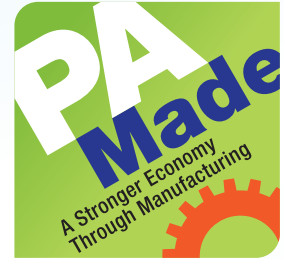

Pennsylvania's True Commonwealth

The State of Manufacturing

Challenges and Opportunities

Executive Summary



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Pennsylvania's Industrial Resource Centers (IRCs)

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

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 mid-sized manufacturing companies adapt and prosper in the face of ever-quicken 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 strategies for shoring up this vital segment of

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.

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%

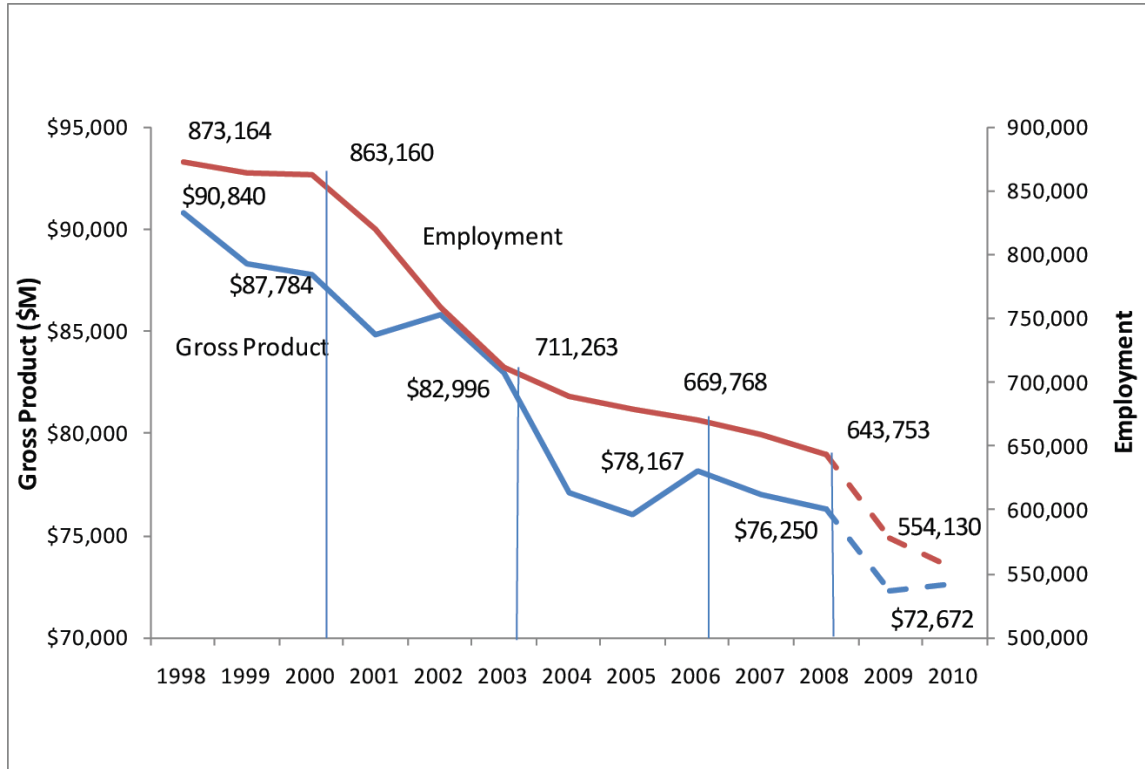
Source: Moody's Economy.com

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.

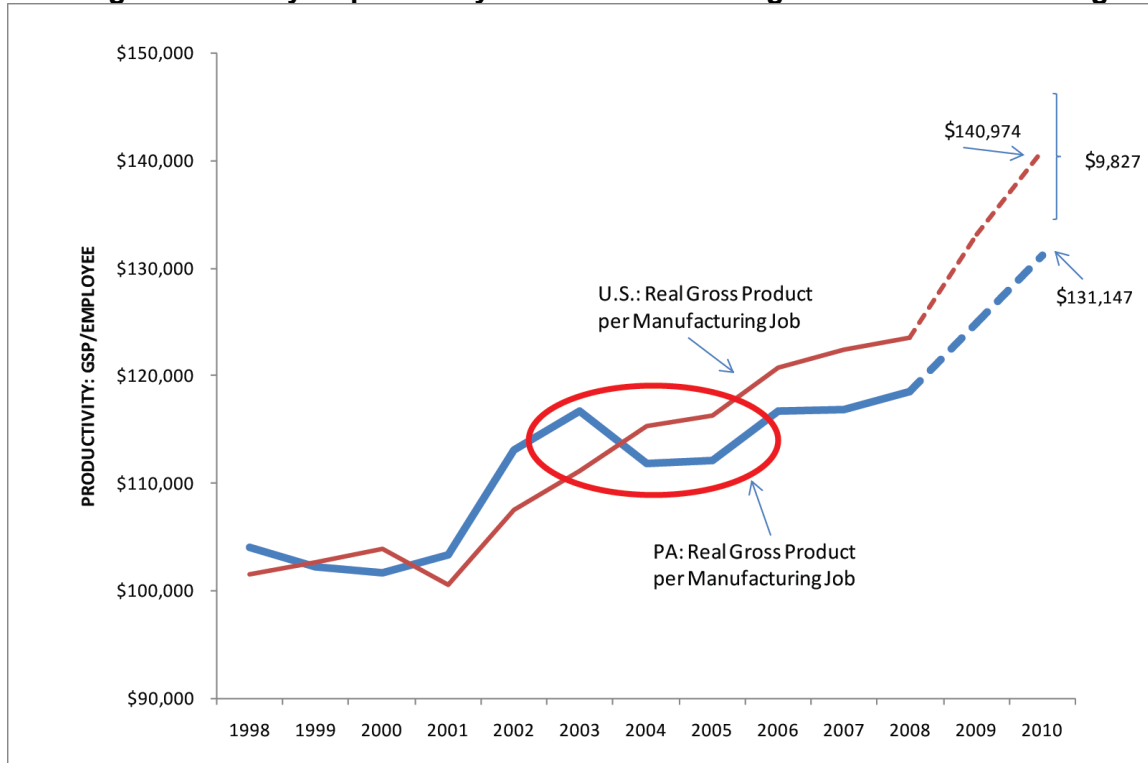
The best of Pennsylvania's manufacturers fight commoditization each and every day and understand that improving productivity is management's job through product innovation. Despite the challenging environment, focus group participants spoke of opportunity. They are developing new products, offering new 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:

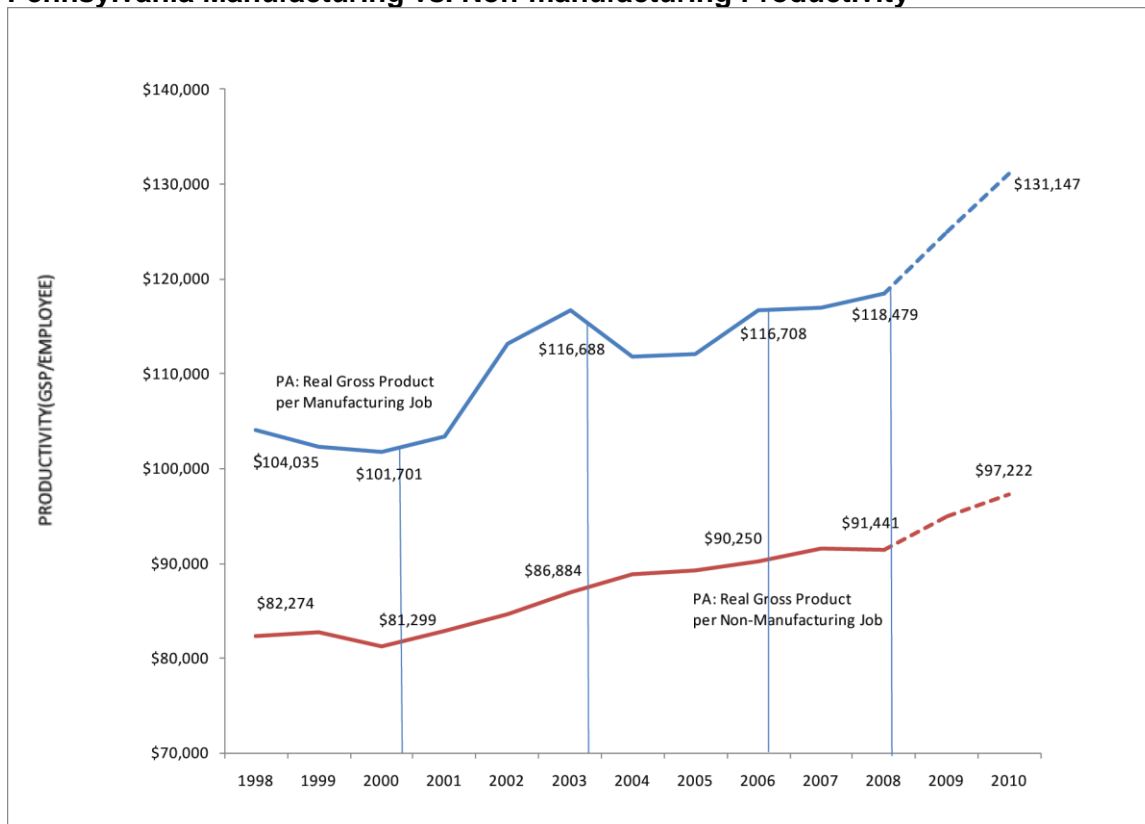
- NAICS 3254 Pharmaceutical and Medicine Manufacturing: -\$3.8 billion
- NAICS 3251 Petrochemical Manufacturing: -\$2.4 billion
- NAICS 3252 Resin and Synthetic Rubber Manufacturing: -\$948 million
- NAICS 3241 Petroleum and Coal Products Manufacturing: -\$868 million
- NAICS 3259 Other Chemical Product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

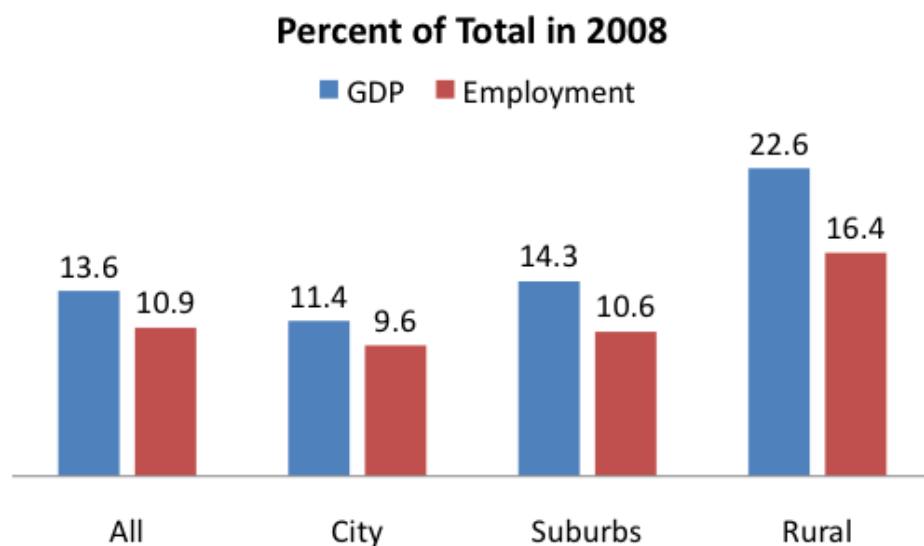
The Geography of Pennsylvania’s Manufacturing

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 mid-sized 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 mid-sized 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 mid-sized 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 mid-sized 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 mid-sized 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

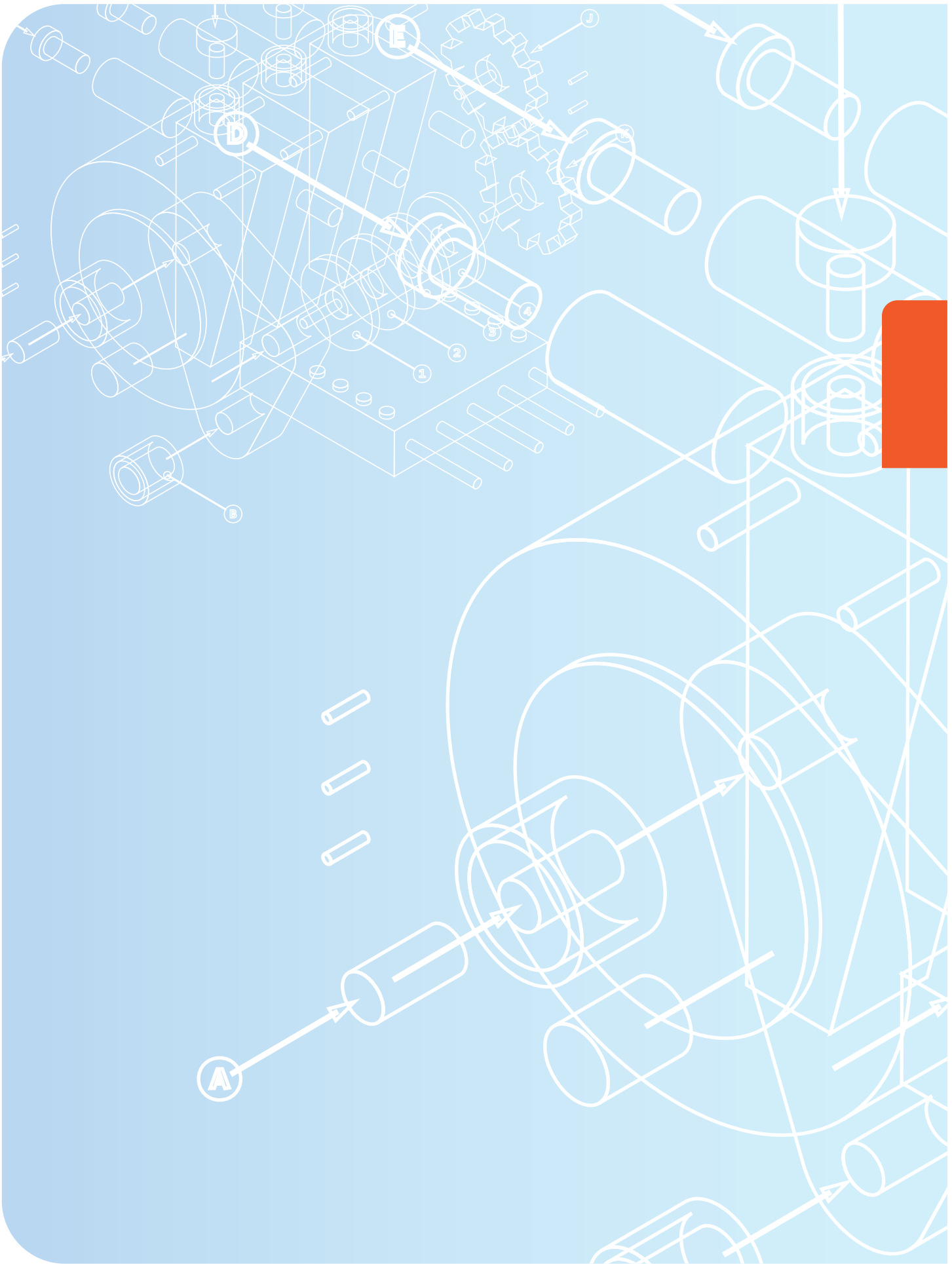
Pennsylvania's manufacturing sector is central to the state's economy. It is the largest sector in terms of the generation of Gross State Product; it is the state's fourth-largest source of jobs; it has the highest productivity of any sector; and it has the highest employment, income, and value added 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.



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