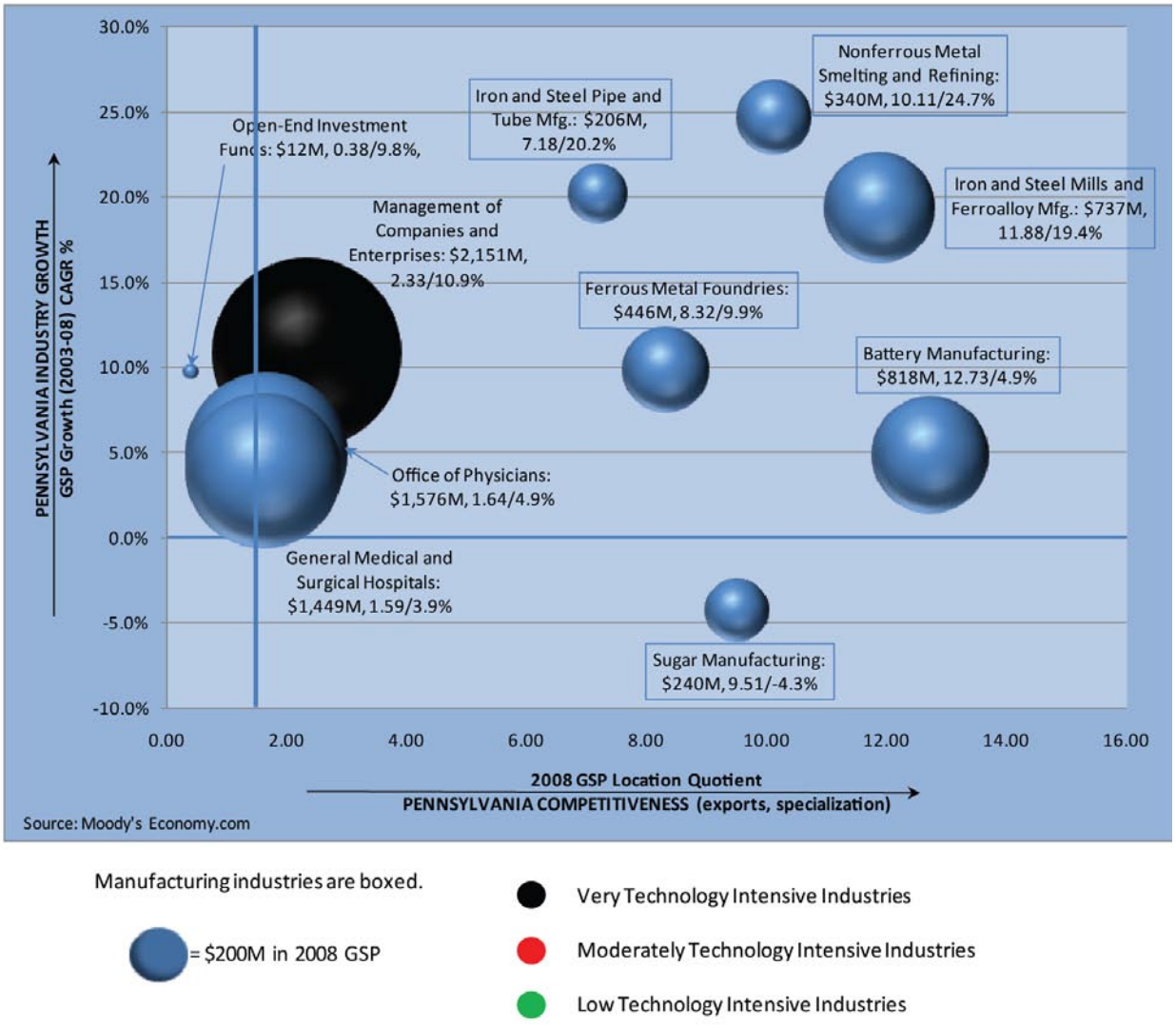
NAICS	Industry Name	2008 GSP ($M)	2005-08 GSP CAGR	2003-08 GSP CAGR	1998-2008 GSP CAGR	2008 GSP Location Quotient	2002-08 Change in LQ
	Service Industries						
5511	Management of Companies and Enterprises	$2,151	14.9%	10.9%	12.0%	2.33	0.99
6211	Offices of Physicians	$1,576	5.1%	4.9%	5.2%	1.64	0.30
6221	General Medical and Surgical Hospitals	$1,449	3.8%	3.9%	5.0%	1.59	0.23
	Metal Manufacturing						
3311	Iron and Steel Mills and Ferroalloy Manufacturing	$737	9.1%	19.4%	7.0%	11.88	4.81
3315	Ferrous Metal Foundries	$446	1.4%	9.9%	2.7%	8.32	2.92
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$340	18.4%	24.7%	10.2%	10.11	5.86
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$206	8.7%	20.2%	8.4%	7.18	3.35
	Other Manufacturing						
3359	Battery Manufacturing	$818	10.2%	4.9%	3.5%	12.73	3.20
3113	Sugar Manufacturing	$240	2.5%	-4.3%	1.8%	9.51	1.55
	Investment Funds						
5259	Open-End Investment Funds	$12	-0.1%	9.8%	11.1%	0.38	0.20

Source: Moody's Economy.com

The region's metal-manufacturing cluster enjoyed high GSP location quotient for 2008 and strong GSP growth from 2003 to 2008. As a result, the four industries making up the cluster are positioned at the far right corner of the top quadrant on the following figure. The three industries in the service cluster have very large and growing GSP. Their location quotients place them among base industries. The Management of Companies and Enterprises is the only technology-intensive industry among the regional drivers.

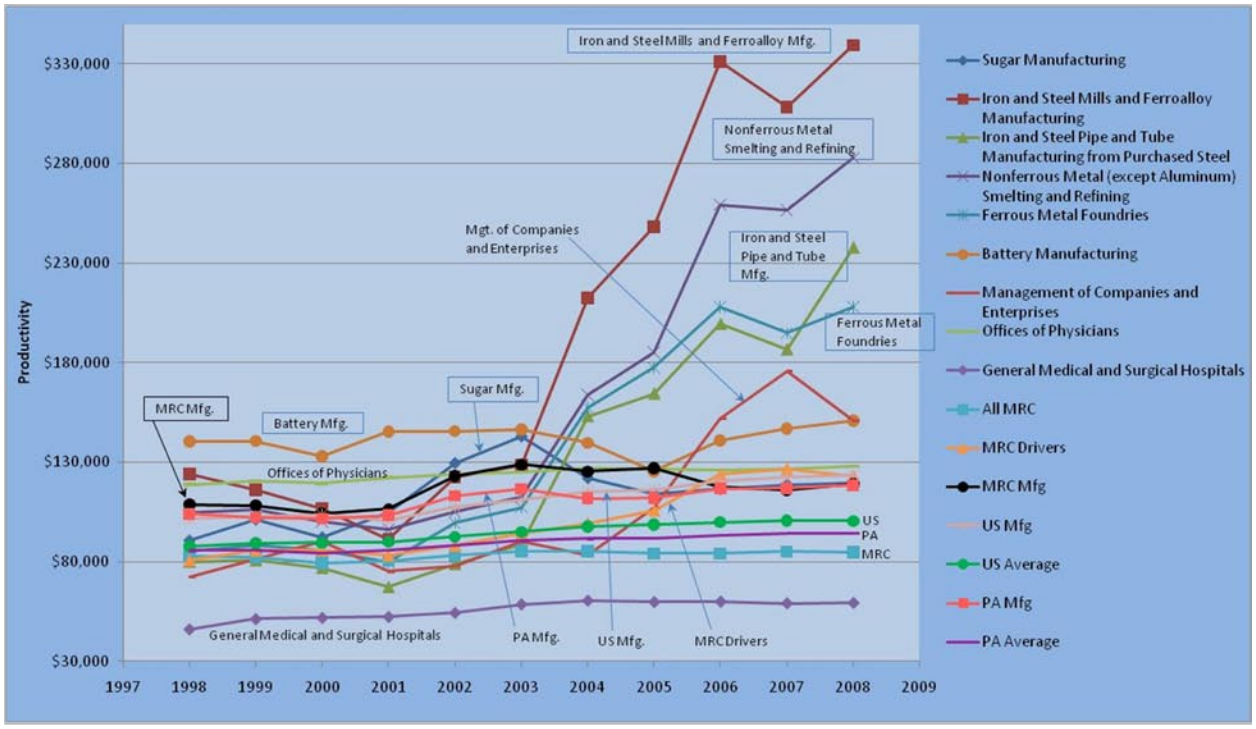
Among the two industries making up the other manufacturing cluster, Battery Manufacturing industry is large, with a strong base position, and grew at a healthy pace of 5 percent from 2003 to 2008. Sugar Manufacturing was the only regional driver to see its GSP decline from 2003 to 2008.

Technology Intensity of Driver Industries



In terms of GSP per employee, the four industries making up the metal-manufacturing cluster are the top-performing among the region's drivers. (It should be noted that NAICS 5259, Open-End Investment Funds, was excluded as an outlier in the following figure.) All of the region's manufacturing driver industries saw their productivity levels in 2008 exceed the average for manufacturing in Pennsylvania. All regional manufacturing drivers except Sugar Manufacturing also exceeded the U.S. average for manufacturing productivity.

Productivity by Regional Driver Industry



Source: Moody's Economy.com, NAICS 5259 excluded from the graph

All four industries in the metal-manufacturing cluster enjoyed high annual rates of productivity growth from 1998 to 2008. Ferrous Metal Manufacturing had an average annual growth rate of 9.3 percent for the decade studied, while productivity for Iron and Steel Pipe and Tube Manufacturing grew at a sizzling 11.5 percent annually. All manufacturing driver industries except Battery Manufacturing exceeded the average annual rate of growth over the decade for manufacturing in the state (1.3%) and in the nation overall (2.0%).

Average Annual Change in Productivity by Regional Driver

NAICS	Industry Name	1998	2008	1998-2008 Productivity CAGR
5259	Open-End Investment Funds	$4,216,036	$6,045,699	3.7%
3311	Iron and Steel Mills and Ferroalloy Manufacturing	$124,142	$339,406	10.6%
3314	Nonferrous Metal (except Aluminum) Smelting and Refining	$104,793	$282,773	10.4%
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$80,054	$237,744	11.5%
3315	Ferrous Metal Foundries	$85,132	$208,012	9.3%
5511	Management of Companies and Enterprises	$72,572	$150,801	7.6%
3359	Battery Manufacturing	$140,447	$150,730	0.7%
6211	Offices of Physicians	$118,818	$127,930	0.7%
3113	Sugar Manufacturing	$90,624	$119,375	2.8%
6221	General Medical and Surgical Hospitals	$46,276	$59,365	2.5%
U.S. Mfg.		$101,530	$123,614	2.0%
U.S. Average		$87,891	$100,495	1.3%
PA Mfg.		$104,038	$118,485	1.3%
PA Average		$85,648	$94,381	1.0%
All MRC		$82,702	$84,871	0.3%
MRC Drivers		$80,922	$123,048	4.3%
MRC Mfg.		$108,884	$119,216	0.9%

Source: Moody's Economy.com

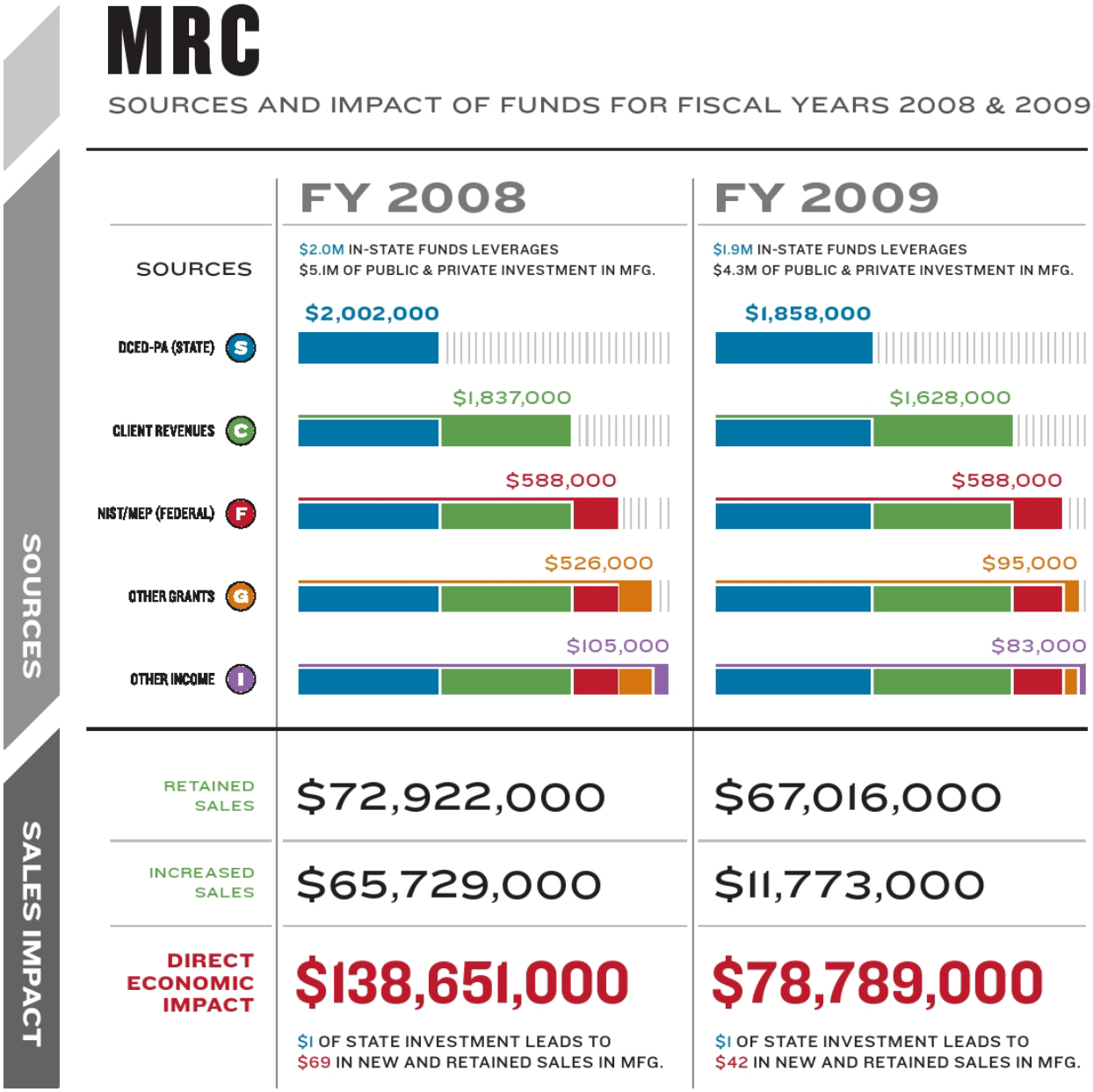
Impact and Return From the MRC

For this analysis, three years of IRC financial data was analyzed by region (FY2008, FY2009, and FY2010). All sources of income were identified. The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client service income. The client fee income is leveraged by the state and federal funding, which tends to have interconnected matching requirements.

To determine the economic impact of IRC activities, MEP survey data was analyzed by region. As part of the survey, manufacturing clients were asked to quantify new and retained sales and new and retained jobs attributable to the work of the IRCs. Funding sources were compared to the economic impact data from the survey. A one-year lag time in impact was assumed, meaning that, for example, FY2008 financial information was compared to FY2009 economic impact data. Two ratios were calculated to determine the economic impact of $1 of funding.

Analysis of IRC financial data reveals that every $1 of state investment in the MRC in 2008 yielded $69 in new and retained sales in the manufacturing sector. As can be seen in the following

graphic, direct economic impact was down dramatically in 2009, following a significant reduction in state funding. The impact of investment in the MRC for fiscal year 2008 was nearly $139 million in new and retained sales in manufacturing and more than 630 new and retained jobs. State cost per job created or retained in the region served by the MRC was $3,086 in 2009.



Northeastern Pennsylvania Industrial Resource Center (NEPIRC)

NEPIRC serves 11 counties in northeastern Pennsylvania:

- Bradford
- Columbia
- Lackawanna
- Luzerne
- Monroe
- Pike
- Sullivan
- Susquehanna
- Tioga
- Wayne
- Wyoming

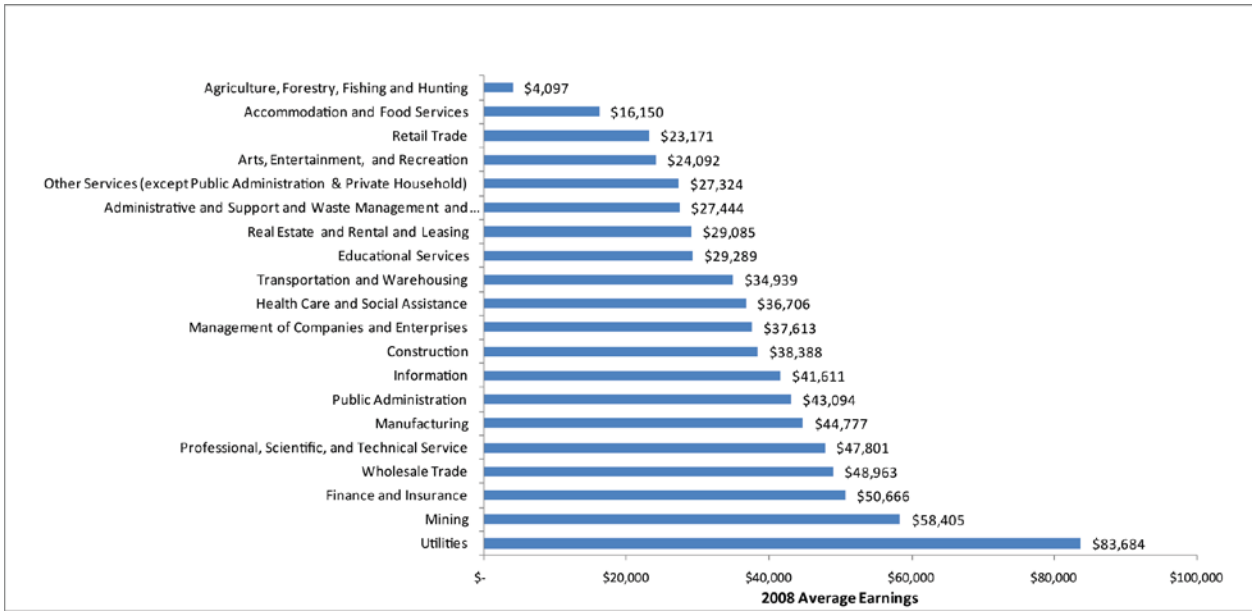
In terms of annual GSP, Manufacturing is the leading industry in the region served by NEPIRC, accounting for more than 17 percent of total regional GSP. However, manufacturing GSP declined, on average, 1 percent annually from 1998 to 2008. Despite this long-term contraction, there are signs that Manufacturing in the region may have begun to turn the tide on losses. The industry began growing, albeit slightly, in 2005 at an average annual rate of 0.5 percent. With 2008 GSP of nearly $5.4 billion, Manufacturing generated $1 billion more than the next-largest industry for the region, Public Administration. However, Manufacturing was the fourth-largest employer for the region in 2008, with some 53,000 workers. Public Administration and Health Care and Social Assistance each employed more than 63,000 workers, and Retail Trade accounted for more than 56,000 jobs in the region.

GSP and Growth Rate by Industry for Region Served by NEPIRC

Industry	Employment 2008	GSP 2008 ($M)	05-08 CAGR	03-08 CAGR	98-08 CAGR	Industry GSP As a % of Regional GSP
Manufacturing	**3,872**	**$5,388**	**0.4%**	**-0.7%**	**-1.0%**	**17.2%**
Public Administration	12,114	$4,222	1.2%	1.5%	1.8%	13.5%
Health Care and Social Assistance	14,677	$3,507	1.9%	2.1%	3.1%	11.2%
Retail Trade	3,767	$2,696	0.4%	1.0%	1.8%	8.6%
Real Estate and Rental and Leasing	63,479	$2,326	1.8%	0.1%	1.5%	7.4%
Finance and Insurance	10,146	$1,677	-1.4%	0.1%	1.4%	5.4%
Wholesale Trade	2,293	$1,515	-0.9%	0.8%	2.7%	4.8%
Utilities	20,054	$1,456	8.4%	1.2%	1.4%	4.6%
Transportation and Warehousing	56,206	$1,359	1.0%	3.4%	2.7%	4.3%
Construction	7,208	$1,210	-5.7%	-0.4%	1.0%	3.9%
Accommodation and Food Services	21,496	$1,065	2.2%	1.6%	1.0%	3.4%
Professional, Scientific, and Technical Service	16,516	$1,064	4.7%	3.6%	3.7%	3.4%
Information	63,459	$1,023	-4.7%	0.2%	1.3%	3.3%
Administrative and Support and Waste Management and Remediation Services	35,867	$855	3.6%	6.0%	6.4%	2.7%
Other Services (except Public Administration & Private Household)	877	$752	0.4%	0.9%	1.8%	2.4%
Educational Services	19,766	$366	1.0%	1.8%	2.3%	1.2%
Arts, Entertainment, and Recreation	9,024	$316	13.5%	10.1%	7.9%	1.0%
Management of Companies and Enterprises	7,486	$200	-8.6%	6.1%	0.4%	0.6%
Agriculture, Forestry, Fishing and Hunting	18,357	$186	-1.4%	1.8%	-0.4%	0.6%
Mining	53,020	$149	-0.1%	5.9%	4.1%	0.5%
	439,684	$31,334	0.8%	1.1%	1.5%	
Source: Moody's Economy.com						
Note: CAGR represents Compound Annual Growth Rate.						

Manufacturing paid an average annual wage in the region of $44,777 in 2008. Accounting for inflation, that figure was only slightly higher than the region's average pay for Manufacturing in 2003. However, Manufacturing advanced compared to other industries, rising from the region's 10th-highest average wage in 2003 to the sixth-highest in 2008. Compared to the 2004 study, Manufacturing's average wage surpassed earnings for Construction, Management of Companies and Enterprises, Administrative and Support Services, and Agriculture. The region's top-paying Wholesale Trade, Finance and Utilities were also among the highest-wage industries in other regions of the state.

Earnings by Industry for Region Served by NEPIRC

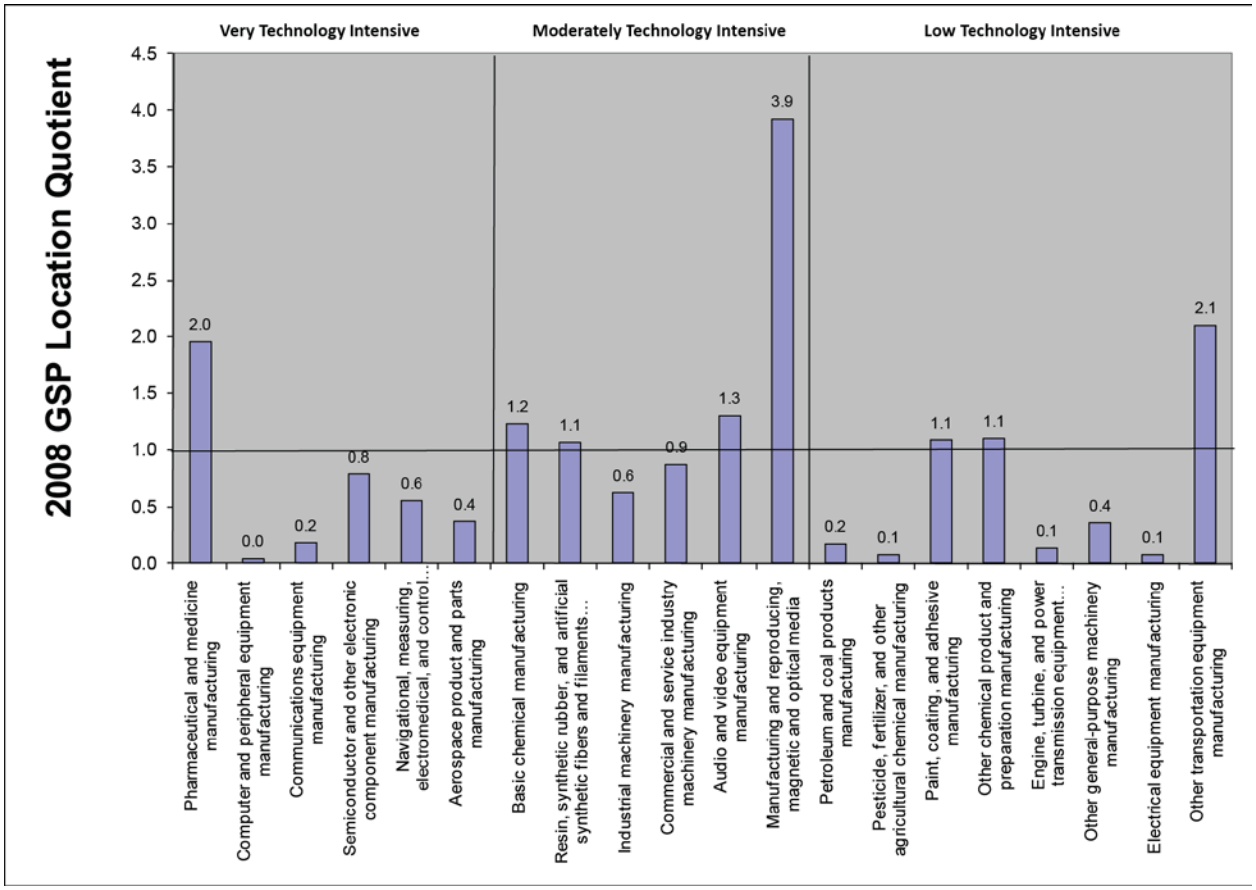


The region served by NEPIRC has industries in all three groups of technology intensity. Eight technologically intense industries have GSP location quotients above 1.1. Despite the decline of Pharmaceutical and Medicine Manufacturing across the state, the industry maintained its competitive position in the region, with a 2008 GSP location quotient of 2.0. A related industry, Basic Chemical Manufacturing, is one of four regionally competitive industries with moderate technology intensity.

Manufacturing and Reproducing Magnetic and Optics Media has the strongest regional presence among this group, with a GSP location quotient of 3.9. This competitive advantage is a result of the region's historic industrial strength in Audio and Video Equipment Manufacturing, which had a location quotient of 4.07 in 2002; although its LQ had fallen significantly by 2008 to 1.3, Audio and Video Equipment Manufacturing remained one of the region's base industries. Another industry with moderate technology intensity that relates to chemical-based activities is the Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing (LQ=1.1).

Among industries with low technology intensity, Other Transportation Equipment Manufacturing is regionally competitive with a 2008 GSP location quotient of 2.1. Two more chemical-related industries – Paint, Coating, and Adhesive Manufacturing and Other Chemical Product and Preparation Manufacturing – have competitive potential, 2008 GSP location quotients of 1.1.

Technology Intensity Among Industries in Region Served by NEPIRC



The presence of several competitive moderately and highly technologically-intense manufacturing industries puts the region on par, or even above, employment levels in such industries for Pennsylvania as a whole and for benchmark states. However, the region's share of total employment in technologically intense industries (7.8%) significantly lags similar employment for the state overall (10.5%) and the nation (11.6%). It even lags the average employment rate of 8.6 percent among benchmark states.

Comparing Employment in Technology-Intensive Industries

	NEPIRC	Pennsylvania	Regional Peers*	United States
Total Technology Intensive Employment in Private Sector	7.8%	10.5%	8.6%	11.6%
Very Technology Intensive				
Very Technology Intensive Manufacturing	1.1%	1.1%	1.1%	1.5%
Very Technology Intensive Pipeline & Telecommunication	0.0%	0.0%	0.0%	0.1%
Very Technology Intensive Service	0.9%	2.6%	2.2%	2.8%
Moderate Technology Intensive				
Moderate Technology Intensive Manufacturing	0.7%	0.5%	0.3%	0.4%
Moderate Technology Intensive Others	2.5%	1.7%	1.5%	2.7%
Moderate Technology Intensive Service	0.8%	1.2%	0.9%	1.2%
Low Technology Intensive				
Low Technology Intensive Manufacturing	0.3%	0.7%	0.5%	0.6%
Low Technology Intensive Pipeline & Telecommunication	0.6%	0.7%	0.6%	0.7%
Low Technology Intensive Service	1.0%	2.1%	1.4%	1.6%
*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV				
Source: Moody's Economy.com				

Regional Driver Industries

Among the eight identified driver industries for the region served by NEPIRC, five are manufacturers. All of these industries enjoyed extremely high GSP and employment location quotients for 2008. Sugar and Paper Manufacturing are traditional mature base industries for the regional economy. Despite its high location quotient (5.75), Sugar Manufacturing saw its GSP shrink slightly over the decade studied. Dramatic declines in Pharmaceuticals and a changing economic structure contributed to a vastly different mix of driver industries than were identified in the 2004 study. General Warehousing and Storage, which was not even included among drivers in the previous study, saw an average annual growth rate of 16.4 percent from 2003 to 2008 and now powers the region.

Driver Industries for the Region Served by NEPIRC

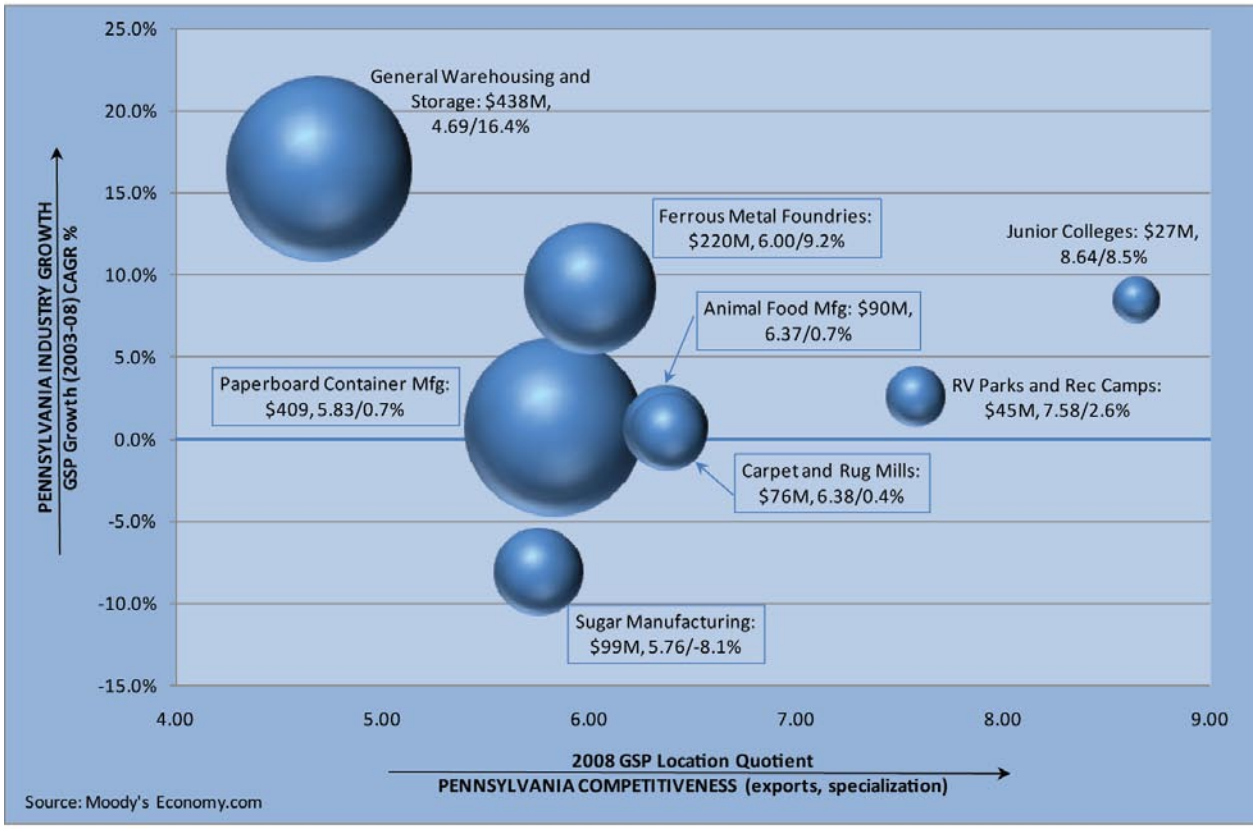
NAICS	Industry Name	2008 GSP ($M)	2005-08 GSP CAGR	2003-08 GSP CAGR	1998-2008 GSP CAGR	2008 GSP Location Quotient	2002-08 Change in LQ
4931	General Warehousing and Storage	$438	11.5%	16.4%	10.8%	4.69	1.88
3222	Paperboard Container Manufacturing	$409	-0.5%	0.7%	0.4%	5.83	1.59
3315	Ferrous Metal Foundries	$220	3.0%	9.2%	6.2%	6.00	2.09
3113	Sugar Manufacturing	$99	-0.4%	-8.1%	-0.2%	5.76	0.09
3111	Animal Food Manufacturing	$90	7.1%	0.7%	2.0%	6.37	1.39
3141	Carpet and Rug Mills	$76	6.5%	0.4%	-0.6%	6.38	1.23
7212	RV (Recreational Vehicle) Parks and Recreational Camps	$45	13.7%	2.6%	-2.1%	7.58	0.44
6112	Junior Colleges	$27	11.0%	8.5%	3.0%	8.64	2.32
Source: Moody's Economy.com							

All the identified eight driver industries have GSP location quotients above 4.0, but only three industries enjoyed high growth in GSP between 2003 and 2008:

- General Warehousing and Storage (LQ = 4.69; GSP growth, 16.4%)
- Ferrous Metal Foundries (LQ = 6; GSP growth, 9.2%)
- Junior Colleges (LQ = 8.64; GSP growth, 8.5%

As can be seen in the following figure, none of the region's drivers are technologically-intense industries.

Technology Intensity of Driver Industries

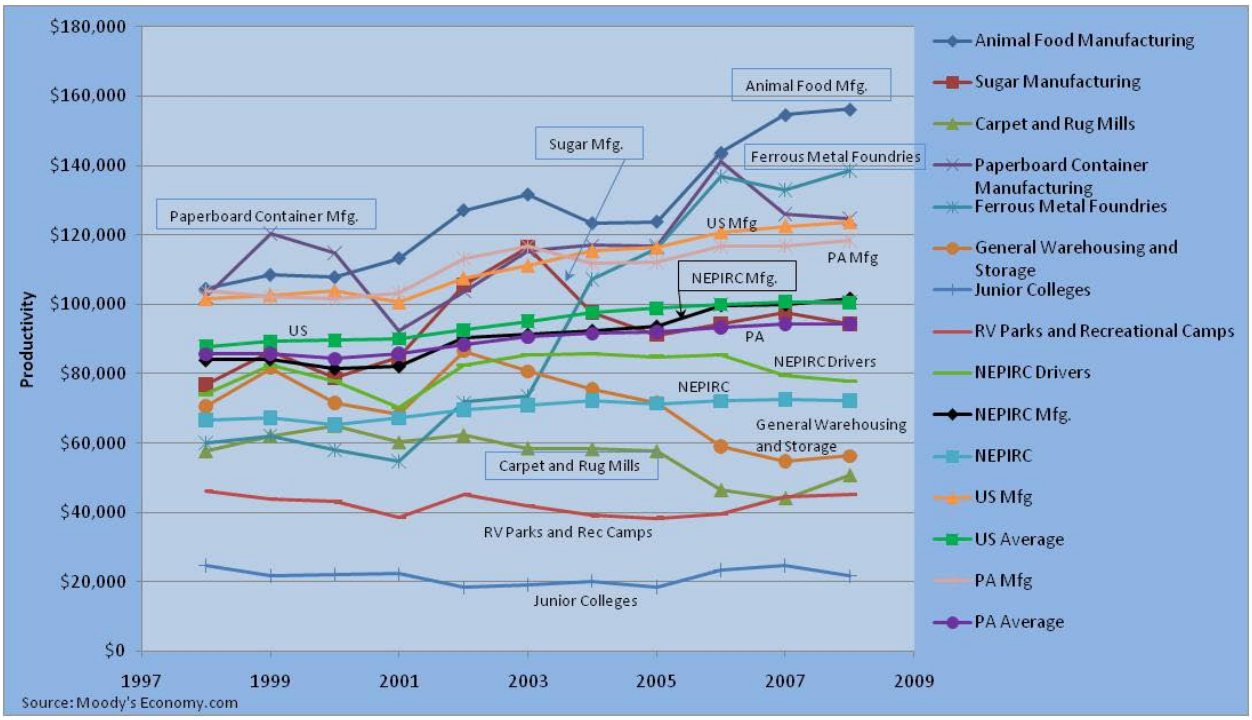


Manufacturing industries are boxed.

= $50M in 2008 GSP

Four of the region's manufacturing drivers had productivity in 2008 above the state average. Three of these industries had GSP per employee that was above the manufacturing average for the state and the nation as a whole. Animal Food Manufacturing had the highest productivity among the driver industries, with $156,212 in GSP per employee.

Productivity by Regional Driver Industry



As the following table shows, four of the region's manufacturing drivers experienced 10-year annual growth rates that exceeded state and national averages for manufacturing. Half of the regional driver industries saw productivity declines from 1998 to 2008; only one of those four – Carpet and Rug Mills – was in manufacturing.

Average Annual Change in Productivity by Regional Driver

NAICS	Industry Name	1998	2008	1998-2008 Productivity CAGR
3111	Animal Food Manufacturing	$104,419	$156,212	4.1%
3315	Ferrous Metal Foundries	$60,095	$138,514	8.7%
3222	Paperboard Container Manufacturing	$102,090	$124,656	2.0%
3113	Sugar Manufacturing	$76,804	$94,437	2.1%
4931	General Warehousing and Storage	$70,521	$56,255	-2.2%
3141	Carpet and Rug Mills	$57,663	$50,712	-1.3%
7212	RV (Recreational Vehicle) Parks and Recreational Camps	$46,240	$45,231	-0.2%
6112	Junior Colleges	$24,739	$21,622	-1.3%
U.S. Average		$87,891	$100,495	1.3%
U.S. Manufacturing		$101,530	$123,614	2.0%
PA Average		$85,648	$94,381	1.0%
PA Manufacturing		$104,038	$118,485	1.3%
All NEPIRC		$66,536	$72,344	0.8%
NEPIRC Drivers		$74,095	$77,888	0.5%
NEPIRC Region Manufacturing Average		$83,963	$101,639	1.9%

Source: Moody's Economy.com

Impact and Return From the NEPIRC

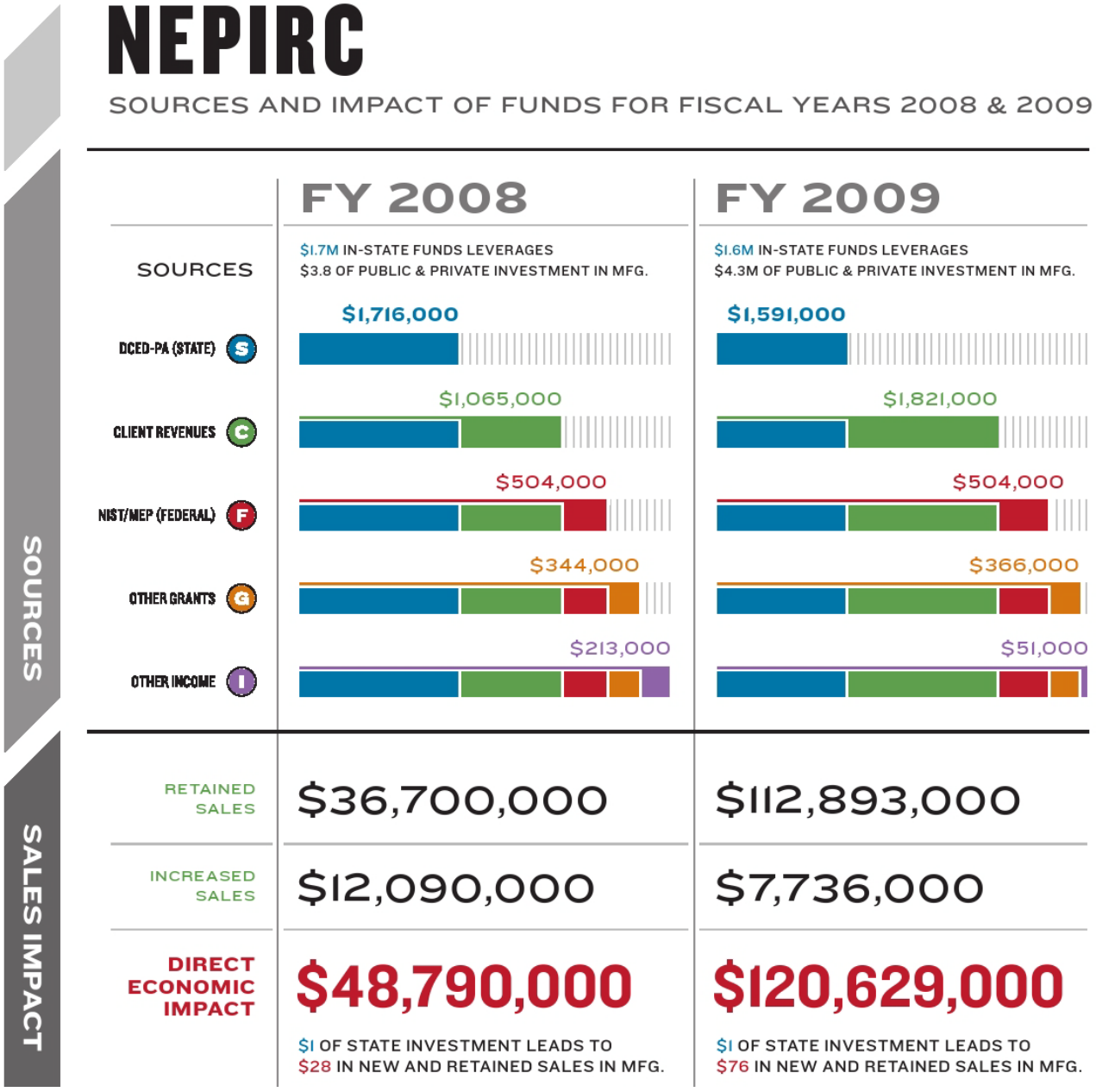
For this analysis, three years of IRC financial data was analyzed by region (FY2008, FY2009, and FY2010). All sources of income were identified. The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client service income. The client fee income is leveraged by the state and federal funding, which tends to have interconnected matching requirements.

To determine the economic impact of IRC activities, MEP survey data was analyzed by region. As part of the survey, manufacturing clients were asked to quantify new and retained sales and new and retained jobs attributable to the work of the IRCs. Funding sources were compared to the economic impact data from the survey. A one-year lag time in impact was assumed, meaning that, for example, FY2008 financial information was compared to FY2009 economic impact data. Two ratios were calculated to determine the economic impact of $1 of funding.

Analysis of IRC financial data reveals that every $1 of state investment in the NEPIRC in 2009 yielded $76 in new and retained sales in the manufacturing sector, as can be seen in the following graphic. The impact of investment in the NEPIRC for fiscal year 2009 was nearly $121 million in new and retained sales in manufacturing and 1,430 new and retained jobs. State cost per job created and retained in the region served by the NEPIRC was $1,113 in 2009.

NEPIRC

SOURCES AND IMPACT OF FUNDS FOR FISCAL YEARS 2008 & 2009



Delaware Valley Industrial Resource Center (DVIRC)

Located in Exton, the DVIRC serves nine counties in the Philadelphia metropolitan area – five in Pennsylvania and four in New Jersey. The service area consists of the following counties:

- Bucks
- Burlington (NJ)
- Camden (NJ)
- Chester
- Delaware
- Gloucester (NJ)
- Montgomery
- Philadelphia
- Salem (NJ)

The region served by the DVIRC is the only Pennsylvania region in which Manufacturing is not the No. 1 industry in terms of annual GSP. Yet, it is the region with the highest manufacturing GSP in the state.

Manufacturing ranks as the No. 3 industry in the region in terms of 2008 GSP and No. 4 in terms of employment. Generating more than $28 billion, Manufacturing accounts for roughly 10 percent of total regional GSP. Real Estate and Rental and Leasing accounted for nearly 16 percent of regional GSP in 2008, leading all other industries. The Professional, Scientific and Technical Services industry was similar in impact to Manufacturing, with slightly higher GSP and slightly lower employment. In terms of employment, the 195,894 jobs Manufacturing provided for in the region were eclipsed by the 375,229 employed Health Care and Social Assistance, 308,314 working in Public Administration and 267,813 engaged in Retail Trade.

As can be seen in the following table, Manufacturing shrank significantly over the past decade, at an average annual rate of 2.2 percent. Mining, which declined at a rate of 0.5 percent yearly, was the only other industry in the region to experience decade-long losses. Real Estate and Rental and Leasing grew by an annual rate of 2.6 percent from 1998 to 2008, and Professional, Scientific and Technical Services experienced an even greater pace of 4.1 percent.

GSP and Growth Rate by Industry for Region Served by DVIRC

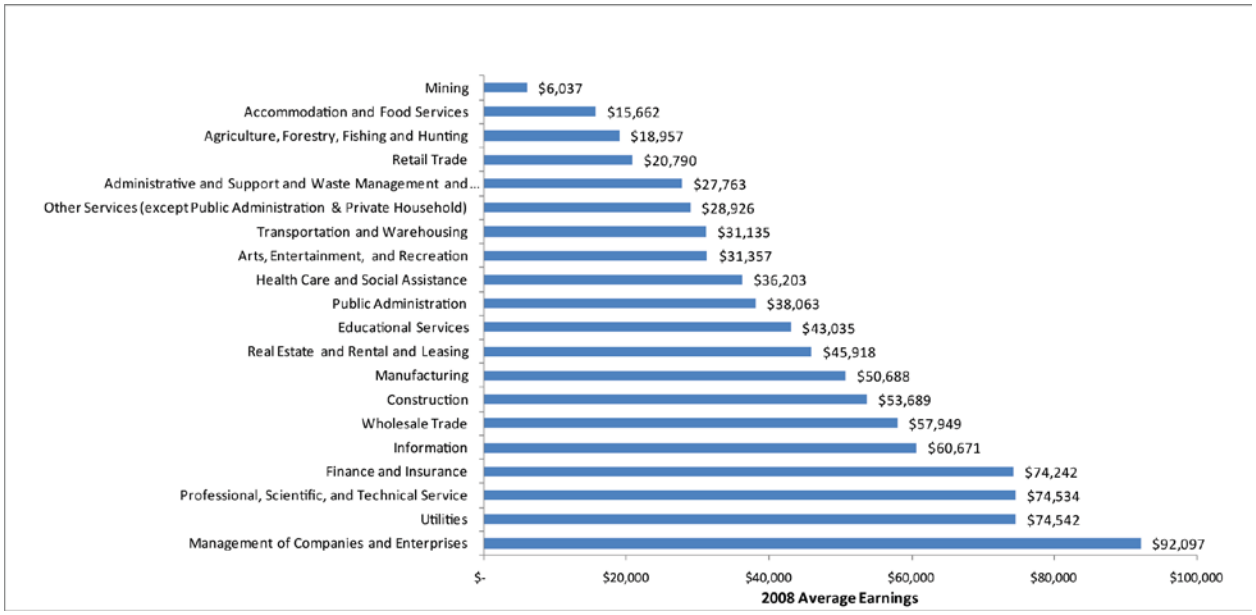
Industry	Employment 2008	GSP 2008 ($M)	05-08 CAGR	03-08 CAGR	98-08 CAGR	Industry GSP As a % of Regional GSP
Real Estate and Rental and Leasing	36,119	$44,793	3.2%	2.2%	2.6%	15.7%
Professional, Scientific, and Technical Service	191,974	$30,209	4.2%	4.9%	4.1%	10.6%
Manufacturing	**195,894**	**$28,168**	**-0.5%**	**-4.3%**	**-2.2%**	**9.9%**
Health Care and Social Assistance	375,229	$25,151	2.2%	2.6%	3.0%	8.8%
Public Administration	308,314	$24,397	-0.2%	0.7%	1.2%	8.5%
Finance and Insurance	140,634	$24,233	-1.4%	0.5%	1.7%	8.5%
Wholesale Trade	117,938	$19,208	0.5%	1.7%	1.7%	6.7%
Retail Trade	267,813	$15,980	-1.8%	-0.7%	0.5%	5.6%
Information	51,122	$11,248	3.0%	1.4%	1.9%	3.9%
Construction	95,565	$10,946	-5.1%	-0.8%	1.4%	3.8%
Administrative and Support and Waste Management and Remediation Services	141,973	$8,735	1.3%	0.5%	1.5%	3.1%
Transportation and Warehousing	75,227	$6,802	1.9%	2.7%	1.7%	2.4%
Utilities	7,915	$6,664	-0.5%	0.6%	1.4%	2.3%
Educational Services	118,060	$6,559	2.3%	2.8%	3.1%	2.3%
Management of Companies and Enterprises	44,996	$6,485	9.0%	12.7%	8.4%	2.3%
Other Services (except Public Administration & Private Household)	107,073	$6,295	0.1%	0.0%	1.2%	2.2%
Accommodation and Food Services	160,024	$5,569	1.9%	2.4%	2.3%	2.0%
Arts, Entertainment, and Recreation	36,159	$2,484	3.0%	2.1%	1.2%	0.9%
Agriculture, Forestry, Fishing and Hunting	13,056	$1,384	0.7%	2.6%	1.1%	0.5%
Mining	9,687	$267	-3.5%	1.8%	-0.5%	0.1%
	2,494,772	$285,579	1.1%	1.2%	1.7%	

Source: Moody's Economy.com

Note: CAGR represents Compound Annual Growth Rate.

Manufacturing paid very high average earnings in 2008, compared to other regions of Pennsylvania. At $50,688, annual manufacturing pay for the DVIRC is significantly greater than the $44,777 average pay for manufacturing work in the region served by NEPIRC, for example. However, manufacturing earnings in the Philadelphia area have decreased since 2003, ranking it No. 8 among regional industries. The 2004 study had ranked manufacturing pay as the fourth-highest among regional industries. High-paying professional services, such as Management of Companies and Enterprises; Professional, Scientific and Technical Services, Finance, and Information paid workers significantly more, on average, in 2008 than did Manufacturing.

Earnings by Industry for Region Served by DVIRC

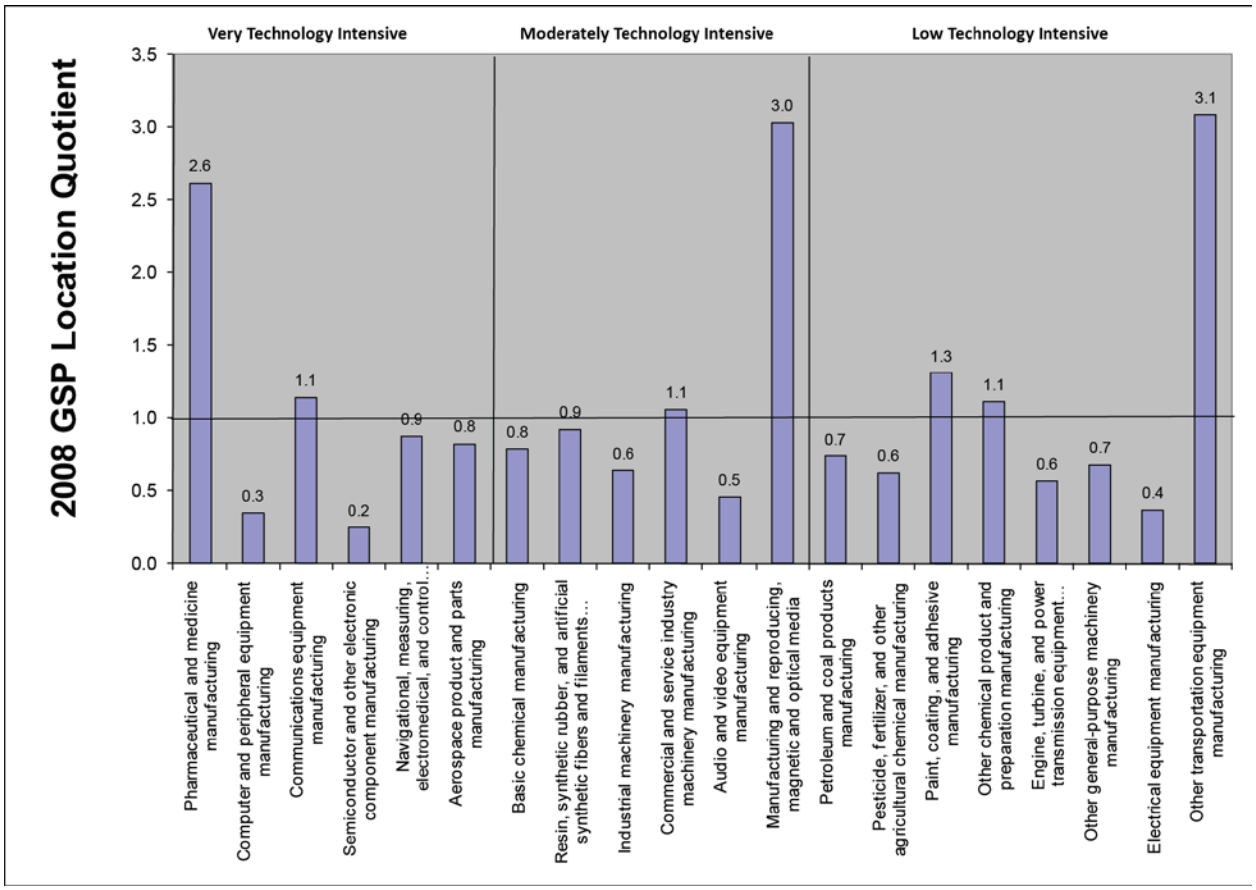


Pharmaceutical and Medical Manufacturing has maintained a competitive advantage in the region, with a GSP location quotient of 2.6. In addition to Pharmaceuticals, Communications Equipment Manufacturing and Navigational, Measuring, Electromedical and Control Instruments Manufacturing are two industries with very high technology intensity that have competitive potential in the region. Among moderately technologically intense industries, Manufacturing and Reproducing Magnetic and Optical Media is regionally competitive, with a GSP location quotient of 3, and Commercial and Service Industry Machinery Manufacturing has competitive potential, with a GSP location quotient of 1.1. Basic Chemical Manufacturing (LQ = 0.8) and the Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing (LQ = 0.9) are two other industries with moderate technology intensity with ties to Pharmaceuticals.

With a GSP location quotient of 3.1, Other Transportation Equipment Manufacturing is regionally competitive among industries with low technology intensity. Two regional industries related to chemical manufacturing are also competitive among this group:

- Paint, Coating, and Adhesive Manufacturing (LQ = 1.3)
- Other Chemical Product and Preparation Manufacturing (LQ = 1.1)

Technology Intensity Among Industries in Region Served by DVIRC



Employment in very technology intense manufacturing industries is higher in the region served by the DVIRC than in Pennsylvania overall and in benchmark states. The region also has a higher share of employment in service industries that are highly or moderately technologically intense. However, total employment in industries that are technologically intense is lower for the region than the state and nation overall. With 9.2 percent of workers employed in technologically intense industries, the region served by the DVIRC does have a slightly greater share of such jobs than do the peer states.

Comparing Employment in Technology-Intensive Industries

	DVIRC	Pennsylvania	Regional Peers*	United States
Total Technology Intensive Employment in Private Sector	9.2%	10.5%	8.6%	11.6%
Very Technology Intensive				
Very Technology Intensive Manufacturing	1.4%	1.1%	1.1%	1.5%
Very Technology Intensive Pipeline & Telecommunication	0.0%	0.0%	0.0%	0.1%
Very Technology Intensive Service	3.2%	2.6%	2.2%	2.8%
Moderate Technology Intensive				
Moderate Technology Intensive Manufacturing	0.4%	0.5%	0.3%	0.4%
Moderate Technology Intensive Others	0.2%	1.7%	1.5%	2.7%
Moderate Technology Intensive Service	1.3%	1.2%	0.9%	1.2%
Low Technology Intensive				
Low Technology Intensive Manufacturing	0.5%	0.7%	0.5%	0.6%
Low Technology Intensive Pipeline & Telecommunication	0.6%	0.7%	0.6%	0.7%
Low Technology Intensive Service	1.7%	2.1%	1.4%	1.6%
*The average of IN, KY, MA, MD, MI, NC, NJ, NY, OH, WV				

Source: Moody's Economy.com

Regional Driver Industries

Fourteen industries provide the economic engine for the region served by the DVIRC. These driver industries can be divided into four clusters: Manufacturing and Logistics; Financial; Education and Health Care; and Casinos.

Among the six drivers in the manufacturing and logistics cluster, four manufacturers have high and growing GSP. These are:

- Pharmaceutical and Medicine Manufacturing
- Iron and Steel Pipe and Tube Manufacturing from Purchased Steel
- Other Transportation Equipment Manufacturing
- Manufacturing and Reproducing Magnetic and Optical Media

These industries also capture a large portion of the regional employment base. All four drivers claim a significant share of the U.S. industry. Other than Pharmaceutical, these industries have high and growing productivity.

Besides high productivity, industries in the financial cluster pay already high and rising earnings compared to the U.S. average. Industries of the education and health-care cluster capture a large portion of the region's employment base. The Casinos industry experienced rapid GSP growth from 2005 to 2008, averaging 54.7 percent annually.

Driver Industries for the Region Served by the DVIRC

NAICS	Industry Name	2008 GSP ($000)	2005-08 GSP CAGR	2003-08 GSP CAGR	1998-2008 GSP CAGR	2008 GSP Location Quotient	2002-08 Change in LQ
	Manufacturing and Logistics						
3254	Pharmaceutical and Medicine Manufacturing	$5,637,873	0.9%	-8.8%	-1.5%	2.64	-2.92
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$436,035	12.8%	16.9%	7.1%	2.44	0.85
3369	Other Transportation Equipment Manufacturing	$255,975	16.4%	11.2%	6.4%	3.12	1.44
3346	Manufacturing and Reproducing Magnetic and Optical Media	$188,661	2.5%	2.5%	-3.3%	3.06	1.23
4889	Other Support Activities for Transportation	$46,374	6.1%	17.8%	16.3%	1.18	0.66
4922	Local Messengers and Local Delivery	$44,600	9.5%	15.1%	39.3%	0.89	0.52
	Financial Sectors						
5259	Open-End Investment Funds	$1,425,461	-15.0%	-3.8%	4.7%	7.18	0.87
5331	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	$388,036	25.0%	17.2%	6.6%	1.50	0.76
5251	Pension Funds	$378,364	-9.2%	-2.9%	-3.9%	2.97	0.13
	Education and Health Care						
6113	Colleges, Universities, and Professional Schools	$4,531,166	1.5%	2.1%	2.2%	2.90	0.05
6223	Specialty (except Psychiatric and Substance Abuse) Hospitals	$1,029,222	6.5%	7.4%	5.8%	4.54	1.06
5612	Facilities Support Services	$186,934	13.1%	22.5%	10.4%	0.91	0.48
6112	Junior Colleges	$55,281	17.3%	12.9%	3.3%	1.93	0.82
	Casinos						
7132	Casinos (except Casino Hotels)	$84,359	54.7%	33.2%	10.7%	0.36	0.26

Source: Moody's Economy.com

Three manufacturing drivers had high 2008 GSP location quotient and positive GSP growth from 2003 to 2008:

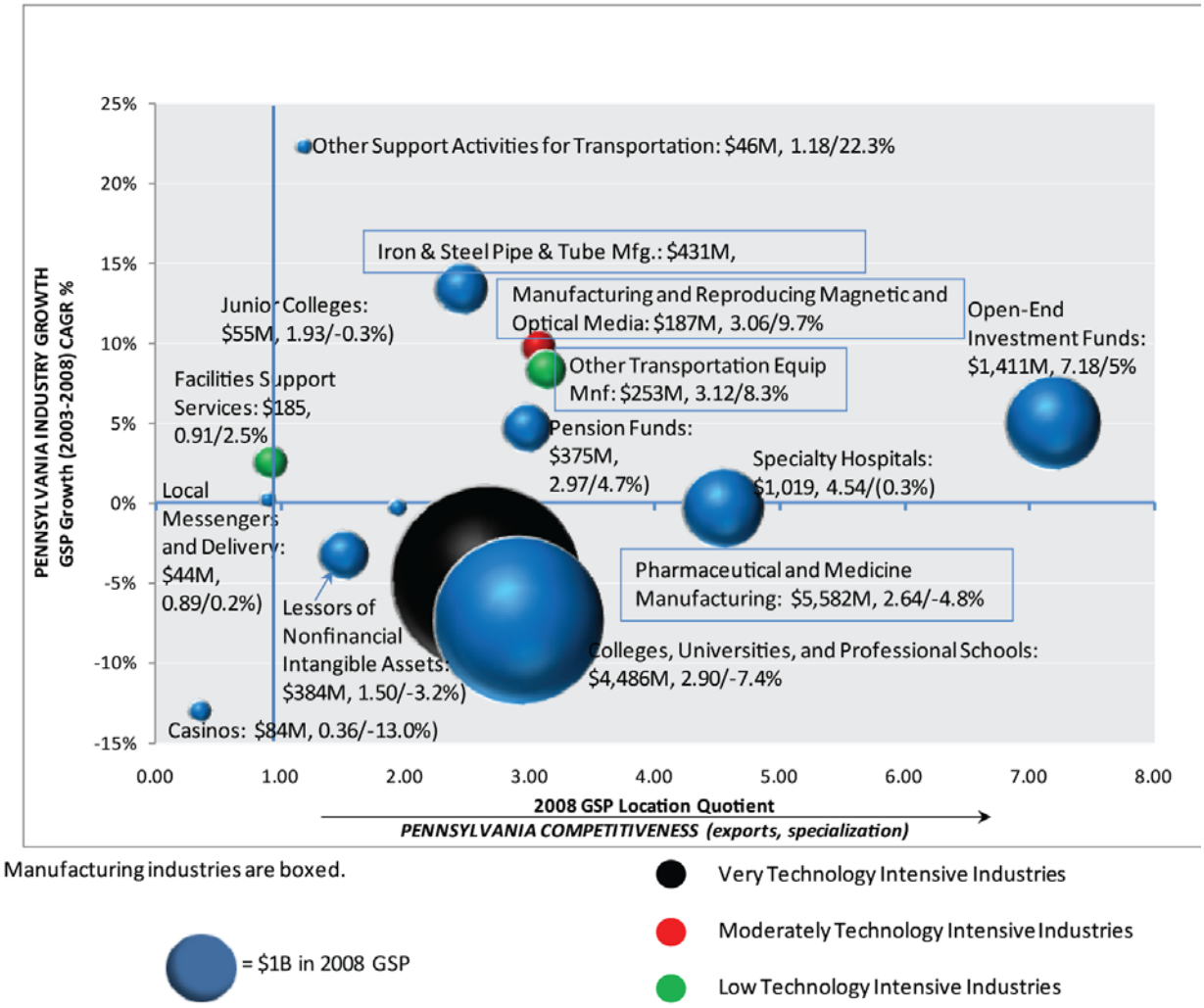
- Iron and Steel Pipe and Tube Manufacturing from Purchased Steel (LQ = 2.4; GSP growth, 13.4%)
- Manufacturing and Reproducing Magnetic and Optical Media (LQ = 3.1; GSP growth, 9.7%)
- Other Transportation Equipment Manufacturing (LQ = 3.1; GSP growth, 8.3%)

Two industries from the financial cluster had similar indicators:

- Pension Funds (LQ = 3.0; GSP growth, 4.7%)
- Open-End Investment Funds (LQ = 7.2; GSP growth, 5%)

As can be seen in the following figure, only one regional driver − Pharmaceutical and Medicine Manufacturing − is an industry with high technological intensity. Manufacturing and Reproducing Magnetic and Optical Media (LQ = 3.1) is a driver industry with moderate technological intensity, and Other Transportation Equipment Manufacturing (LQ = 3.1) and Facilities Support Services (LQ = 0.9) are driver industries with low technology intensity.

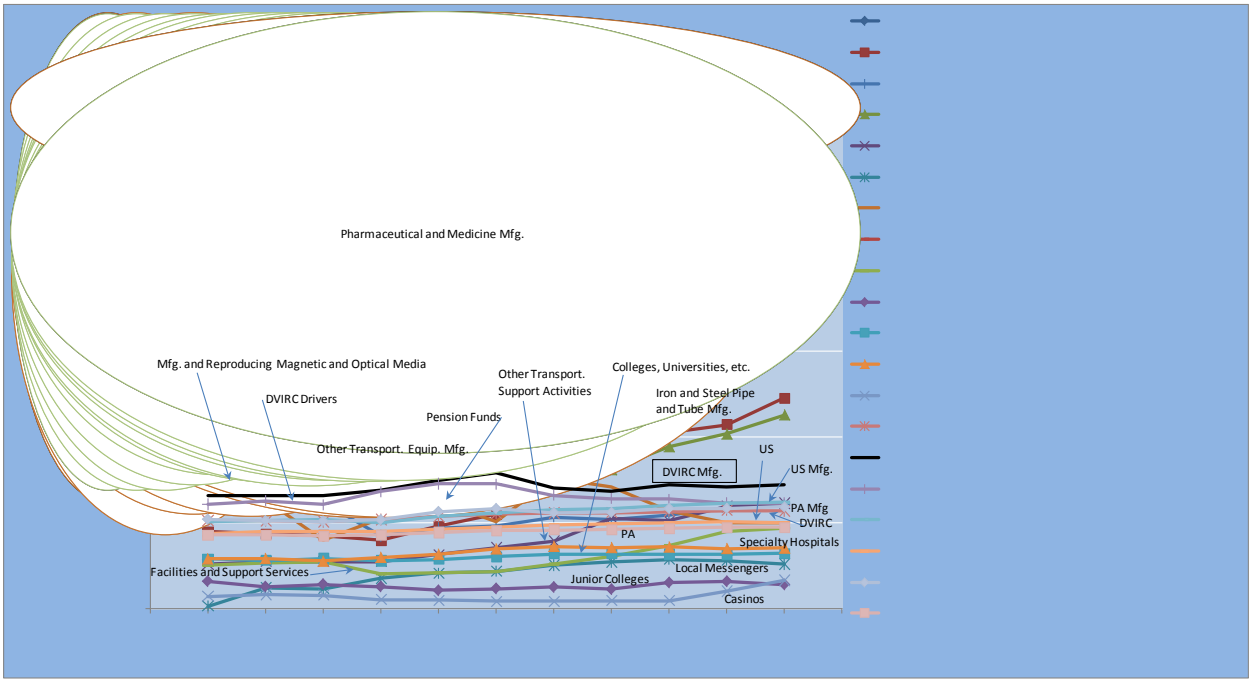
Technology Intensity of Driver Industries



The Open-End Investment Funds industry had the highest productivity among regional drivers in 2008, at more than $3.1 trillion. As an outlier among the drivers, it was excluded from the following figure depicting industry productivity.

Productivity levels for eight of the 14 regional drivers exceeded the Pennsylvania average for GSP per employee in 2008. All four regional manufacturing drivers surpassed the state average for manufacturing productivity in 2008, and all but Manufacturing and Reproducing Magnetic and Optical Media exceeded the U.S. manufacturing average.

Productivity by Regional Driver Industry



Although GSP per employee for Pharmaceutical and Medicine Manufacturing was far above the U.S. average for manufacturing, the $322,127 achieved in 2008 was actually lower than productivity levels for the regional industry in 1998. Productivity for the regional driver declined, on average, 1.5 percent annually over the decade studied. Manufacturing and Reproducing Magnetic and Optical Media saw even greater rates of productivity decline, averaging 3.3 percent annually from 1998 to 2008. Pension Funds was the only other regional driver that experienced productivity losses over the 10-year period. All other drivers of the regional economy achieved productivity gains over the study period, with most vastly outpacing the national average.

Average Annual Change in Productivity by Regional Driver

NAICS	Industry Name	1998	2008	1998-2008 Productivity CAGR
	Manufacturing and Logistics			
3254	Pharmaceutical and Medicine Manufacturing	$352,380	$322,127	-0.9%
3312	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	$89,309	$244,964	10.6%
3369	Other Transportation Equipment Manufacturing	$123,108	$225,330	6.2%
4889	Other Support Activities for Transportation	$51,516	$122,682	9.1%
3346	Manufacturing and Reproducing Magnetic and Optical Media	$146,789	$121,092	-1.9%
4922	Local Messengers and Local Delivery	$3,397	$52,164	31.4%
	Financial Sectors			
5259	Open-End Investment Funds	$1,370,330	$3,112,361	8.5%
5331	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	$182,237	$581,764	12.3%
5251	Pension Funds	$118,641	$99,806	-1.7%
	Education and Health Care			
5612	Facilities Support Services	$51,178	$93,327	6.2%
6223	Specialty (except Psychiatric and Substance Abuse) Hospitals	$58,157	$70,611	2.0%
6113	Colleges, Universities, and Professional Schools	$57,771	$64,183	1.1%
6112	Junior Colleges	$31,777	$28,004	-1.3%
	Casinos			
7132	Casinos (except Casino Hotels)	$14,592	$33,108	8.5%
U.S. Average		$87,891	$100,495	1.3%
U.S. Manufacturing		$101,530	$123,614	2.0%
PA Average		$85,648	$94,381	1.0%
PA Manufacturing		$104,038	$118,485	1.3%
All DVIRC		$102,406	$114,063	1.1%
DVIRC Drivers		$121,533	$122,583	0.1%
DVIRC Region Mfg. Average		$131,427	$143,806	0.9%

Source: Moody's Economy.com

Impact and Return From the DVIRC

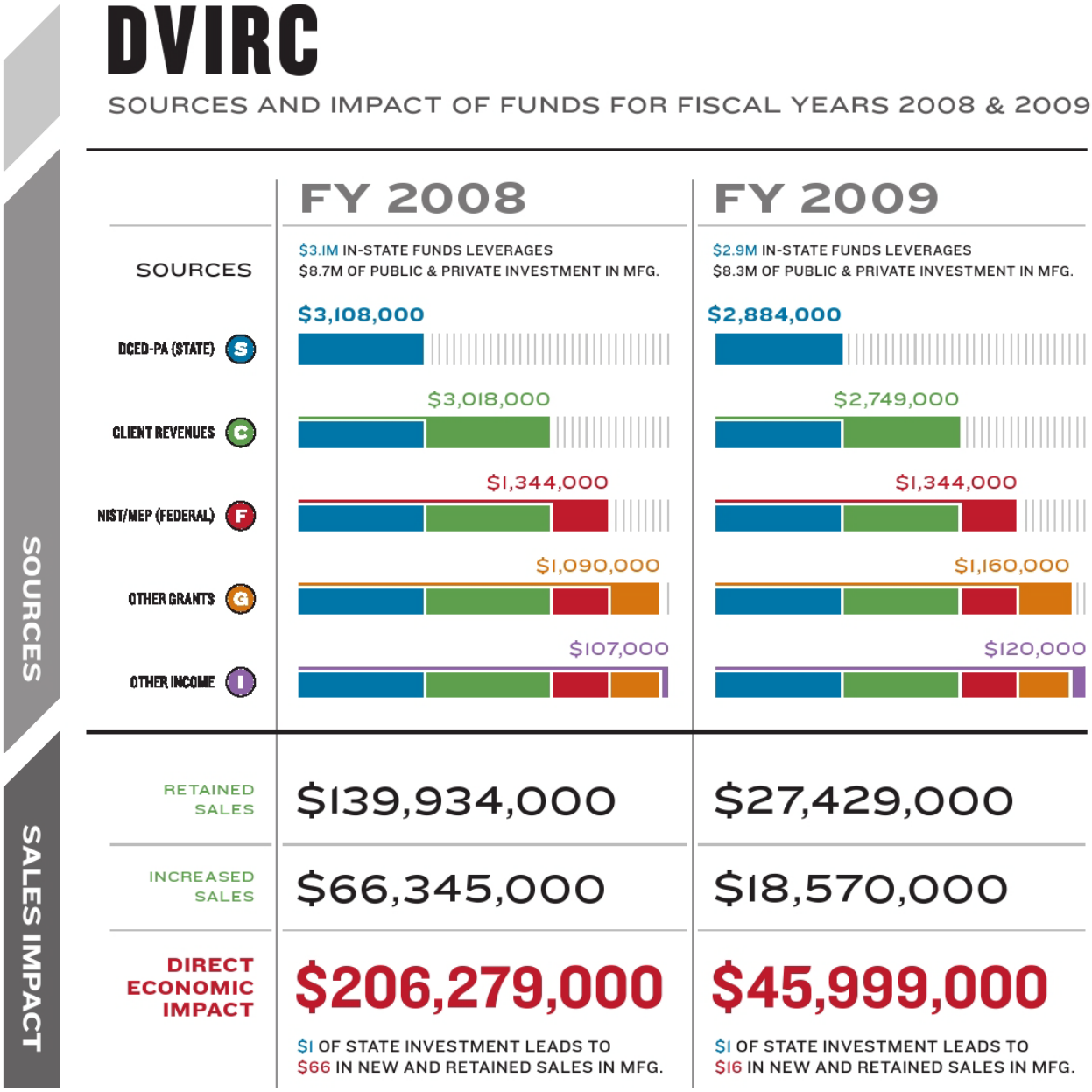
For this analysis, three years of IRC financial data was analyzed by region (FY2008, FY2009, and FY2010). All sources of income were identified. The IRC program has three primary sources of revenue: PA-DCED (state) grants, National Institute of Standards and Technology Manufacturing Extension Partnership (federal) grants, and client service income. The client fee income is leveraged by the state and federal funding, which tends to have interconnected matching requirements.

To determine the economic impact of IRC activities, MEP survey data was analyzed by region. As part of the survey, manufacturing clients were asked to quantify new and retained sales and new and retained jobs attributable to the work of the IRCs. Funding sources were compared to the economic impact data from the survey. A one-year lag time in impact was assumed, meaning that, for example, FY2008 financial information was compared to FY2009 economic impact data. Two ratios were calculated to determine the economic impact of $1 of funding.

Analysis of IRC financial data reveals that every $1 of state investment in the DVIRC in 2008 yielded $66 in new and retained sales in the manufacturing sector. As can be seen in the following graphic, direct economic impact was down dramatically in 2009, following a reduction in state funding. The impact of investment in the DVIRC for fiscal year 2008 was more than $206 million in new and retained sales in manufacturing and 930 new and retained jobs. State cost per job created and retained in the region served by the DVIRC was $3,098 in 2009.

DVIRC

SOURCES AND IMPACT OF FUNDS FOR FISCAL YEARS 2008 & 2009



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APPENDIX

APPENDIX A: Classification of Technologically-Intensive Industries

Technological Intensity	Industry	Tech Intensity Level (1-3)	NAICS	NAICS Description
Very Technologically Intensive	Manufacturing	1	3254	Pharmaceutical and medicine manufacturing
		1	3341	Computer and peripheral equipment manufacturing
		1	3342	Communications equipment manufacturing
		1	3344	Semiconductor and other electronic component manufacturing
		1	3345	Navigational, measuring, electromedical, and control instruments manufacturing
		1	3364	Aerospace product and parts manufacturing
	Pipeline & Telecommunication	1	5179	Other telecommunications
	Service	1	5112	Software publishers
		1	5182	Data processing, hosting, and related services
		1	5413	Architectural, engineering, and related services
		1	5415	Computer systems design and related services
		1	5417	Scientific research-and-development services
Moderately Technologically Intensive	Manufacturing	2	3251	Basic chemical manufacturing
		2	3252	Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing
		2	3332	Industrial machinery manufacturing
		2	3333	Commercial and service industry machinery manufacturing
		2	3343	Audio and video equipment manufacturing
		2	3346	Manufacturing and reproducing magnetic and optical media
	Others	2	1131	Forestry
		2	1132	Forestry
		2	2111	Oil and gas extraction
		2	2211	Electric power generation, transmission, and distribution
	Service	2	4234	Professional and commercial equipment and supplies, merchant wholesalers
		2	5416	Management, scientific, and technical consulting services
Low Technologically Intensive	Manufacturing	3	3241	Petroleum and coal products manufacturing
		3	3253	Pesticide, fertilizer, and other agricultural chemical manufacturing
		3	3255	Paint, coating, and adhesive manufacturing
		3	3259	Other chemical product and preparation manufacturing
		3	3336	Engine, turbine, and power transmission equipment manufacturing
		3	3339	Other general-purpose machinery manufacturing
		3	3353	Electrical equipment manufacturing
		3	3369	Other transportation equipment manufacturing
	Pipeline & Telecommunication	3	4861	Pipeline transportation of crude oil
		3	4862	Pipeline transportation of natural gas
		3	4869	Other pipeline transportation
		3	5171	Wired telecommunications carriers
		3	5172	Wireless telecommunications carriers (except satellite)
		3	5174	Satellite telecommunications
	Service	3	5211	Monetary authorities, central bank
		3	5232	Securities and commodity exchanges
		3	5511	Management of companies and enterprises
		3	5612	Facilities support services
		3	8112	Electronic and precision equipment repair and maintenance

Note: NAICS 5191 -Libraries & archives is excluded from the high-tech industries list due to a change of NAICS definition.

APPENDIX B: State and Local Tax Impact of Increased Sales in Companies Served by IRCs

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations	Total
Dividends					$2,701,752	$2,701,752
Social Ins. Tax: Employee Contribution	$80,167	$0				$80,167
Social Ins. Tax: Employer Contribution	$344,907					$344,907
Indirect Bus. Tax: Sales Tax			$8,179,733			$8,179,733
Indirect Bus. Tax: Property Tax			$8,628,660			$8,628,660
Indirect Bus. Tax: Motor Vehicle Lic			$179,479			$179,479
Indirect Bus. Tax: Severance Tax			$0			$0
Indirect Bus.Tax: Other Taxes			$2,524,171			$2,524,171
Indirect Bus. Tax: S/L NonTaxes			$566,407			$566,407
Corporate Profits Tax					$1,804,537	$1,804,537
Personal Tax: Income Tax				$4,849,002		$4,849,002
Personal Tax: Non-Taxes (Fines- Fees)				$708,820		$708,820
Personal Tax: Motor Vehicle License				$231,602		$231,602
Personal Tax: Property Taxes				$112,066		$112,066
Personal Tax: Other Tax (Fish/Hunt)				$109,290		$109,290
Total State and Local Tax	**$425,074**	**$0**	**$20,078,450**	**$6,010,779**	**$4,506,290**	**$31,020,593**

APPENDIX C: State and Local Tax Impact of Federal Investment in IRC Operations

Description	Employee Compensation	Proprietor Income	Indirect Business Tax	Households	Corporations	Total
Dividends					$29,897	$29,897
Social Ins. Tax: Employee Contribution	$1,701	$0				$1,701
Social Ins. Tax: Employer Contribution	$7,317					$7,317
Indirect Bus. Tax: Sales Tax			$124,824			$124,824
Indirect Bus. Tax: Property Tax			$131,675			$131,675
Indirect Bus. Tax: Motor Vehicle Lic			$2,739			$2,739
Indirect Bus. Tax: Severance Tax			$0			$0
Indirect Bus.Tax: Other Taxes			$38,519			$38,519
Indirect Bus. Tax: S/L NonTaxes			$8,643			$8,643
Corporate Profits Tax					$19,968	$19,968
Personal Tax: Income Tax				$112,725		$112,725
Personal Tax: Non-Taxes (Fines- Fees)				$16,478		$16,478
Personal Tax: Motor Vehicle License				$5,384		$5,384
Personal Tax: Property Taxes				$2,605		$2,605
Personal Tax: Other Tax (Fish/Hunt)				$2,541		$2,541
Total State and Local Tax	**$9,018**	**$0**	**$306,400**	**$139,733**	**$49,865**	**$505,016**

APPENDIX D: Pennsylvania's Top 10 Industry Multipliers

The following four tables detail the Pennsylvania industries that saw the greatest increases in added value due to direct and indirect effects stemming from increased sales and employment among companies that received IRC services. As can be seen, several of the industries appear on all three top 10 lists. Toilet preparation manufacturing, for example, topped all three lists, growing total value added to more than $79 million, experiencing output of nearly $332 million, adding 402 jobs and increasing labor income by nearly $26 million. Direct and indirect effects from increased sales and employment of companies that used IRC services also boosted management of companies and enterprises to nearly $27 million in value-added, nearly $41 million in GSP and by nearly 160 jobs. The wholesale trade business saw similar value-added and GSP numbers, and gained nearly 200 jobs. Three other manufacturing industries appeared on all four lists: ball and roller bearing manufacturing, machine shops, and unlaminated plastics profile shape manufacturing. Combined, they accounted for more than $30 million in value added, roughly $73 million in total GSP, 282 jobs and nearly $19 million in labor income. Other plastics product manufacturing also appeared among the industries that saw the greatest increases in labor income – nearly $4 million – due to direct and indirect effects from increases sales among companies receiving IRC services. Other industries that support manufacturing also appeared among the industries most benefiting from the effects of IRC services. These included scientific research and development services, management of companies and enterprises, electric power generation, transmission and distribution, and employment services.

Top 10 Industries in Terms of Value Added Affected by Increased Sales of Companies

Description	Total Employment	Total Labor Income	Total Value Added	Total Output
Toilet Preparation Manufacturing	402	$25,563,381	$79,039,732	$331,895,939
Management of Companies and Enterprises	159	$19,892,741	$26,617,249	$40,979,061
Wholesale Trade Businesses	196	$15,467,593	$26,520,285	$40,701,346
Imputed Rental Activity for Owner-Occupied Dwellings	0	$0	$14,088,261	$20,799,695
Real Estate Establishments	88	$2,626,571	$12,359,033	$15,836,881
Ball and Roller Bearing Manufacturing	76	$5,777,272	$11,799,737	$27,000,361
Machine Shops	117	$7,413,892	$9,704,785	$21,999,487
Unlaminated Plastics Profile Shape Manufacturing	89	$5,572,133	$9,057,520	$23,927,102
Scientific Research and Development Services	81	$8,726,997	$7,705,830	$13,163,059
Electric Power Generation, Transmission, and Distribution	9	$1,988,521	$7,259,307	$9,827,130

Top 10 Industries in Terms of Output Affected by Increased Sales of Companies

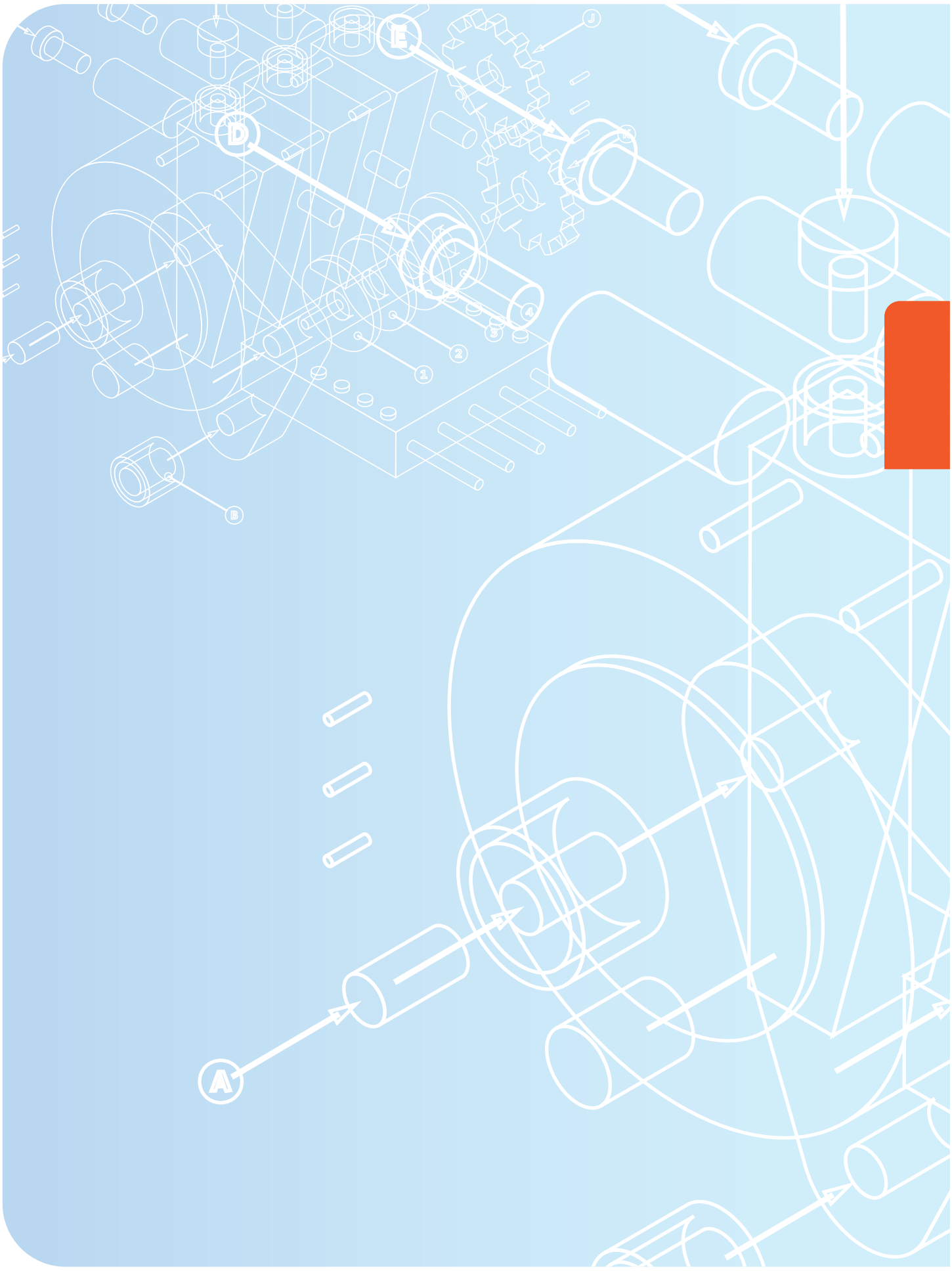
Description	Total Employment	Total Labor Income	Total Value Added	Total Output
Toilet Preparation Manufacturing	402	$25,563,380	$79,039,732	$331,895,939
Management of Companies and Enterprises	159	$19,892,741	$26,617,249	$40,979,061
Wholesale Trade Businesses	196	$15,467,593	$26,520,285	$40,701,346
Ball and Roller Bearing Manufacturing	76	$5,777,272	$11,799,737	$27,000,360
Unlaminated Plastics Profile Shape Manufacturing	89	$5,572,133	$9,057,520	$23,927,102
All Other Forging, Stamping, and Sintering	65	$3,576,528	$4,820,506	$23,034,494
Machine Shops	117	$7,413,892	$9,704,785	$21,999,487
Imputed Rental Activity for Owner-Occupied Dwellings	0	$0	$14,088,261	$20,799,695
Other Plastics Product Manufacturing	97	$3,867,808	$5,682,337	$16,333,487
Real Estate Establishments	88	$2,626,570	$12,359,033	$15,836,881

Top 10 Industries in Terms of Employment Affected by Increased Sales of Companies

Description	Total Employment	Total Labor Income	Total Value Added	Total Output
Toilet Preparation Manufacturing	402	$25,563,381	$79,039,732	$331,895,939
Wholesale Trade Businesses	196	$15,467,593	$26,520,285	$40,701,346
Food Services and Drinking Places	168	$3,200,142	$4,704,557	$9,162,484
Management of Companies and Enterprises	159	$19,892,741	$26,617,249	$40,979,061
Machine Shops	117	$7,413,892	$9,704,785	$21,999,487
Other Plastics Product Manufacturing	97	$3,867,808	$5,682,337	$16,333,487
Unlaminated Plastics Profile Shape Manufacturing	89	$5,572,133	$9,057,520	$23,927,102
Real Estate Establishments	88	$2,626,571	$12,359,033	$15,836,881
Scientific Research and Development Services	81	$8,726,997	$7,705,830	$13,163,059
Employment Services	79	$2,406,602	$2,597,264	$3,293,577

Top 10 Industries in Terms of Labor Income Affected by Increased Sales of Companies

Description	Total Employment	Total Labor Income	Total Value Added	Total Output
Toilet Preparation Manufacturing	402	$25,563,381	$79,039,732	$331,895,939
Management of Companies and Enterprises	159	$19,892,741	$26,617,249	$40,979,061
Wholesale Trade Businesses	196	$15,467,593	$26,520,285	$40,701,346
Scientific Research and Development Services	81	$8,726,997	$7,705,830	$13,163,059
Machine Shops	117	$7,413,892	$9,704,785	$21,999,487
Ball and Roller Bearing Manufacturing	76	$5,777,272	$11,799,737	$27,000,361
Unlaminated Plastics Profile Shape Manufacturing	89	$5,572,133	$9,057,520	$23,927,102
Offices of Physicians, Dentists, and Other Health Practitioners	68	$5,268,644	$6,114,380	$8,692,559
Private Hospitals	79	$4,891,112	$5,136,177	$9,582,175
Other Plastics Product Manufacturing	97	$3,867,808	$5,682,337	$16,333,487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