

A Call To Action

West Virginia Could Have a More
Competitive Manufacturing Future –
But Only If We Act Now



The West Virginia Manufacturers Association
September 2017

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This report uses *A New Blueprint-Making the American South's Manufacturing Sector More Competitive by 2030* as its foundation and includes verbatim or slightly edited language throughout. The document customizes the recommendations for the West Virginia Manufacturers Association and refines and updates the index data.

Both documents were researched and written by Ted Abernathy of Economic Leadership of Raleigh, North Carolina. This report includes contributions from Rebecca R. McPhail, President of the West Virginia Manufacturers Association.



Introduction

We live in challenging times, for our country and our state. The things that need to be done to prepare West Virginia’s people and places for the future are daunting, and at times can seem overwhelming, but we love our state and we believe an even brighter future is possible, if we act now.

Over the past half-century, across West Virginia, children watched their parents and grandparents get up each day and go to work in our state’s factories. They made the things that built prosperity and supported families. West Virginia manufacturing plants were the source of community wealth and pride. Today, West Virginians face rapid change and rising anxiety.

The West Virginia Manufacturers Association understands the challenge, and that hard choices must be made. We have looked closely at future trends and current data, and we believe that improving our state’s manufacturing competitiveness is a strategic choice that will yield benefits to the whole state. We believe that we can learn from the best practices and the best research, and can shape thoughtful, intentional strategies that will work. Alan Kay’s quote, “[The best way to predict the future is to invent it](#)” is our guide. To be more competitive, to attract new manufacturing jobs and new investment, we need work together and invent a new West Virginia manufacturing future.

Manufacturing has always been important to America. Last year, according to the National Association of Manufacturers, it contributed almost \$2.2 trillion to the United States economy. It is more important to the future than ever before. Global competition and rapid technological transformation have

“Manufacturing is the seed corn for other jobs in the U.S.”

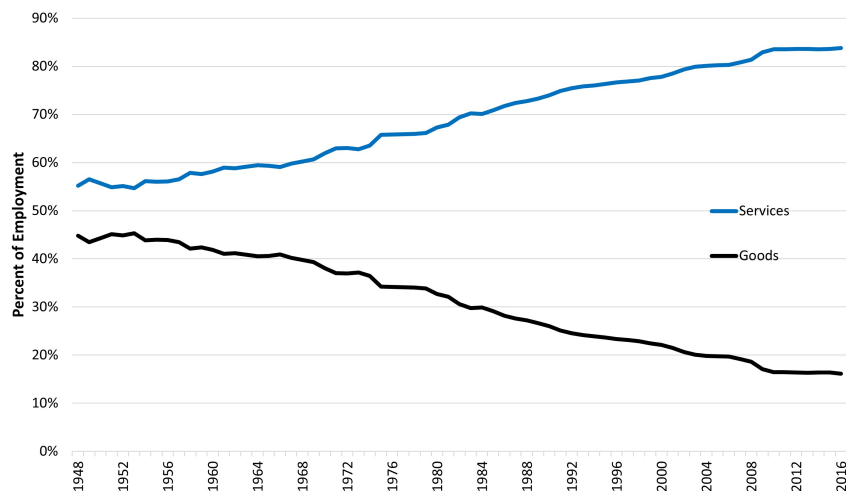
Peter Navarro

“American manufacturing was the bedrock of a century of American prosperity and security.”

Make: An American Manufacturing Movement

The Council on Competitiveness and the U.S. Manufacturing Competitiveness Initiative

Private Sector Employment 1948-2016



Source: US Bureau of Labor Statistics

created new headwinds for state policy makers and elected officials as they struggle to support future manufacturing.

As service-sector jobs have grown, manufacturing employment has declined and traditional industries have been replaced with new advanced industry clusters. If West Virginia wants to be the home of globally competitive manufacturing, continuous competitive analysis and, most importantly, new thinking is needed.



Our image of a manufacturing plant and a typical manufacturing worker must change. **In the future, a typical West Virginia manufacturer will have more highly skilled workers, more sophisticated automation, require more advanced infrastructure, and depend on new innovations and new markets to succeed.** Things that are not yet conceived of will be produced in places that cannot currently compete. Some places will emerge as the best destination for manufacturing and other places will see manufacturing jobs disappear. At the West Virginia Manufacturers Association, we understand that West Virginia policy makers must be aggressive and make changes and investments to improve the state's manufacturing competitiveness, if we expect to successfully compete in the years to come.

In 2013, the Foundation for the American South at the Southern Governors Association (SGA) began exploring possibilities for developing a new regional manufacturing strategy. The project focused on data collection and analysis, and collaboration, and included:

- Creating a discussion and collaboration group of the region's manufacturing leaders to identify priorities and concerns;
- A deep data dive assessing manufacturing in the American South;
- The release and promotion of Innovation U 2.0, a compilation of university best practices for instigating technological innovation, entrepreneurship and business partnerships;
- Development of information demonstrating the importance of R&D to the continued success of manufacturing sub-sectors, particularly small and medium sized businesses;
- Development of a "Southern Regional Manufacturing Index" to aggregate complex data and allow multi-factor competitive analysis by individual state leaders; and

- A literature review to inform the development of a set of best practice recommendations in key areas to improve manufacturing competitiveness.

The Southern Governors' 2013 Annual Report, *Advanced Manufacturing in the American South*, states that, "The starting point for an acceleration of advanced manufacturing development should be a strategic plan." Today, policy deliberations are not just held in Governors' offices or the committee rooms of legislatures, but happen today in a changing idea landscape. Policy think-tanks, and business groups like the West Virginia's Manufacturers Association are more active and sophisticated at contributing ideas and promoting change. This new approach is neither top-down, nor is it traditional grass roots, but rather a networked approach of thinkers and doers across sectors that are seizing the opportunity to collaborate and address a need.

Just as many reports recognize that manufacturing products and processes have changed, so must our strategic approach to policy. This document for West Virginia borrows from and builds on, *A New Blueprint- Making the American South's Manufacturing Sector More Competitive by 2030*, and from a new report from the Virginia Manufacturers Association. We raise ideas and explore ways to measure competitiveness. This new West Virginia "Call to Action" is crafted by aggregating the research and the recommendations from many recent reports.

The foundation for this report's policy recommendations begins and builds from the *SGA's Advanced Manufacturing in the American South* report. Although originally targeted to Governors, the recommendations resonate with a broad range of policy activists. The research yielded the following state policy principles:

- **Utilize Strategic Planning** to properly allocate resources and coordinate actions. Require measurable goals and a high-level policy champion to help secure results. Clusters should be identified and included as a core component of the strategic plan.
- **Focus on Regionalism and Region-Based Economic Growth.** Clusters include firms and employees that cross the traditional boundaries of cities, counties and states. Regions are often stronger than their component jurisdictions and include a wide array of stakeholders who can benefit from a common effort to promote industrial development.
- **Embrace Policy Coordination** to facilitate horizontal and vertical structures in government. Well-defined policy coordination in turn supports policy accountability.
- **Encourage Accountability** with quantifiable metrics.
- **Pursue Partnerships and Collaboration** engaging multiple public and private organizations and individuals.
- **Encourage Competition** to gain resource efficiency.
- **Promote Value-Added, Not Simply Low Costs.** Focus on the building of income and wealth for residents. The keys to promoting value-added are to invest in productivity-enhancing assets, including workers and infrastructure, and to recruit firms that offer the promise of high earnings, high levels of capital investment, and an active R&D agenda.

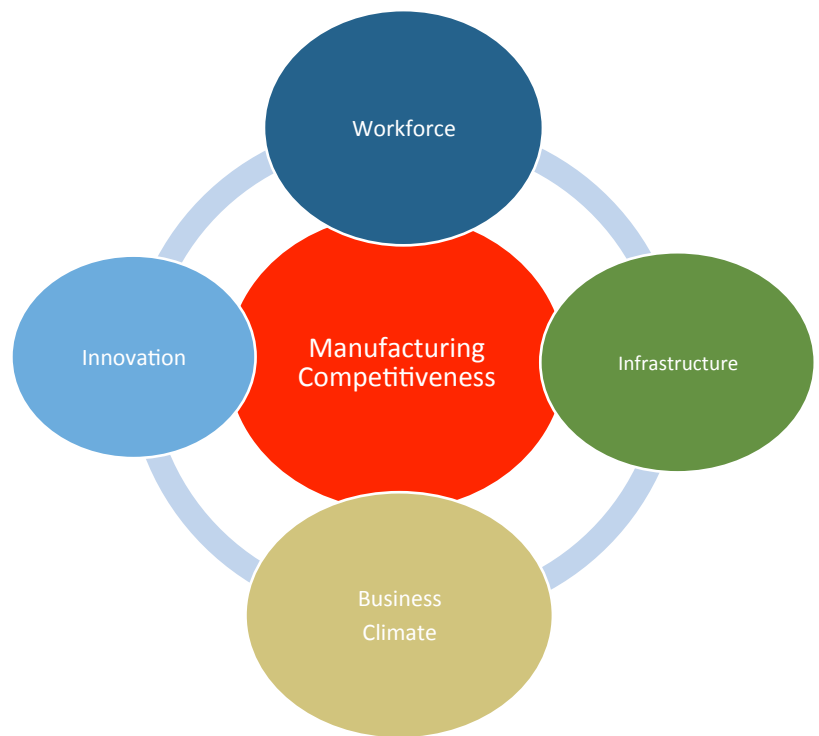
- **Build on Existing Strengths** to see better and faster results.
- **Support Autonomy and Decentralization** to customize the efforts to meet local market demands and needs.
- **Ensure a Culture of Adaptability and Flexibility** to position for inevitable and rapid change.

Participants in this project concluded that targeted industrial recruitment, a cluster-based focus on public infrastructure, technology research and development, incentives, entrepreneurship, and education and human capital “offer the greatest promise of growth in advanced manufacturing.”

The report emphasized continuous measurement, regionalism, and a focus on value-added. It also raised the need to be flexible and quickly adaptable.

Based on these previous findings, and those of many other studies, this review focuses on and offers recommendations for improving manufacturing competitiveness in a broad sense, with specific emphasis on four areas, **business climate, workforce, innovation, and infrastructure.**

While there are many other important factors, these are common to almost all best-thinking literature today, and reflect the input from the manufacturing groups that have contributed throughout the process.



United States Manufacturing in 2017

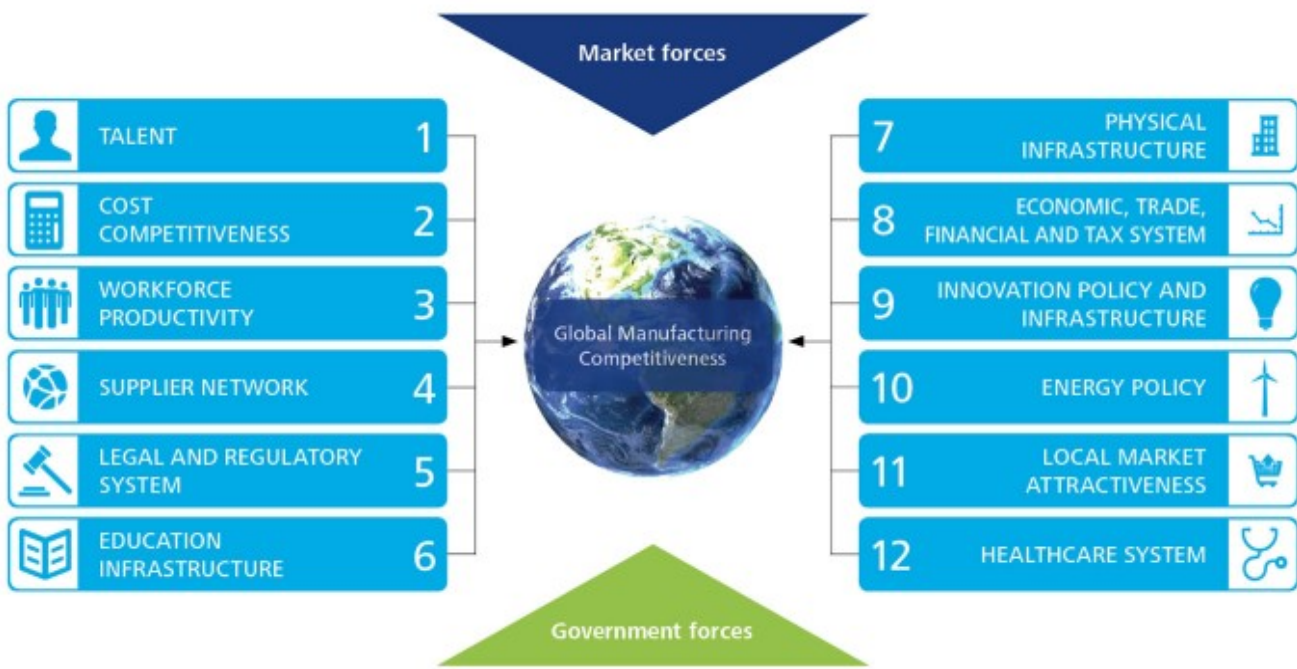
Despite a continuous barrage of editorials and articles bemoaning the death of manufacturing, the United States remains one of the world's most competitive countries for goods production. In its 2016 study, *Global Manufacturing Competitive Index*, Deloitte Touche Tohmatsu Limited and the U.S. Council on

“The rumors of the demise of the U.S. manufacturing industry are greatly exaggerated.”
Elon Musk

Competitiveness concluded that the United States, China and Germany continue to be the top countries in the world for manufacturing and will remain so in the coming years. The study predicts that the United States, currently ranked second, will retake the top spot by 2020.

The chart below shows those factors that drive our country’s competitiveness and the factors that were used to measure the United States against other countries. Based on the report’s CEO Survey, our national strengths are innovation policy and infrastructure, physical infrastructure, talent, and the legal and regulatory environment. Cost competitiveness was found to be our weakest area.

Global CEO Survey: Drivers of Global Manufacturing Competitiveness



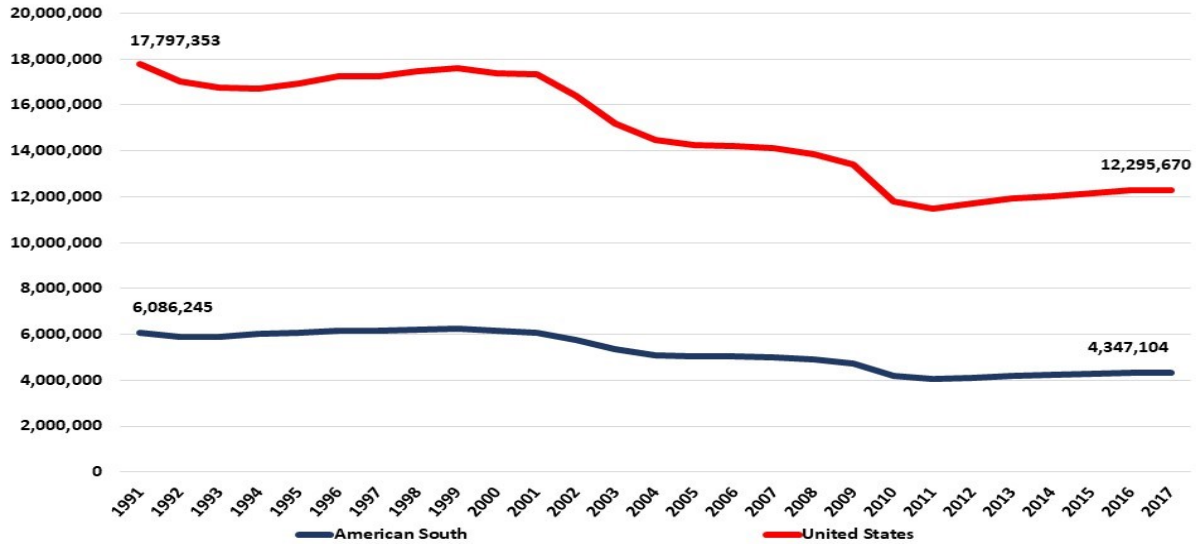
Source: Deloitte Touche Tohmatsu Limited and U.S. Council on Competitiveness, *2016 Global Manufacturing Competitiveness Index*

Concerns about the future of manufacturing date back several decades. It does not take a crystal ball to know that the manufacturing sector will continue to experience rapid change. Today, as books and reports announce the coming of Industry 4.0, new concern is widespread. The future fate of American manufacturing is a common discussion in business boardrooms and at political events. In *The Industries of the Future*, Alex Ross concludes, “innovation and globalization have created opportunity the likes of which have never before existed”. Another recent widely talked-about book, Martin Ford’s *Rise of the Robots*, has a subtitle that captures the other side of the discussion, “Technology and the Threat of a Jobless Future.”

Between 1990 and the end of 2016 manufacturing employment in the United States dropped from 17.8 million jobs to 12.3 million. Job losses from technological gains, global outsourcing

and foreign competition have cost millions their livelihood and cost many southern communities their economic engines.

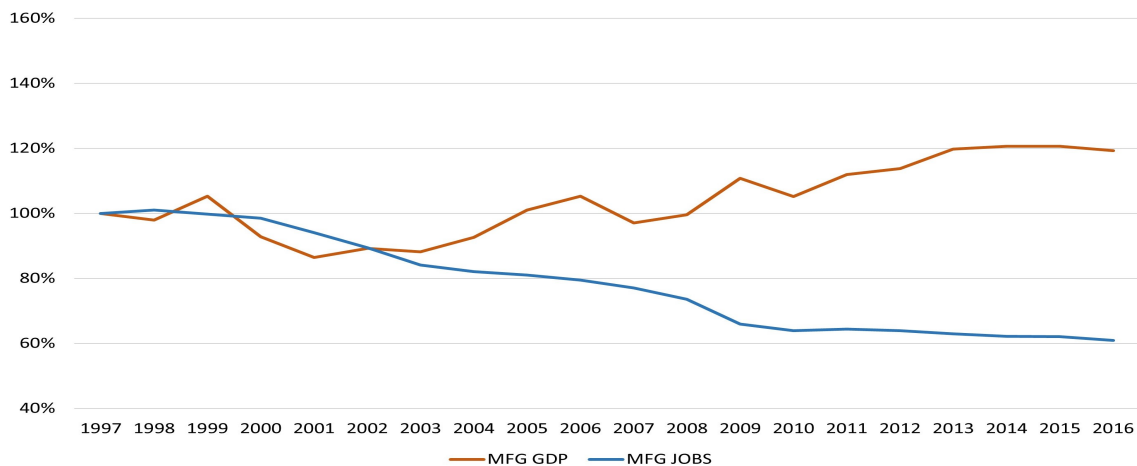
Manufacturing Jobs in the United States and the American South 1990 - 2016



Source: US Bureau of Labor Statistics

Much of the recent public policy angst has ignored manufacturing output numbers. Today, according to the Federal Reserve, and despite the doomsday prophets, **U.S. factories produce twice as much they did in the mid-1980s**. We know that output is only half of the story. We produce those goods with one-third fewer workers. Over the past 20 years West Virginia's manufacturing output (GDP) has grown by about 20 percent even as employment in manufacturing has declined significantly.

West Virginia Manufacturing Jobs and Manufacturing GDP Growth 1997 – 2016 (normalized as percent of levels in 1997)



Source: Jobs: US Bureau of Labor Statistics & GDP: US Bureau of Economic Analysis

While the U.S. continues to produce close to 20 percent of all products worldwide, that statistic provides no comfort to places that have suffered the loss of businesses and jobs. Boarded-up factories in West Virginia towns are a daily reminder of their bygone economic foundations. West Virginia has experienced significant losses; nevertheless, manufacturing remains critical to the state's economic future. While the loss of manufacturing jobs during the recession was severe, since 2010 when the recovery began, manufacturing has stabilized nationally. West Virginia and several other southern states have continued to lose manufacturing jobs, but most at a reduced rate.

ANNUAL MANUFACTURING JOB CHANGES 2011-2016

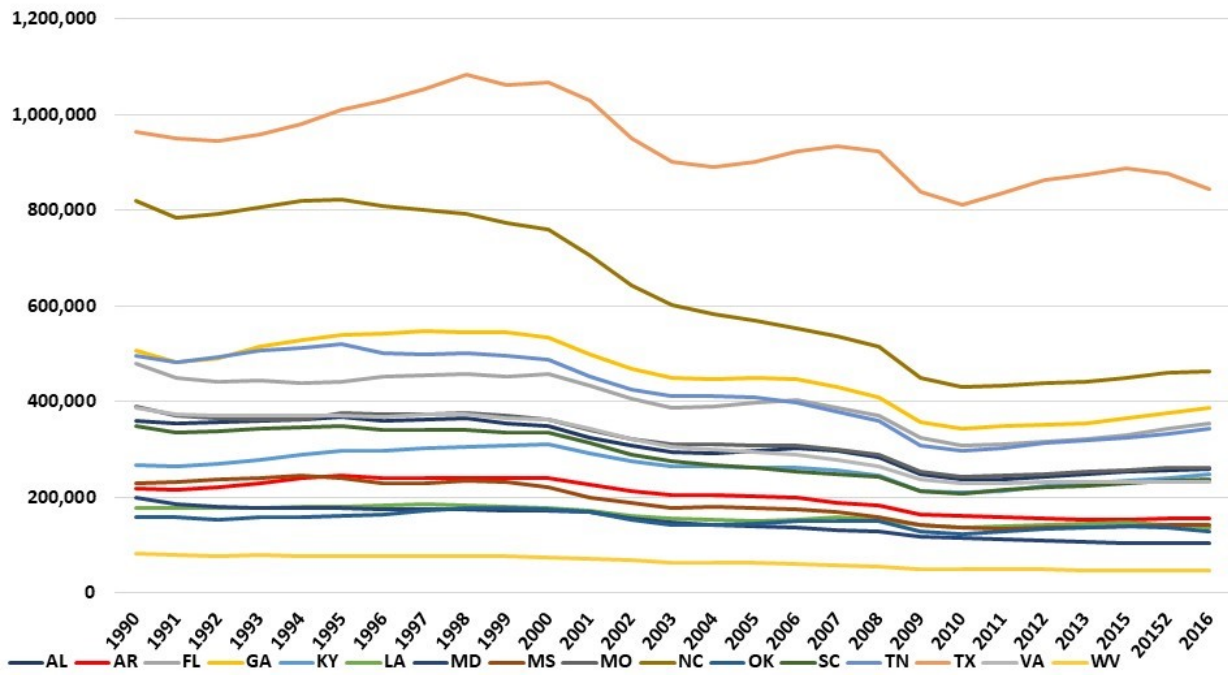
	2011	2012	2013	2014	2015	2016
Southern States	1.63%	1.85%	1.04%	1.66%	1.29%	0.00%
Non-Southern States	1.99%	1.68%	0.60%	1.16%	1.02%	0.07%
United States	1.86%	1.74%	0.76%	1.34%	1.11%	0.04%

MANUFACTURING JOBS - AVERAGE ANNUAL QCEW

	2011	2016	Change in jobs	% Change in jobs
AL	237,326	260,473	23,147	9.8%
AR	159,353	154,788	(4,565)	-2.9%
FL	311,263	354,798	43,535	14.0%
GA	349,046	385,987	36,941	10.6%
KY	212,496	247,960	35,464	16.7%
LA	139,660	135,912	(3,748)	-2.7%
MD	113,033	103,536	(9,497)	-8.4%
MS	135,252	143,088	7,836	5.8%
MO	246,220	263,375	17,155	7.0%
NC	434,698	464,475	29,777	6.9%
OK	129,731	128,713	(1,018)	-0.8%
SC	215,113	238,049	22,936	10.7%
TN	303,781	342,568	38,787	12.8%
TX	836,035	845,339	9,304	1.1%
VA	230,203	231,256	1,053	0.5%
WV	49,448	46,787	(2,661)	-5.4%

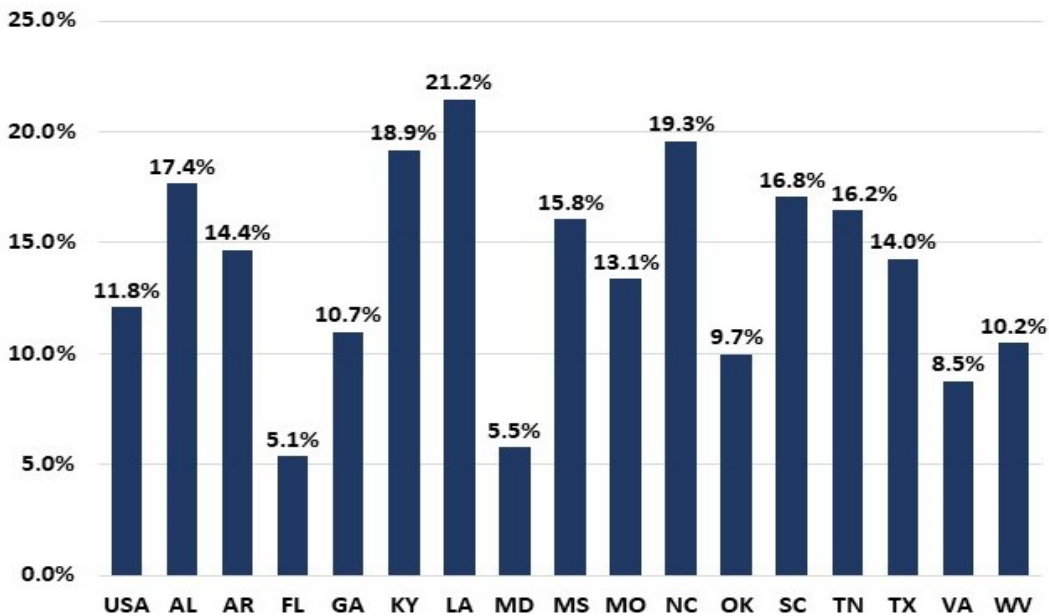
Source: US Bureau of Labor Statistics. Quarterly Census of Employment and Wages

Manufacturing Employment by State American South 1990 - 2016



Source: US Bureau of Labor Statistics

Southern States Manufacturing as a Share of GSP 2016



Source: US Bureau of Economic Analysis

As the previous charts show the number of jobs or percentage of state GDP from manufacturing varies greatly among southern states. But industry sectors are transforming and production continues to move, so every state has the opportunity to expand manufacturing in the future. Because of the well-documented public benefits of manufacturing, including increased tax base, higher multiplier impacts, (IMPLAN estimates that for every dollar spent in manufacturing an additional \$1.81 is added to the economy) and higher wages, policy makers almost always target the industry in their economic development strategies.

“According to U.S. Executives, favorable US policies centered on sustainability technology transfer, monetary control, science and innovation, foreign direct investment, intellectual property protection, and safety and health regulations help create a competitive advantage for their businesses. On the other hand, US executives identified policies around corporate tax rates, healthcare policies, labor and taxation of foreign earnings as a disadvantage for manufacturers in the United States.”

2016 Global Manufacturing - Competitiveness Index,
Deloitte

As the manufacturing sector continues to evolve, the shift to higher value advanced industries is increasing the competitiveness of more developed places. The Deloitte report concludes that talent, cost competitiveness, productivity, and supplier networks are the most important factors, in that order.

West Virginia's Manufacturing Future



Remaining competitive begins with anticipating the future needs of manufacturing companies and for some places, like West Virginia, a recalibration of public policy. KPMG, in [*Global Manufacturing Outlook: Preparing for Battle: Manufacturers Get Ready for Transformation 2015*](#), states “Constant disruption, rising pricing pressures, volatile input costs, intense

competition and continuous innovation have all forced manufacturers to rethink their business models and long-term growth plans.” Policy makers need to understand the implications of these changes and adjust their approach accordingly.

Rob Atkinson, president of the Information Technology and Innovation Foundation, in the report *Measuring Up*, lays out one vision of changing manufacturing business models:

New vs Old Manufacturing Business Models

Issue	Old	New
Scope of competition	National	Global
Organizational form	Hierarchical	Networked
Production System	Mass production	Flexible production
Key factor of production	Capital/Labor	Innovation/Ideas
Key technological driver	Mechanization	Digitization
Competitive advantage	Economies of scale	Innovation quality
Relationships of firms	Go-it-alone	Collaboration
Skills	Job-specific	Broad and changing
Workforce	Organizational man	“Intrapreneur”
Nature of Employment	Secure	Risky

The speed of technological change, the rising skill expectations of a company’s workforce and global competition with immediate access to ideas has necessitated these changes. In aggregate, these changes portend a need for policy making that is quickly adaptable, future focused and that is in constant discussions with industry leaders.

According to the [International Economic Development Council](#) (IEDC), “Manufacturing competitiveness requires serious investment in research and development. Only by constantly improving products and production techniques can manufacturers stay globally competitive. Companies can no longer operate entire supply chains, conduct all research and development in-house or contract with firms only in their region.”

IEDC has highlighted what it believes places need to prioritize to support new manufacturing.

- “Building a quality workforce

“Manufacturing has been transformed. If a manufacturing worker or plant owner from 1960 were transported to the present, he or she would recognize little in the modern world of manufacturing. Manufacturing has become a highly technical, innovative, dynamic and networked industry”

IEDC-Economic Development Research Partners Jobs in the Making: Economic Strategies to Grow Manufacturing, 2011

- Cultivating innovation capacity
- Supporting manufacturing entrepreneurship
- Forging global networks
- Going green as major manufacturers aggressively pursue energy and waste reductions. Corporate decision-makers are increasingly evaluating locations on these terms.”

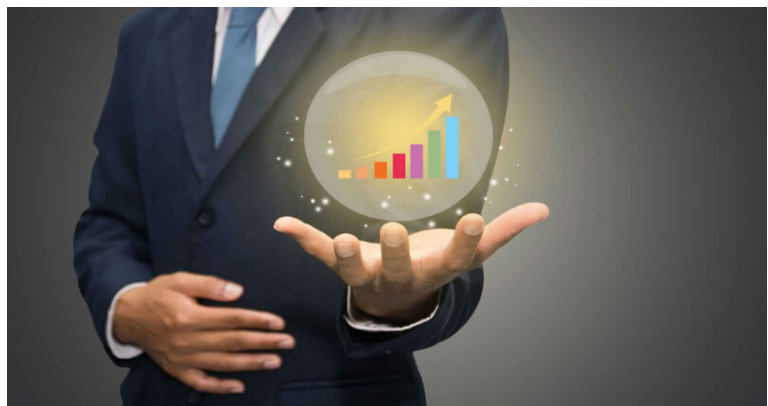
Dozens of other studies over the past decade generally agree on the key areas of focus to support manufacturing. They provide the foundation for developing intentional state or regional action.

We believe that if the United States and West Virginia want to compete for new manufacturing, we will need to maintain our business competitiveness, educate and train our citizens with new and higher skills, enhance our infrastructure with an emphasis on digital, and improve the flow of new ideas and innovations.

Manufacturing Competitive Indexes

Every week a different rankings article, index or set of numbers is released and either celebrated or lamented by state officials. The specific factors that influence an individual investment decision is particular to a business, but if we know generally what is important to manufacturers, it is possible to aggregate factors and better understand a state’s competitiveness.

As states work to stay competitive in manufacturing the data that measures their progress can be overwhelming. The West Virginia Manufacturers Association has worked to develop a multifactor **Manufacturing Competitiveness Index** that allows policy-makers to aggregate complex data and inform strategic choices. Multifactor data is used by many organizations to rank states. Widely promoted ranking by CNBC, Forbes and Chief Executive Magazine are used by economic development organizations and site selectors.



For example, CNBC's 2017 *America's Top States for Business* uses 60 individual measures to create rankings in 10 categories that are combined for an overall state ranking. The year, West Virginia ranked at the bottom, 50th, when all the categories were combined. The lowest rankings came in the Economy (50th), Workforce (49th), Technology and Innovation (49th) and Business Friendliness (49th). The best rankings were in Cost of Doing Business (4th), and Cost of Living (22nd). Forbes also has West Virginia ranked 50th this year, while Chief Executive has the state ranked 37th.

The West Virginia Manufacturers Association staff reviewed the metrics used in the *Manufacturing Competitiveness Index* report, which was part of *A New Blueprint – Making the American South's Manufacturing Sector More Competitive by 2030*, and the newer Virginia Manufacturing Report from June 2017 with a revised metrics list. The original report contained 46 metrics divided into five categories: Business Climate, Workforce, Infrastructure, Innovation and Economic Strength. The metrics were equally weighted and the categories of metrics were equally weighted in calculating final state rankings.

In total, 52 metrics were used in the Virginia index ranking, including 11 new data measurements, while dropping five metrics that the Virginia Manufacturing Association Board considered less relevant. Unlike the original *Blueprint*, the Virginia report weighted the five categories of measures. For this new analysis, we used the revised metrics list from the Virginia report, with the data updated through August 2017, but maintained the unweighted categories from the original *Blueprint*. The following changes were made to the list of metrics used from the original report.

Business Climate. Two new metrics were added to the original eight, (1) the value of \$100, reflecting the cost of living, and (2) greenhouse gas emissions per capita; and one metric from the original report was deleted: hourly minimum wage.

Workforce. The 15 metrics in Workforce include all of the original metrics and six new metrics that were developed to broaden the focus on available workforce and credentialing: (1) average 8th grade reading score, (2) average 8th grade math score, (3) veteran unemployment rate, (4) veteran percentage share of total population, (5) total number of sub-baccalaureate occupational credentials awarded in the field of manufacturing, construction, repair and transportation, and (6) number of sub-baccalaureate occupational credentials conferred in the field of manufacturing, construction, repair and transportation as a percent of total credentials awarded.

Infrastructure. This category includes nine metrics, eight from the original report and one new metric: percentage of population without 25 Mbps/3 Mbps broadband access.

Innovation. The Innovation category has the smallest number of included metrics with seven. One metric, start-up firms per 1,000 firms was moved from Economic Strength to Innovation and three metrics from the original report were deleted: (1) patents issued per million workers,

(2) higher education R&D in S&E fields as a percentage of GDP, and (3) SBIR and STTR funding per \$1 million of GDP.

Economic Strength. This category measures a state’s recent economic performance in the areas of GDP, income and exports, and includes twelve metrics, including ten from the original report. The two new metrics are: (1) manufacturing establishments total capital expenditures, and (2) manufacturing establishment's total capital expenditures per manufacturing employee. Two metrics were deleted: manufacturing establishments as percent of total establishments, and change in total exports per capita.

Data was gathered from public sources including the Bureau of Economic Analysis, National Science Foundation, Bureau of Labor Statistics, Energy Information Administration, and the US Census Bureau. Indicators were standardized to account for differences in states’ population or economy size. The most recent available data was used, meaning most data is from the year 2016 or 2015. In order to evaluate time trends, a five-year percent change was used.

Index Results

Business Climate Index

Manufacturing has long been sensitive to labor costs and the cost of doing business. These factors are often cited as critical reasons when manufacturing companies relocate. The Business Climate Index focuses on wages, taxes, and legal barriers. These metrics are usually directly related to state government policy and represent clear actions in which states can make changes to benefit their manufacturing competitiveness. The Business Climate Index consisted of the following nine metrics.

Business Climate Index Metrics

- Manufacturing Industry Health Scorecard (Conexus Indiana) 2016
- Top marginal corporate tax rate 2017
- Legal Climate Rankings 2015
- Air Quality -Average Exposure to PM2.5 2015
- Workers Comp insurance premium per \$100/payroll 2016
- State and Local Tax Costs for Capital- Intensive Manufacturing 2014
- State and Local Tax Costs for Labor- Intensive Manufacturing 2014



- NEW: Value of \$100 2016
- NEW: Greenhouse Gas Emissions Per Capita (Metric Tons of CO2) 2014
- DELETED: Hourly minimum wage

Southern States Business Climate Index Performance

State	Business Climate Rank	State	Business Climate Rank
North Carolina	3	Louisiana	25T
Virginia	4	South Carolina	25T
Georgia	13T	Arkansas	29
Tennessee	13T	Florida	33
Missouri	15	Texas	34
Maryland	18	Mississippi	40
Alabama	21	Oklahoma	42
Kentucky	24	West Virginia	46

Workforce Index

The availability of a skilled labor force is consistently ranked in the top five factors impacting site selection by Area Development magazine year after year. In 2017, it was again ranked #1.

Today, manufacturing business leaders often complain about difficulties in finding skilled manufacturing employees such as CNC machinists. As manufacturing becomes more advanced and computer-based, the importance of STEM education rises when considering the manufacturing workforce. The Workforce Index measures education, health of the population, creative class population, and manufacturing productivity. The Workforce Index consisted of the following fifteen metrics.

Workforce Index Metrics

- Percentage of Population with Adult Obesity 2016
- Persons age 18 to 24 not attending school, not working, and no degree beyond high school 2015
- High School Graduation Rate for all students 2014-15
- Labor Force Participation Rate 2016
- Manufacturing Output Per Manufacturing Employee 2016
- Change in Manufacturing Output Per Manufacturing Employee 2010-2016
- Age 25-44 Population Growth 2011-2016
- Completed Tech & STEM Education Programs Per 1,000 Enrolled Students 2015
- Percent Change in Tech & STEM Education Program Completions 2010-2015
- NEW: Average 8th Grade Reading Score 2015

- NEW: Average 8th Grade Math Score 2015
- NEW: Veteran Unemployment Rate 2015
- NEW: Veteran % share of total population 2015
- NEW: total number of sub-baccalaureate occupational credentials in manufacturing 2013
- NEW: sub-baccalaureate occupational credentials in manufacturing as % of total credentials 2013

Southern States Workforce Index Performance

State	Workforce Rank	State	Workforce Rank
Maryland	6	Georgia	38
Virginia	9	Florida	40
Texas	10	Louisiana	41
Missouri	19	South Carolina	42
Oklahoma	20T	Alabama	44
North Carolina	23	Arkansas	46
Kentucky	27	West Virginia	49
Tennessee	34	Mississippi	50

Infrastructure Index

Highway accessibility was ranked as the number two factor for site selection by *Area Development* in 2017 and is usually among the top 10 factors. Over 85 percent of managers considered highway accessibility as very important or important when deciding on a new facility, expansion, or relocation. Infrastructure is still tremendously significant for manufacturing firms because of the need to move products to major markets. The growing trend of large industrial parks (with large distribution centers) and consumer demand for on-time, quick delivery also drives the call for improved infrastructure. The American Society of Civil Engineers currently gives the nation a grade of D+ when it comes to infrastructure, estimating a needed investment of \$3.6 trillion by 2020. These findings show that for economic development, infrastructure is a quantity as well as a quality issue. Improving aging infrastructure not only supports current industry, but is also seen as a way to spur growth. Broadband was added and is now often a key infrastructure measure. The Infrastructure Index consisted of the following nine metrics.

Infrastructure Index Metrics

- Total State Spending on Transportation Per Capita FY2016
- Average Retail Electricity Price for Industrial Customers, Cents Per kWh Feb 2017
- Percent of structurally deficient bridges 2016
- Percentage growth in Freight Shipments tons (thousands) 2007-2012

- Miles of Interstate highways per 10,000 population 2015
- Percentage growth in Freight Shipments \$\$ (millions) 2007-2012
- Average Retail Natural Gas Price for Industrial Customers, \$ per thousand cubic feet Feb 2017
- State Transportation Expenditures as % of Total Expenditures FY2015
- NEW: Percentage of Population Without 25 Mbps/3 Mbps Broadband Access - All Areas 2015

Southern States Infrastructure Index Performance

State	Infrastructure Rank	State	Infrastructure Rank
Texas	1	North Carolina	29
Virginia	11	Arkansas	33
Kentucky	13	Georgia	35
Oklahoma	20	West Virginia	36
Maryland	22T	Alabama	38
Florida	24	Tennessee	43
Mississippi	25	South Carolina	44
Louisiana	27	Missouri	50

Innovation Index

The Innovation Index measured states’ performance in university technology transfer, patent development, research & development funding, and venture capital funding. Innovation and research help spur new manufacturing companies and products. Innovation is a tool that grows manufacturing from within a region, as businesses are more likely to start and remain close to their original research connection. An area known for innovation and a talented technological workforce is more likely to attract businesses looking to relocate. It is also more likely to draw top talent in the creative class (persons age 25 to 44). The Innovation Index consisted of the following seven metrics.

Innovation Index Metrics

- Technology Licenses and Options Executed from Universities 2015
- Patents Issued 2010-2015
- Total Technology Industry Employment Growth 2011-2016
- Total R&D % of GDP 2012
- Business Performed R&D - % of Private Industry Output 2013
- Venture Capital Funding Per \$1 Million of GDP 2015
- Start-Up Firms per 1,000 Firms 2016 (**moved from Economic Strength to Innovation**)
- DELETED: Patents Issued per 1 Million Workers

- DELETED: Higher Education R&D in S&E Fields as a Percentage of GDP
- DELETED: SBIR and STTR Funding Per \$1 million of GDP

Southern States Innovation Index Performance

State	Innovation Rank	State	Innovation Rank
Missouri	8	South Carolina	31
North Carolina	9	Alabama	36
Georgia	12	Kentucky	40
Texas	16T	Oklahoma	42
Maryland	16T	Arkansas	44
Florida	18	Mississippi	45
Virginia	25	Louisiana	47
Tennessee	27	West Virginia	50

Manufacturing Economic Strength

The Economic Strength Index evaluated the existing presence of the manufacturing industry within each state, and also evaluated indicators of overall economic performance. Existing industry in a state can create a clustering effect and attract further manufacturing to the area. Clusters have been known to attract other prospective businesses because of the benefit of higher concentrations of skilled employees and regional suppliers. A strongly performing overall economy beyond manufacturing is important for prospective companies as growth inspires innovation, talent movement, and investment. The Economic Strength Index consisted of the following twelve metrics.

Manufacturing Economic Strength Index Metrics

- Manufacturing's Share of Gross State Product 2016
- Change in Manufacturing's Share of Gross State Product 2011 -2016
- Growth in Manufacturing GDP 2011 - 2016
- Total Manufacturing Employment 2016
- Manufacturing Employment as percent of Total Employment 2016
- Change in Real GDP per Capita 2011-2016
- Change in Real Personal Income per Capita 2011-2016
- Change in Real GDP chained 2009 dollars 2011-2016
- Exports of Manufactured Goods % change 2015 - 2016
- Total Exports of Goods Per Capita 2016
- NEW: Manufacturing establishments total capital expenditures (\$millions) 2015
- NEW: Manufacturing establishments total capital expenditures per manufacturing employee 2015

State	Economic Strength Rank	State	Economic Strength Rank
Tennessee	4	North Carolina	22
Kentucky	6	Oklahoma	24
South Carolina	7	Florida	25
Texas	8	Mississippi	30
Alabama	9T	Arkansas	32
Missouri	18	West Virginia	40
Georgia	19T	Maryland	45
Louisiana	19T	Virginia	46

Overall Manufacturing Competitiveness Index All States

In addition to each of the five indexes a composite index was create from all of the data points. As the chart below shows, West Virginia is ranked as the least competitive state in overall manufacturing competitiveness. The chart below provides a quick visual reference with states ranked among the 15-best coded in green and states scoring in the bottom 15-coded red.

Top 15 Ranked States

Bottom 15 Ranked States

		BUSINESS CLIMATE	WORKFORCE	INFRA-STRUCTURE	INNOVATION	ECONOMIC STRENGTH
1	Minnesota	9	8	7	15	9
2	Utah	10	11	17	4	21
3	Washington	32	4	13	2	16
4	Texas	34	10	1	16	8
5	Iowa	6	14	8	34	12
6	Massachusetts	17	7	39	3	17
7	Colorado	28	3	17	10	27
8	North Carolina	3	23	29	9	22
9	Virginia	4	9	11	25	46
10T	Idaho	21	37	9	19	13
10T	Connecticut	11	18	6	22	42
12	North Dakota	23	5	3	39	30
13	Michigan	2	47	46	5	1
14T	Ohio	8	28	40	26	5
14T	Pennsylvania	31	14	30	21	11
14T	Maryland	18	6	22	16	45
17T	Nebraska	4	13	21	35	36

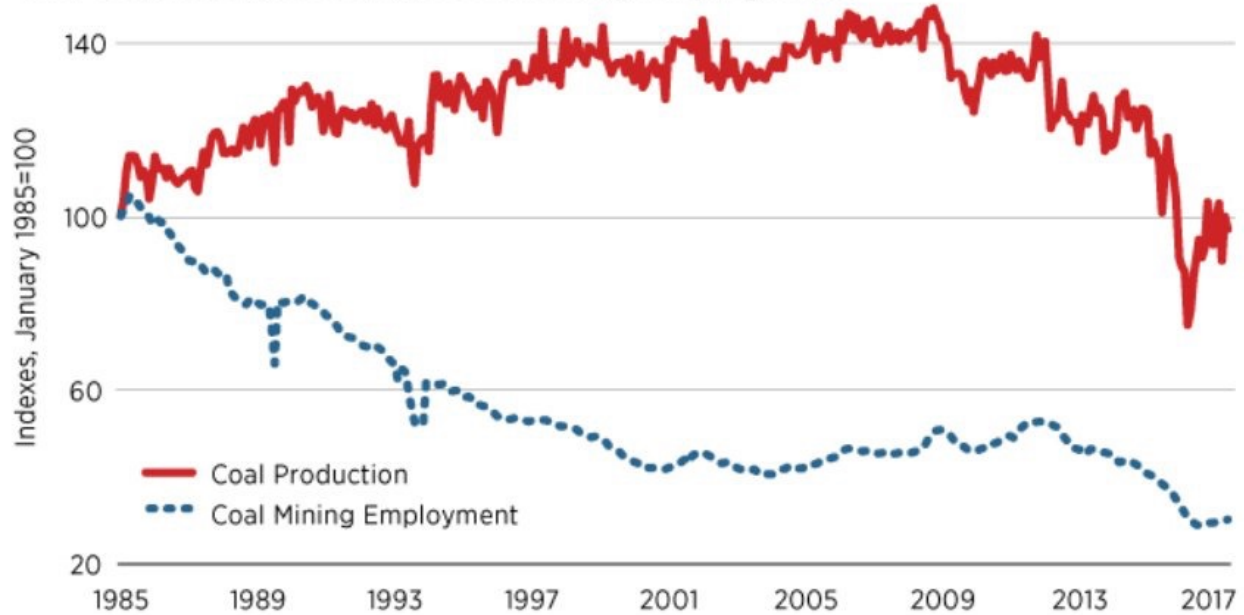
17T	South Dakota	1	16	2	43	47
19T	Kentucky	24	27	13	40	6
19T	Missouri	15	19	50	8	18
21	Oregon	7	35	34	7	29
22	Kansas	20	22	12	33	27
23T	Illinois	50	24	16	11	14
23T	New Hampshire	16	12	44	20	23
25	Georgia	13	38	35	12	19
26	Indiana	25	20	47	24	3
27T	Tennessee	13	34	43	27	4
27T	Wisconsin	38	16	26	27	14
29	Wyoming	18	1	22	49	39
30	Montana	45	2	5	41	37
31	California	49	33	49	1	2
32	Arizona	12	31	48	13	34
33	New York	34	43	31	5	26
34	Florida	33	40	24	18	25
35	Vermont	30	31	4	38	43
36T	Alabama	21	44	38	36	9
36T	Oklahoma	42	20	20	42	24
38T	South Carolina	25	42	44	31	7
38T	New Jersey	39	25	37	14	34
40	Delaware	34	39	15	22	48
41	Louisiana	25	41	27	47	19
42	Nevada	37	45	10	32	38
43	Maine	41	30	31	30	44
44	Rhode Island	43	28	40	36	33
45	Arkansas	29	46	33	44	32
46	New Mexico	44	48	19	29	49
47	Mississippi	40	50	25	45	30
48	Hawaii	48	26	42	46	41
49	Alaska	47	35	27	48	50
50	West Virginia	46	49	36	50	40

Although very different from state to state, the manufacturing competitiveness analysis of the American South shows that most of the states enjoy some competitive advantages. This provides a solid foundation for manufacturing success. As the sector continues to evolve, a greater focus on higher skills for workers and increased innovation is needed. Infrastructure, while currently a competitive advantage in many states, will need aggressive improvements to maintain that position in the coming years. For West Virginia, this type of data analysis emphasizes the need for improvements.

Recommendations for West Virginia

We all know that the past few years have been very challenging for West Virginia. From 2013 to 2016, West Virginia's growth in jobs (50th) GDP per capita (47th) and wage growth (50th) were among the lowest in the country. Unless significant changes are made soon, better days seem unlikely. Coal production remains important to the state, but as the chart below shows, new, good jobs are needed to replace those that have been lost over the past 30 years.

U.S. Coal Production and Coal Mining Employment



SOURCES: Energy Information Administration/Haver Analytics and Bureau of Labor Statistics/Haver Analytics.

■ FEDERAL RESERVE BANK OF ST. LOUIS

Manufacturing offers an important opportunity to create new, good jobs for our state if we take the actions needed to be more competitive. Based on the research and data, the state's strengths, weaknesses, opportunities and threats are summarized below.

SWOT Analysis of West Virginia's Manufacturing Competitiveness

Strengths	Weaknesses
<ul style="list-style-type: none"> • Low, best-10 cost of living & business • Low energy costs • Solid growth in manufacturing output per employee • Solid state spending per capita on transportation 	<ul style="list-style-type: none"> • Overall state economy • Low rankings for legal climate • High taxes for labor-intensive manufacturing • Low labor force participation • Low levels of innovation and entrepreneurship
Opportunities	Threats

<ul style="list-style-type: none"> • Legislative focus on business climate • Targeted middle-skills workforce development improvements • Better leverage universities to grow technology sector and attract innovation assets • Expand global trade, especially exports 	<ul style="list-style-type: none"> • Workforce aging and state ability to attract millennial workers • Lack of broadband coverage could leave many Virginia regions behind • Health indices could limit future productivity • State & local manufacturing tax burden is too high
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Understanding our competitive position is the first step, but more importantly what can we do to improve our standings. The sections that follow provide recommendations for improved manufacturing competitiveness.

Overall Strategic Checklist to Strengthen Manufacturing in West Virginia

- Begin with A New Policy Focus on Business Competitiveness
- Use Cluster Practices as the Organizing Principle
- Understand, Anticipate and Embrace Change
- Commit to a More Competitive State Business Climate
- Enhance Workforce Skills-Focus on Demand-Driven Tools
- Promote Increased Innovation
- Invest in Infrastructure
- Collaborate to Compete

1) Begin with a State Policy Focus on Business Competitiveness

The *Global Competitiveness Report* of the World Economic Forum defines competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country". For West Virginia, we need to understand the state's current advantages and weaknesses, prepare a specific strategy or roadmap to make improvements and then take actions that address the future needs of manufacturing companies.

“Competitiveness is an economy’s ability to produce goods and services that meet the test of international markets while its citizens earn a standard of living that is both rising and sustainable over the long run.”

Economist Howard Rosen

We recommend that the public and private sector work together to develop a five-year strategic action agenda with the goal of improving the state’s manufacturing competitiveness.

2) Use Cluster Practices as the Organizing Principle

A state cluster approach provides a framework and the organizing principles for actions as well as ideas for specific actions. Since Dr. Michael Porter of Harvard University began spreading the word about the competitive implications of clusters in the 1990s it has been one of the few economic development principles that has remained relevant, supported and sometimes frustrating. **In the face of heightened competition, clusters create a competitive or productive advantage.** As defined in the National Governors Association (NGA) and the U.S. Council on Competitiveness report, *Cluster-Based Strategies for Growing State Economies*, “a cluster is a group of firms, related economic actors, and institutions that are located near one another and that draw productive advantage from their mutual proximity and connections.”

Many states and regions have used manufacturing or “advanced manufacturing” as a targeted cluster. The **Brookings Institution** has even created a specific methodology to identify the thirty-plus manufacturing subsectors that they consider advanced. But while general strategies can support all manufacturing, more specific support and investment is better suited for individual sectors.

The NGA has been publishing cluster reports for 15 years that suggest state strategies to build stronger clusters and create advantages that extend beyond low costs. Their 2002 report, *A Governor’s Guide to Cluster-Based Economic Development*, discussed the hard and soft benefits from clustering. “Hard benefits are gained from more efficient business transactions, wiser investments, and reduced expenditures... Soft benefits are derived from learning benchmarking and sharing that expands knowledge and leads to innovation, imitation and improvement.”

More specifically, the report clearly shows how the competitive advantages are attained.

Hard Benefits of Clusters

Asset

Local supply chains

Specialized workforce

Specialized services

Choices of inputs

Range of firms

Benefits

Design efficiencies

Higher productivity

Faster and easier access

Lower costs, higher quality

Joint ventures, network opportunities

Soft Benefits of Clusters

<u>Asset</u>	<u>Benefits</u>
Association	Collective vision, planning influence
Trust	Inter-firm collaboration and networks
Learning (1)	Technology transfer and innovation
Learning (2)	Tacit knowledge and know-how
Informal labor market	Efficiencies, career ladders

For states that have prioritized cluster strategies in their economic development approach the question has long been, what specifically do we do to have the most efficient impact? Again, the NGA and the U.S. Council on Competitiveness, in *Cluster-based Strategies for Growing State Economies*, made six specific recommendations for policy makers.

- 1) **“Establish a solid foundation:** Every cluster has some fundamental needs that are not cluster specific but that affect the ability of clusters to succeed. These include the region’s educational assets, physical infrastructure, attractiveness to creative talent, and capacity for aligning the efforts of regional educational, workforce and economic institutions.
- 2) **Build relationships:** Interfirm collaboration facilitates learning and the aggregation of intangible assets, especially the tacit knowledge that resides within company employees and practices. State leaders can help by convening a cluster leadership council and supporting cluster associations.
- 3) **Deepen skills and talent:** By nature, clusters attract and enhance talent, but government can reinforce this tendency by creating cluster hubs at community

Growing State Economies

Twelve Actions

- 1) Create a competitive tax and regulatory environment
- 2) Put entrepreneurial activity at the top of the state agenda
- 3) Distinguish among different kinds of entrepreneurs and businesses
- 4) Cast a wide net
- 5) Teach entrepreneurship skills and attitudes at all educational levels
- 6) Build a start-up environment and culture
- 7) Find high-growth companies and help them
- 8) Get your entrepreneurs to give back
- 9) Help companies open doors to new global customers
- 10) Reward strong ties between universities, companies and entrepreneurs
- 11) Build innovation clusters
- 12) Build ecosystems not programs

The National Governors Association - Growing State

colleges, fostering cluster-focused professional science master's programs at nearby universities, encourage cluster-training consortia, and encouraging cluster-based career advancement paths.

- 4) **Align innovation investments:** States can realize higher returns in their investments in research and development (R & D) centers of excellence, and business innovation by focusing on clusters.
- 5) **Accelerate entrepreneurship:** Talent and research are necessary, but it takes entrepreneurship to translate good ideas into successful products and services. Governors can promote entrepreneurship by supporting networks, creating cluster-focused incubators, organizing small business centers around cluster expertise, and encouraging entrepreneurship education programs in high schools and postsecondary institutions.
- 6) **Open global priorities:** Successful clusters extend their networks to distant competitors, vendors and institutions. Government can help by supporting participation in international conferences, trade shows, and study tours; by providing export assistance; and by establishing cluster-based learning exchanges.”

We recommend that more detailed cluster strategies be developed, including supply chain analysis for automotive, aerospace and chemical manufacturing, to build on West Virginia’s Department of Commerce’s current “key industries”.

3) Understand, Anticipate and Embrace Change

To strengthening the manufacturing ecosystem in West Virginia, requires a consistent effort to both follow trends and also to anticipate the future. Over the next 15 years, no one knows whether artificial intelligence, additive manufacturing, autonomous vehicles, the Internet of Things, or virtual reality will have the most impact on manufacturers. Each will almost certainly bring disruption and change to those industries that we classify as “advanced manufacturing.” Many of the products and processes that we call new and advanced today will be obsolete and forgotten by 2030.

In PwC’s report, *How to Drive Innovation and Business Growth*, innovations are categorized as:

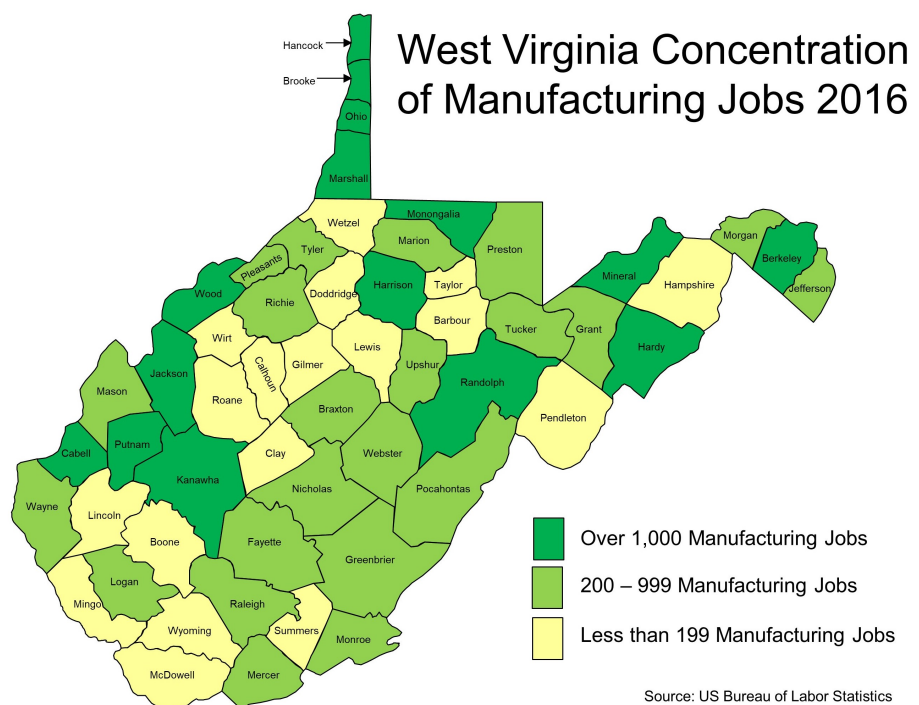
- Incremental Innovations make small changes to a company’s existing technologies and business models.
- Breakthrough Innovations make significant changes to either the technology or business model, producing significant growth.
- Radical Innovations, which take place more rarely, combine technology and business model innovation to create major new industries with exponential growth.

Radical innovations are often rapid, follow incremental innovations and can take years to develop. But if recent history is any predictor, we are entering a time where radical innovations may become more commonplace. Just a little more than 10 years ago, there were no iPhones, Facebook, Twitter, YouTube, Uber or Pandora. It does not take much imagination to envision a 2030 manufacturing plant where unique production specifics are electronically controlled by the customer, where virtual reality trains and re-trains workers daily, where drones are a major component of delivery infrastructure and where production is completely mobile, moves often and follows the best business environment.

The first three industrial revolutions were driven by mechanization and the availability of power, assembly line organization of production, and finally computerized automation. Industry 4.0 was first defined by the German government and refers, in part, to the new ability for information interaction between the production systems and the products involved. Rapid transformation creates real complications for policy makers.

Do we make rules and make investments for those things that are certain today or do we try to anticipate what will be needed in the future? By injecting anticipation in the decision process, we risk waste and constituent ridicule. But if we wait for new sectors to be fully realized, it is unlikely that we will be on board soon enough to capture the rewards. The four areas of policy focus discussed earlier: business climate, workforce skills, infrastructure and innovation - while subject to change, will remain the foundation for a competitive place for the foreseeable future. By focusing on policy flexibility and continuous competitive analysis, decision makers can increase their impact.

As West Virginia competes for manufacturing jobs, competitiveness has become more than just an existing strong manufacturing presence. An environment that supports manufacturing businesses across a variety of needs is necessary to stand out against the competition. Every region of West Virginia has manufacturing jobs. The sectors differ and regional strengths and



weaknesses are very different, but in all cases good policy should be supported by relevant readily available information.

We recommend that West Virginia’s higher education community work with the private sector to develop better, systemic processes to anticipate and understand the changes impacting the state’s economy and also develop a communication strategy to share the information with policy makers, the business community and the public.

4) Ensure a Competitive Business Climate

Annually for the past 31 years, *Area Development Magazine* has surveyed corporate executives and site selection consultants to determine the top factors that they believe are most important for corporate investment decisions. The corporate tax rate, state and local incentives, tax exemptions and fast track permitting are regularly among the most important factors.

A state’s overall business climate is a product of many factors including workforce talent, infrastructure and innovation that will be discussed in the next three sections. Apart from those areas the costs of doing business, tax and incentive policies, the regulatory situation and the consistency and fairness of the state legal systems appear to be the most often cited.

The [Heritage Foundation](#) summarizes, “Economic research has empirically demonstrated that a positive business environment fosters enterprise development and overall economic growth. Determining what constitutes a positive business environment depends widely on factors often outside the

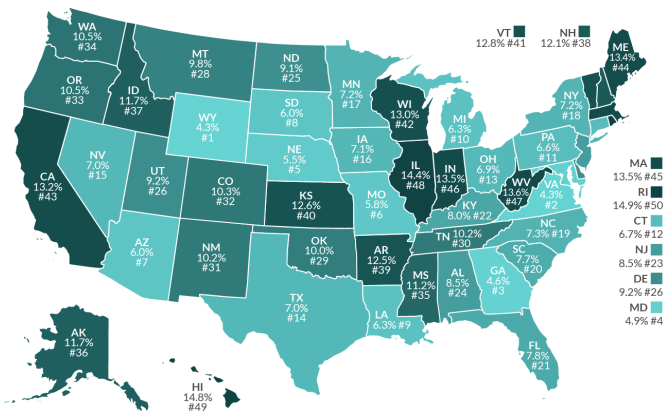
Top Factors for Companies Considering New Investment

- 1) Availability of skilled labor
- 2) Highway accessibility
- 3) Labor costs
- 3) Proximity to major markets
- (3) State & local incentives
- (3) Available land
- (3) Tax exemptions
- (8) Energy availability and costs
- (9) Proximity to suppliers
- (10) Training programs/Technical schools
- (11) Availability buildings
- (12) Accessibility to a major airport

Source: [Area Development 31th Annual Survey of Corporate Executives](#), March 2017

Location Matters: The State Tax Costs for Labor-Intensive Manufacturing Facilities

Total Effective State and Local Tax Rate on a Mature Labor-Intensive Manufacturing Facility, 2014



Notes: Map shows effective combined state and local tax rate for a hypothetical mature labor-intensive manufacturer located in a mid-sized city in each state. The model firm, which is at least ten years old, is assumed to employ 300 people, chiefly in management, installation, maintenance, production, and assembly. We assume a capital investment of \$65 million, including a 250,000 square foot suburban industrial building owned by the business. Revenue is approximately \$174 million with a gross profit ratio of 20 percent and earnings before tax of 7 percent. The equity ratio is assumed to be 30 percent. We also assume that all property and payroll is located within the state, while sales are assumed to be distributed among all 50 states in proportion to the relative population of each state.
Source: Tax Foundation, *Location Matters* (August 2015)

Total Effective State and Local Tax Rate
Lower Rate Higher Rate

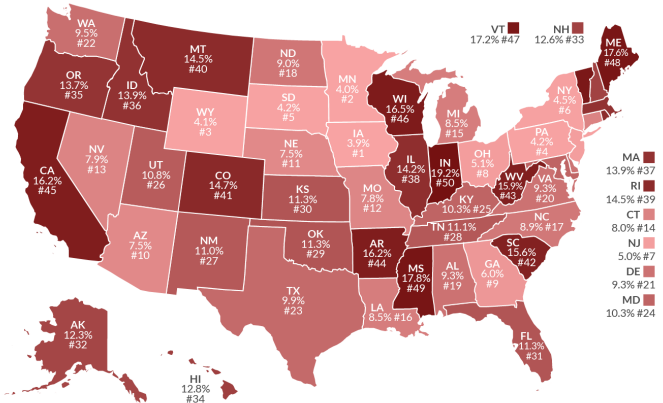
influence of the average business owner. The wide range of factors affecting business environments includes commercial law, sound public institutions, open trade policy, infrastructure, technology and others.”

For policy makers, ensuring the best business climate is often complicated by tradeoffs. Regulations versus safety, incenting some companies and not others, and fairness in regulation are typical discussions. Inherently, developing strategies is about making choices. What may be the best and obvious choice for some places will be a nonstarter for others.

West Virginia’s bottom or near bottom rankings for business-friendliness, legal climate and state and local tax costs for both labor and capital-intensive manufacturing need to be a priority now. A low cost of doing business, low worker’s compensation costs and low energy cost provide a foundation to build on, but much more must be done.

Location Matters: The State Tax Costs for Capital-Intensive Manufacturing Facilities

Total Effective State and Local Tax Rate on a Mature Capital-Intensive Manufacturing Facility, 2014



Map shows effective combined state and local tax rate for a hypothetical mature capital-intensive manufacturer located in a midsize city in each state. The model firm, which is at least ten years old, is assumed to have 200 positions, including management, administrative, installation and maintenance, production, transportation, and materials employees. We assume it has a capital investment of \$300 million, including a 250,000 square foot suburban industrial building owned by the firm. Revenue is assumed to be approximately \$200 million with a gross profit ratio of 25 percent, earnings before tax of 10 percent, and an equity ratio of 50 percent. We also assume that all property and payroll is located within the state, while sales are assumed to be distributed among all 50 states in proportion to the relative population of each state.

Source: Tax Foundation, Location Matters (August 2015)



TAX FOUNDATION

@TaxFoundation

We recommend that improvements to the state’s manufacturing business climate be an immediate top priority for the Governor and the legislature. We recommend that a public-private commission be created to develop a legislative and policy agenda for 2018 that identifies opportunities for improvements to legal, regulatory, and manufacturing taxes that would improve the state’s rankings by ten places within the next five years.

5) Enhance Workforce Skills

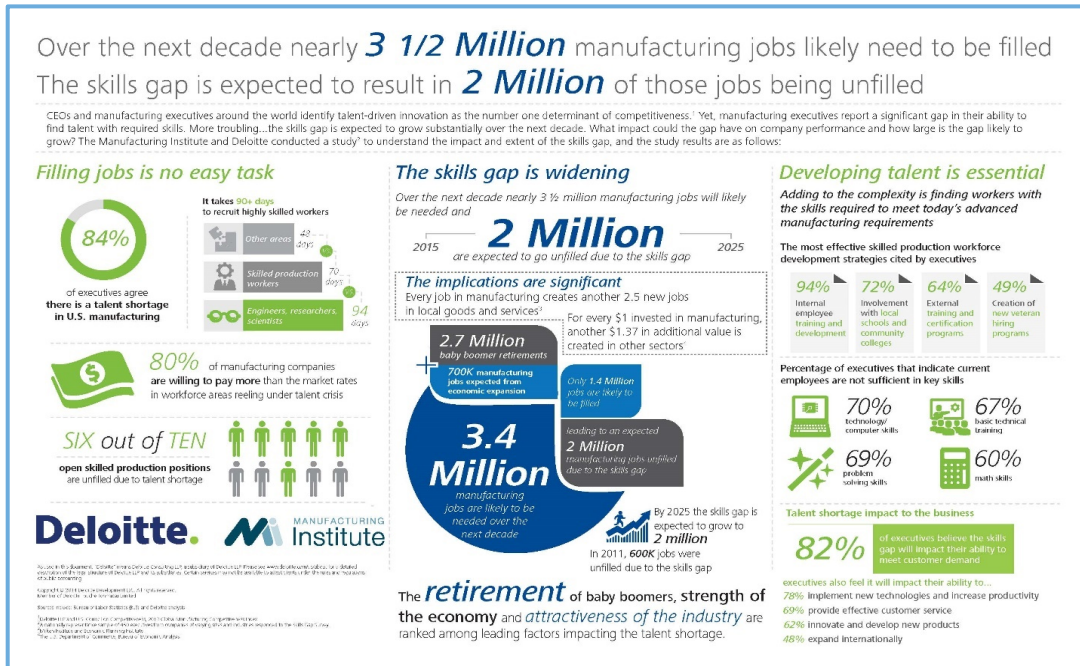
Among business groups, trade associations, economic developers and elected officials, the policy conundrum of 2017 is the millions of people that need a good job and business’ loud lament that they cannot find qualified workers. This year no other public policy issue is more discussed or bemoaned.

U.S. manufacturers consistently say that they have trouble finding workers. [The Manufacturing Institute and Deloitte Consulting](#) estimate that nearly 70 percent of firms will

“Investments in an innovative economy will pay off only if a base of middle-skilled talent is in place to meet projected demand for skills in new innovative industries.”

[Driving Innovation from The Middle, SGA 2011](#)

experience “moderate to severe shortage” of qualified workers and 84 percent believe that there is a talent shortage.



Overcoming public perception is one issue that must be addressed. SME, an organization that serves the manufacturing industry, released a study in 2016 that shows that many parents view manufacturing as outdated, dirty, not exciting or challenging and not well-paying. Jeffrey Krause, CEO of SME said, “A serious misconception is that manufacturing is dirty, dark or dangerous; and isn’t seen as an optimal career choice. The reality is far from that.” The report concludes that the average U.S. manufacturing worker makes \$77,506 a year.

Finding workers with the right skills is another area where we can make progress. The Manufacturing Institute and Deloitte Consulting report, *The Skills Gap in Manufacturing in 2015 and Beyond*, states that “Over the next decade, nearly three and half million manufacturing jobs likely need to be filled and the skills gap is expected to result in two million of those jobs going unfilled. An estimated 2.7 million jobs are likely to be needed as a result of retirements of the existing workforce, while 700,000 are likely to be created due to natural business growth.” The skills highlighted as most deficient include technology/computer, problem solving, basic technical training and math.

The National Association of Manufacturers has examined how to overcome this skills gap, suggesting that a unified voice to align stakeholders can build a new system to deliver mid-skilled manufacturing talent. In SGA’s *Driving Innovation from the Middle - Middle Skill Jobs in the American South’s Economy*, recommendations included sector partnerships, establishing career pathways and

“There is no good job today that does not require more and better education to get it, hold it, or advance in it.”

Thomas Friedman

counting middle-skill credentials.

Governors were encouraged to:

- Set a bold goal for the number of residents to be trained with market-ready skills
- Change the perception of middle-skill jobs;
- Make sure that training dollars go toward in-demand credentials aligned with real jobs;
- Ensure that community colleges and public universities are filling the gaps;
- Engage your Workforce Investment Boards; and
- Convene industry leaders in a partnership targeting open middle-skill positions.

The talent bar for a successful manufacturing worker is clearly rising. High school graduation was rarely a prerequisite for the textile mill, but today's manufacturing jobs often require certification and skills earned after a high school diploma. How do we bridge the gap between the workforce's current skills and what it takes to be successful in the coming years? The 2013 Report on the Future of the South, *Reimagining Workforce Development*, researched by the Southern Growth Policies Board, presented three broad recommendations as key to our future success. Borrowing from the three "R's" that have historically been central to our education system, we need to:

1) Re-imagine Readiness

Many say that we have lost a strong connection between education and jobs; that education needs to be recoupled with work in a more systemic way.

Key Actions:

- Strengthen the curriculum connections between education and job skills
- Re-think credentials and their value in the workplace
- Give students more exposure to the world of work
- Scale technology so that every student can benefit from a high quality, personalized learning experience

2) Re-engage Adult Learners and Disconnected Youth

Nearly half of the workforce in 2030 are already working today. At the same time, more than one in seven young people are disconnected from the foundations for future success—neither working nor in school. We need to re-engage both adults and youth in the education system to continuously update their skills in order to meet our need for a talented workforce in the future.

Key Actions:

- Target workers with some credits, but no degree or credential
- Help dislocated workers rejoin the workforce
- Recover disconnected youth

3) Re-align Relationships and Resources

We need to better align education, workforce and economic development assets to create clear pathways and smooth transitions that will facilitate lifelong learning.

Key Actions:

- Create continuity in education and workforce development from early childhood through career
- Align and track data across the educational and workforce pipeline
- Engage businesses in a meaningful way

We Recommend that West Virginia take a more demand-driven approach to education and workforce development, focusing on the issues of the employer.

Some of the key components of a demand-driven workforce development system include:

- Formal connections among employers, unions, educators, government, not-for-profit service providers, and citizens in the labor market to identify, anticipate and respond to training and education needs,
- Up-to-date and easily accessible labor market information,
- Job placement, retention and support services that improve access to employment and help both employers and employees,
- The means to certify and quantify knowledge and skills gained outside the formal education system that are accepted by employers, and
- Expanded work experience options, including apprenticeships.

6) Promote Innovation

Rapid change predetermines that innovation will fuel growth and that places that embrace and support innovation will benefit. Policies that support innovation have been another much-published topic over the past decade. [The Pew Center on the States and the National Governors Association identified a framework for innovation](#), and their research suggested that when these components were present innovation was more likely:

- Expertise - new discoveries, new knowledge and new insight comes from people with the necessary resources
- Interaction between sectors and individuals
- Diversity of thought
- Application-commercialization

Research from the Southern Growth Policies Board recommended that a strong innovation-focused state would:

- 1) Build a governance structure competitively positioned on taxes, regulation, and leadership.
- 2) Conduct a regulatory audit to identify impediments to business innovation.
- 3) Promote a culture that supports entrepreneurship, creativity, risk, and change.
- 4) Continuously monitor changing economic conditions with broadly distributed feedback, including benchmarking against competitors.
- 5) Monitor and engage new global markets and shifting priorities for direct foreign investment and export promotion.
- 6) Maintain consistent organizational capacity with responsibility to create innovation-based jobs and companies.
- 7) Establish an advisory group for science and technology, with representatives from government, education and the private sector, to advise the governor and legislators.

West Virginia's technology industry's five-year employment growth was the lowest in the country. High technology manufacturing is where significant growth is occurring nationally and West Virginia has some examples of success. We must capture more.

We recommend that the Governor establish a public-private-higher education Innovation and Technology group to research the state's technology sector and develop a set of recommendations for 2019.

7) Invest in Infrastructure

The 2016 IEDC Economic Development Research Partners report, *Critical Condition: Infrastructure for Economic Development*, defines infrastructure as “the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions.” Economic infrastructure is defined by scholar Johan Fourie as, “infrastructure that promotes economic activity such as roads, highways, railroads, airports, sea ports, electricity, telecommunications, water supply and sanitation”.

This report and many others have sounded alarms about the risk of a declining infrastructure in America. “Historical evidence suggests that the astonishing economic development that the United States experienced over the past two centuries was made possible by the high-quality infrastructure the nation had the foresight to invest in.” But the national infrastructure today, “faces serious challenges that deserve urgent attention.”

Infrastructure has always been important for corporate investment decisions. *KPMG's report, Bridging the Global Infrastructure Gap*, reports that only 14 percent of senior executives believe that current infrastructure is “completely adequate”, while 90 percent say that “the quality and availability of infrastructure directly affects where they locate and expand business operations.”

Global rankings such as those by the World Economic Forum and national assessments such as those from the American Society of Civil Engineers warn that what was once a clear competitive advantage for the United States is less so today. Investments in public infrastructure are falling and the American Society of Civil Engineers estimates it will take over \$3.5 trillion in new investment to bring the nation's infrastructure into good repair. Without good infrastructure, job growth wanes and investments flow to opportunities elsewhere.

The federal government is exacerbating the problem. At the beginning of the last century the federal government was the major player, providing infrastructure. The Federal Highway Act of 1916

created a funding model where the federal government paid for the construction of new roads, and state and local governments maintained them. Similar arrangements helped small communities build water and sewer systems. During the Great Depression, the Works Progress Administration (WPA) put people back to work building hundreds of thousands of miles of roads, thousands of bridges and iconic projects such as the Golden Gate Bridge and the Hoover Dam. According to the [Center for Budget and Policy Priorities](#), state and local governments currently account for nearly 75 percent of public infrastructure spending (this particular report counts education building in infrastructure).

Global trade has grown, and to be competitive U.S. companies need to efficiently move goods. More often today their business model is built on just-in-time delivery. Business travel is increasing. Power generation and distribution is transforming. Finally, the digital revolution depends on cellular and broadband networks that connect us all.

Across the country, strategic tradeoffs are vexing policy makers as they seek new revenue sources for improving and extending infrastructure. User fees, toll roads, revised gas tax models, I-banks, and public-private partnerships are debated and discussed as solutions, but many states face complex opposition to every alternative.

Infrastructure competitiveness will be determined by a combination of future funding from federal, state and local sources. While this complicates the process of collaboration, it is similar to business climate, workforce skills and innovation, each with multiple funders and actors.

In this area, West Virginia has some competitive strengths to build on. One area of weakness is the availability of high-speed broadband to significant portions of the state, limiting the potential for business growth.

“Despite the fact that infrastructure is a critical part of daily life for Americans, the infrastructure deficit in the United States grows with each passing day.”

Paying for Local Infrastructure in a New Era of Federalism

National League of Cities

We recommend that the work of the West Virginia Broadband Council continues to be a priority and that the Council continues to pursue USDA Community Connect grants to expand broadband into underserved areas of the state.

8) Collaborate to Compete



As was highlighted earlier in this paper, collaboration is hard. A hyper-politicized policy environment, special-interest influence and a scarcity of resources combine to make working together to improve the state’s general competitiveness a task for only the ardent few. Despite the difficulties, best practice research suggests that collaborative, multi-sector, and often bipartisan approaches must be developed.

The U.S. Council on Competitiveness’ 2010 report, *Collaboration*, examined how collaboration among regional or in our case state and regional actors worked best. They found that:

- “Less successful regions...seem to lack the ability to think, plan and act **regionally**
- Regardless of whether a region can bring the right people to the table or develop a strategic plan, the true test is whether the region can **act effectively**
- The key to creating collaboration is effective **leadership**
- The structures are more frequently networked than formalized
- Leaders need to be bridge builders, boundary crossers, and conveners”

The West Virginia Manufacturers Association has a strong and active board and can be a strong partner with public leaders to make our state’s economy stronger.

We recommend that our organization and its members aggressively respond to this call to action; by encouraging the public sector to embrace and enact the recommendations contained in this report, by enthusiastically participating in the recommended collaborative efforts needed to make progress, and by developing a public dashboard to measure progress.

Appendix 1

MANUFACTURING COMPETITIVENESS INDEX

BUSINESS CLIMATE	Manufacturing Industry Health Scorecard (Conexus Indiana) 2016	top marginal corporate tax rate 2017	Legal Climate Rankings (2015)	Air Quality - PM2.5 (2015)	Workers Comp insurance premium per \$100/payroll 2016	State and Local Tax Costs for Capital-Intensive Manufacturing 2014	State and Local Tax Costs for Labor-Intensive Manufacturing 2014	Value of \$100 2016	Greenhouse Gas Emissions Per Capita (Metric Tons of CO2) 2014	AVERAGE RANKING	STATE RANK
Alabama	6	19	46	33	26	19	23	3	39	23.8	21
Alaska	46	49	12	4	46	32	36	43	47	35.0	47
Arizona	19	31	25	37	13	10	7	27	19	20.9	12
Arkansas	19	16	41	37	3	44	39	2	35	26.2	29
California	19	19	47	50	50	44	43	47	2	35.7	49
Colorado	38	16	16	9	16	41	32	39	25	25.8	28
Connecticut	16	1	22	24	46	14	12	45	6	20.7	11
Delaware	38	19	1	37	45	19	26	38	21	27.1	34
Florida	38	36	44	10	18	29	21	35	12	27.0	33
Georgia	36	7	31	41	24	9	3	19	19	21.0	13
Hawaii	46	43	30	14	34	34	49	50	17	35.2	48
Idaho	14	22	6	49	23	36	36	20	8	23.8	21
Illinois	19	34	48	46	43	38	48	36	29	37.9	50
Indiana	1	5	18	47	2	50	45	15	43	25.1	25
Iowa	1	22	4	33	27	1	16	11	40	17.2	6
Kansas	9	28	19	21	10	29	40	14	37	23.0	20
Kentucky	1	28	39	44	15	24	22	5	44	24.7	24
Louisiana	19	11	49	21	41	15	9	15	46	25.1	25
Maine	31	43	14	13	37	48	44	29	13	30.2	41
Maryland	38	7	28	33	13	24	4	46	9	22.4	18
Massachusetts	19	12	17	10	8	36	45	44	4	21.7	17
Michigan	1	5	24	24	17	15	9	22	24	15.7	2
Minnesota	16	26	13	17	29	2	17	30	26	19.6	9
Mississippi	9	45	43	27	22	49	35	1	32	29.2	40
Missouri	19	3	42	37	31	12	6	8	33	21.2	15
Montana	46	38	34	3	40	39	28	23	44	32.8	45
Nebraska	31	16	3	15	19	10	5	13	42	17.1	4
Nevada	46	38	35	43	9	13	14	31	18	27.4	37
New Hampshire	9	12	5	10	34	33	38	42	11	21.6	16
New Jersey	19	35	38	24	49	7	23	48	15	28.7	39
New Mexico	46	46	45	7	31	27	30	24	37	32.6	44
New York	44	41	21	17	48	6	17	49	1	27.1	34
North Carolina	16	3	7	23	29	17	19	18	17	16.6	3
North Dakota	44	50	15	2	1	18	25	17	49	24.6	23
Ohio	9	12	27	45	11	8	13	7	31	18.1	8
Oklahoma	31	28	33	33	43	29	29	9	41	30.7	42
Oregon	6	1	32	8	7	35	33	34	5	17.9	7
Pennsylvania	31	22	37	48	24	4	11	32	30	26.6	31
Rhode Island	36	37	26	15	42	39	50	33	7	31.7	43
South Carolina	1	31	36	29	33	42	20	12	22	25.1	25
South Dakota	19	26	9	6	19	4	7	4	28	13.6	1
Tennessee	9	15	23	30	21	28	30	10	23	21.0	13
Texas	19	31	40	42	11	23	14	28	36	27.1	34
Utah	19	7	10	27	6	26	26	26	34	20.1	10
Vermont	19	48	2	5	37	47	41	37	2	26.4	30
Virginia	38	7	11	20	5	19	1	40	13	17.1	4
Washington	14	38	29	17	36	22	33	41	10	26.7	32
West Virginia	31	42	50	32	4	43	47	6	48	33.7	46
Wisconsin	6	22	20	30	39	46	42	20	27	28.0	38
Wyoming	38	47	8	1	28	3	2	25	50	22.4	18

MANUFACTURING COMPETITIVENESS INDEX

WORKFORCE	Percentage of Population With Adult Obesity (2016)	Persons age 18 to 24 not attending school, not working, and no degree beyond high school 2015	High School Graduation Rate for all students 2014-15	Labor Force Participation Rate (2016)	Manufacturing Output Per Manufacturing Employee (2016)	Change in Manufacturing Output Per Manufacturing Employee (2010-2016)	Age 25-44 Population Growth (2011-2016)	Completed Tech & STEM Education Programs Per 1,000 Enrolled Students (2015)	Percent Change in Tech & STEM Education Program Completions (2010-2015)	Average 8th Grade Reading Score	Average 8th Grade Math Score	Veteran Unemployment Rate 2015	Veteran % share of total population 2015	total number of sub-baccalaureate occupational credentials in manufacturing 2013	sub-baccalaureate occupational credentials in manufacturing as % of total credentials 2013	AVERAGE RANKING	STATE RANK
Alabama	47	41	3	48	35	11	37	11	48	43	50	16	16	27	22	30.3	44
Alaska	30	41	46	14	47	3	5	34	36	40	32	14	1	45	29	27.8	35
Arizona	21	41	44	40	16	23	17	32	43	32	25	27	18	9	24	27.5	31
Arkansas	47	46	25	45	46	9	30	44	38	43	41	31	13	24	14	33.1	46
California	4	27	31	34	5	5	15	46	33	43	41	47	47	1	35	27.6	33
Colorado	1	14	45	12	17	38	2	10	16	14	13	32	10	14	12	16.7	3
Connecticut	9	8	14	15	13	36	50	27	36	4	20	34	48	19	4	22.5	18
Delaware	27	14	22	31	22	47	18	31	6	32	32	9	35	49	50	28.3	39
Florida	13	27	42	42	38	25	6	30	17	32	41	42	26	4	41	28.4	40
Georgia	30	41	40	33	34	35	29	18	29	37	35	36	13	5	8	28.2	38
Hawaii	3	14	33	29	42	2	3	50	44	47	35	2	4	47	36	26.1	26
Idaho	13	27	39	22	41	33	15	49	29	9	20	44	7	40	33	28.1	37
Illinois	33	19	22	17	14	19	45	23	26	21	28	40	44	3	15	24.6	24
Indiana	40	19	15	20	11	43	38	7	17	14	9	27	33	23	36	23.5	20
Iowa	37	6	1	2	29	27	30	33	35	14	13	9	36	28	31	22.1	14
Kansas	29	19	20	9	27	10	33	40	24	21	20	38	21	26	21	23.9	22
Kentucky	44	37	8	46	28	29	43	22	27	14	37	19	28	10	3	26.3	27
Louisiana	46	47	43	43	1	40	20	3	8	48	49	45	33	6	2	28.9	41
Maine	24	10	12	28	49	48	45	48	17	14	17	25	10	39	20	27.1	30
Maryland	24	14	16	9	8	21	22	1	13	14	25	11	26	33	32	17.9	6
Massachusetts	2	1	13	18	6	14	24	6	20	2	1	48	45	35	42	18.5	7
Michigan	40	27	36	37	18	31	41	9	46	31	37	46	40	18	42	33.3	47
Minnesota	17	1	32	3	21	6	27	43	34	6	2	7	42	17	27	19.0	8
Mississippi	49	50	47	49	44	22	40	26	4	50	46	40	36	31	15	36.6	50
Missouri	34	19	10	16	32	28	36	20	11	21	29	27	21	21	25	23.3	19
Montana	6	27	19	23	10	1	10	14	11	6	9	17	5	46	17	14.7	2
Nebraska	37	6	5	3	40	34	23	45	39	9	13	1	28	36	6	21.7	13
Nevada	8	37	49	35	33	32	11	28	2	43	41	49	10	44	49	31.4	45
New Hampshire	10	1	7	6	39	16	47	47	5	1	2	13	21	48	47	20.7	12
New Jersey	13	19	2	24	12	42	42	16	41	5	4	39	50	29	45	25.5	25
New Mexico	18	47	50	46	26	39	33	42	13	49	46	19	13	34	27	33.5	48
New York	6	19	38	39	20	44	26	24	29	32	32	33	49	13	46	30.0	43
North Carolina	35	27	22	36	7	40	33	15	15	38	29	22	17	11	19	24.4	23
North Dakota	36	1	17	1	30	4	1	8	45	21	7	6	28	43	13	17.4	5
Ohio	32	19	34	31	25	17	39	11	39	28	17	25	31	12	40	26.7	28
Oklahoma	42	37	20	38	37	12	14	5	20	32	41	22	9	16	7	23.5	20
Oregon	20	27	48	30	2	50	12	36	7	14	25	49	21	37	39	27.8	35
Pennsylvania	26	19	26	27	23	15	30	4	42	9	20	34	40	7	9	22.1	14
Rhode Island	10	10	29	21	45	18	28	35	49	29	29	5	43	38	11	26.7	28
South Carolina	39	41	35	43	31	26	19	38	20	40	40	15	7	25	23	29.5	42
South Dakota	23	14	27	5	48	24	13	17	46	21	17	2	18	42	17	22.3	16
Tennessee	45	36	9	41	24	20	25	41	29	29	37	37	18	15	10	27.7	34
Texas	43	37	4	25	3	7	4	25	10	38	20	22	32	2	30	20.1	10
Utah	5	10	26	6	36	49	8	13	2	9	13	27	45	32	26	20.5	11
Vermont	12	1	11	12	50	46	48	39	50	2	5	2	36	50	48	27.5	31
Virginia	21	10	20	19	15	45	21	19	25	21	7	11	2	22	36	19.6	9
Washington	19	27	41	25	9	37	7	2	27	21	9	17	6	8	5	17.3	4
West Virginia	50	47	18	50	19	13	48	29	1	40	46	42	21	41	44	33.9	49
Wisconsin	27	8	6	8	43	30	44	21	23	6	6	19	39	20	34	22.3	16
Wyoming	16	27	37	11	4	8	9	37	9	9	9	8	3	30	1	14.5	1

MANUFACTURING COMPETITIVENESS INDEX

INFRASTRUCTURE	Total State Spending on Transportation Per Capita (FY2016)	Average Retail Electricity Price for Industrial Customers, Cents Per KwH (Feb 2017)	percent of structurally deficient bridges (2016)	% growth in Freight Shipments tons (thousands) (2007-2012)	% growth in Freight Shipments \$\$ (millions) (2007-2012)	Miles of Interstate highways per 10,000 people (2015)	Average Retail Natural Gas Price for Industrial Customers, \$ per thousand cubic feet (Feb 2017)	State Transportation Expenditures as % of Total Expenditures (FY2015)	Percentage of Population Without 25 Mbps/3 Mbps Broadband Access - All Areas (2015)	AVERAGE RANKING	STATE RANK
Alabama	48	17	21	42	24	20	9	31	41	28.1	38
Alaska	1	49	32	29	35	2	39	3	46	26.2	27
Arizona	46	15	4	46	49	28	29	50	28	32.8	48
Arkansas	31	8	17	25	27	18	35	39	45	27.2	33
California	41	44	11	32	32	47	43	45	10	33.9	49
Colorado	40	29	13	8	17	26	19	41	20	23.7	17
Connecticut	5	46	22	1	2	41	41	14	1	19.2	6
Delaware	7	34	8	14	21	49	46	25	5	23.2	15
Florida	24	38	3	36	32	45	30	5	13	25.1	24
Georgia	42	10	6	39	41	39	11	43	18	27.7	35
Hawaii	4	50	13	40	46	50	50	10	2	29.4	42
Idaho	22	13	30	18	36	8	8	16	38	21.0	9
Illinois	37	23	25	15	16	29	31	18	18	23.6	16
Indiana	49	33	22	26	31	23	27	47	36	32.7	47
Iowa	18	9	49	9	18	16	13	22	32	20.7	8
Kansas	34	31	26	10	8	10	25	25	32	22.3	12
Kentucky	17	11	24	44	30	24	7	13	34	22.7	13
Louisiana	43	7	41	21	15	22	6	41	40	26.2	27
Maine	20	41	42	12	19	13	47	23	25	26.9	31
Maryland	8	40	15	33	20	44	48	8	9	25.0	22
Massachusetts	12	47	31	27	28	43	45	16	5	28.2	39
Michigan	35	32	37	23	42	38	27	30	25	32.1	46
Minnesota	10	36	16	13	25	31	10	8	25	19.3	7
Mississippi	19	21	39	20	7	14	22	37	50	25.4	25
Missouri	44	22	40	47	37	19	38	24	41	34.7	50
Montana	14	2	28	11	11	3	33	6	49	17.4	5
Nebraska	23	27	45	24	10	15	20	25	34	24.8	21
Nevada	38	5	1	48	14	20	5	45	16	21.3	10
New Hampshire	39	45	38	31	28	30	49	15	13	32.0	44
New Jersey	13	42	29	16	39	48	40	19	5	27.9	37
New Mexico	29	20	18	35	6	7	12	49	41	24.1	19
New York	25	3	35	17	48	42	37	33	2	26.9	31
North Carolina	26	14	33	30	40	37	34	11	13	26.4	29
North Dakota	2	39	43	21	3	5	2	1	31	16.3	3
Ohio	47	25	20	18	42	33	14	48	16	29.2	40
Oklahoma	33	4	43	5	9	17	32	31	47	24.6	20
Oregon	32	18	10	49	47	25	17	29	20	27.4	34
Pennsylvania	15	28	48	28	26	32	42	11	11	26.8	30
Rhode Island	27	48	50	2	5	46	44	39	2	29.2	40
South Carolina	30	16	34	45	44	27	16	38	38	32.0	44
South Dakota	9	35	47	3	1	4	18	2	22	15.7	2
Tennessee	50	19	9	50	50	12	24	43	28	31.7	43
Texas	28	6	2	4	4	36	3	21	22	14.0	1
Utah	45	12	5	41	45	9	26	19	11	23.7	17
Vermont	6	43	12	7	12	6	22	7	36	16.8	4
Virginia	11	24	19	43	22	34	15	4	22	21.6	11
Washington	36	1	7	38	13	40	39	25	5	22.7	13
West Virginia	16	26	46	34	34	11	1	34	48	27.8	36
Wisconsin	21	37	27	6	23	35	21	36	28	26.0	26
Wyoming	3	30	35	36	38	1	4	34	44	25.0	22

MANUFACTURING COMPETITIVENESS IND

INNOVATION	Technology Licenses and Options Executed from Universities (2015)	Patents Issued (2010-2015)	Total Technology Industry Employment Growth (2011-2016)	Total R&D % of GDP (2012)	Business Performed R&D - % of Private Industry Output (2013)	Venture Capital Funding Per \$1 Million of GDP (2015)	Start-Up Firms per 1,000 Firms (2016)	AVERAGE RANKING	STATE RANK
Alabama	36	35	37	22	29	35	36	32.9	36
Alaska	49	50	44	48	49	46	23	44.1	48
Arizona	16	16	13	17	15	30	8	16.4	13
Arkansas	34	42	46	45	44	41	29	40.1	44
California	1	1	7	4	1	1	6	3.0	1
Colorado	23	14	19	19	19	7	7	15.4	10
Connecticut	41	18	35	8	6	9	45	23.1	22
Delaware	46	37	43	6	3	13	14	23.1	22
Florida	4	10	14	35	32	28	2	17.9	18
Georgia	10	15	5	32	29	11	11	16.1	12
Hawaii	47	45	27	41	42	46	38	40.9	46
Idaho	31	25	24	11	12	19	13	19.3	19
Illinois	17	7	15	17	16	14	25	15.9	11
Indiana	15	21	23	14	14	36	41	23.4	24
Iowa	18	27	33	29	25	42	49	31.9	34
Kansas	29	28	42	28	23	30	31	30.1	33
Kentucky	37	32	48	38	32	39	16	34.6	40
Louisiana	35	38	47	49	47	43	31	41.4	47
Maine	25	41	10	38	32	12	37	27.9	30
Maryland	14	22	31	2	19	6	26	17.1	16
Massachusetts	3	4	11	2	2	2	28	7.4	3
Michigan	12	6	1	7	5	25	33	12.7	5
Minnesota	9	9	25	14	12	16	34	17.0	15
Mississippi	39	43	38	35	47	46	35	40.4	45
Missouri	19	24	6	12	9	22	2	13.4	8
Montana	32	46	28	41	44	44	27	37.4	41
Nebraska	33	40	22	35	36	18	40	32.0	35
Nevada	48	31	4	44	39	40	1	29.6	32
New Hampshire	21	30	20	9	7	8	48	20.4	20
New Jersey	27	8	36	10	10	10	17	16.9	14
New Mexico	30	36	41	1	32	23	30	27.6	29
New York	2	3	9	32	29	4	10	12.7	5
North Carolina	8	13	3	22	17	15	18	13.7	9
North Dakota	28	48	29	38	39	45	9	33.7	39
Ohio	11	12	30	27	23	29	48	25.7	26
Oklahoma	40	34	45	45	44	37	21	38.0	42
Oregon	13	17	11	13	8	17	14	13.3	7
Pennsylvania	5	11	31	22	18	20	42	21.3	21
Rhode Island	41	39	34	14	26	33	43	32.9	36
South Carolina	37	29	18	30	36	34	20	29.1	31
South Dakota	43	47	25	45	42	38	39	39.9	43
Tennessee	20	26	16	30	38	27	24	25.9	27
Texas	6	2	21	32	28	26	5	17.1	16
Utah	22	23	2	19	11	3	4	12.0	4
Vermont	45	33	40	22	21	24	47	33.1	38
Virginia	24	20	38	19	27	21	19	24.0	25
Washington	7	5	7	5	3	5	12	6.3	2
West Virginia	44	44	50	41	39	46	50	44.9	50
Wisconsin	26	19	17	22	21	32	44	25.9	27
Wyoming	not reported	49	49	50	49	46	22	44.2	49

MANUFACTURING COMPETITIVENESS INDEX

ECONOMIC STRENGTH	Manufacturing's Share of Gross State Product 2016	Change in Manufacturing's Share of Gross State Product 2011 -2016	Growth in Manufacturing GDP 2011 - 2016	Total Manufacturing Employment 2016	Manufacturing Employment as percent of Total Employment 2016	Change in Real GDP per Capita (2011-2016)	Change in Real Personal Income per Capita (2011-2016)	Change in Real GDP (2011-2016) chained 2009 dollars	Exports of Manufactured Goods % change 2015 - 2016	Total Exports Per Capita (2016)	Manufacturing establishments total capital expenditures (\$millions) 2015	Manufacturing establishments total capital expenditures per manufacturing employee 2015	AVERAGE RANKING	STATE RANK
Alabama	9	6	13	17	5	32	39	39	6	9	13	8	16.3	9
Alaska	49	3	2	49	45	50	50	50	48	50	49	44	40.8	50
Arizona	35	22	29	26	36	41	26	19	15	34	36	50	30.8	34
Arkansas	16	30	32	28	7	26	18	31	46	42	27	25	27.3	32
California	26	7	4	1	30	1	1	3	17	25	2	28	12.1	2
Colorado	40	35	30	30	41	11	2	4	16	44	30	27	25.8	27
Connecticut	27	32	40	27	22	40	45	46	37	15	31	47	34.1	42
Delaware	42	40	47	45	39	45	44	35	47	11	45	18	38.2	48
Florida	45	14	6	12	43	22	37	8	18	36	19	41	25.1	25
Georgia	28	37	31	11	25	14	33	10	41	22	10	13	22.9	19
Hawaii	50	9	3	48	50	25	10	21	50	49	50	43	34.0	41
Idaho	20	16	12	37	22	26	13	13	1	32	35	7	19.5	13
Illinois	18	35	37	5	18	16	6	31	35	14	9	26	20.8	14
Indiana	1	20	22	7	1	20	15	23	12	7	8	19	12.9	3
Iowa	8	26	18	23	4	7	30	11	32	17	16	10	16.8	12
Kansas	13	32	34	25	12	30	32	35	34	26	20	16	25.8	27
Kentucky	5	2	7	18	6	34	30	37	8	5	15	9	14.7	6
Louisiana	3	4	28	31	33	48	33	48	38	2	6	1	22.9	19
Maine	34	44	48	38	28	31	35	42	14	43	41	35	36.1	44
Maryland	44	30	41	34	46	37	45	31	26	45	33	24	36.3	45
Massachusetts	29	26	26	19	33	14	10	15	13	20	24	38	22.3	17
Michigan	4	12	11	4	3	5	9	14	9	6	7	23	8.9	1
Minnesota	15	7	9	14	13	17	14	17	21	19	18	31	16.3	9
Mississippi	14	9	21	29	8	36	37	44	28	21	32	33	26.0	30
Missouri	19	12	17	16	24	23	29	30	7	33	21	40	22.6	18
Montana	38	1	1	47	43	38	41	26	48	48	42	3	31.3	37
Nebraska	25	46	44	35	18	29	47	23	20	23	34	29	31.1	36
Nevada	47	16	23	40	47	47	28	28	2	24	43	36	31.8	38
New Hampshire	23	22	24	36	15	12	12	19	5	27	39	49	23.6	23
New Jersey	39	39	43	20	36	21	24	29	26	29	25	39	30.8	34
New Mexico	48	32	46	44	49	32	42	43	41	47	38	5	38.9	49
New York	46	26	38	10	42	18	6	25	44	37	5	6	25.3	26
North Carolina	6	49	39	9	14	35	27	21	11	28	12	30	23.4	22
North Dakota	41	22	5	46	40	4	36	1	24	30	46	17	26.0	30
Ohio	10	20	20	3	8	9	24	18	23	13	3	22	14.4	5
Oklahoma	33	37	25	32	31	2	8	5	39	46	24	12	24.5	24
Oregon	2	50	50	24	15	46	5	37	3	8	29	42	25.9	29
Pennsylvania	22	19	16	6	18	6	18	16	28	31	4	15	16.6	11
Rhode Island	37	11	14	42	28	26	20	40	4	40	47	48	29.8	33
South Carolina	11	25	15	21	10	23	15	12	10	3	17	20	15.2	7
South Dakota	31	26	35	41	17	43	49	31	45	41	44	45	37.3	47
Tennessee	12	16	10	13	10	9	22	9	18	12	14	21	13.8	4
Texas	17	44	19	2	32	3	15	2	43	4	1	4	15.5	8
Utah	24	47	42	33	27	13	4	7	31	10	28	11	23.1	21
Vermont	32	47	49	43	18	39	22	45	22	16	48	34	34.6	43
Virginia	36	43	45	22	36	44	40	41	36	39	22	37	36.8	46
Washington	20	41	26	15	25	7	3	6	39	1	23	46	21.0	16
West Virginia	30	14	33	39	35	42	48	47	33	35	37	14	33.9	40
Wisconsin	7	41	36	8	2	19	21	27	28	18	11	32	20.8	14
Wyoming	43	5	8	50	48	49	43	49	25	38	40	2	33.3	39

Appendix 2 – Data Sources

SOURCES:	
ECONOMIC STRENGTH	
Manufacturing's Share of Gross State Product (2016)	US Bureau of Economic Analysis (BEA)
Change in Manufacturing's Share of Gross State Product (2011 -2016)	US Bureau of Economic Analysis (BEA)
Growth in Manufacturing GDP (2011 - 2016)	US Bureau of Economic Analysis (BEA)
Total Manufacturing Employment (2016)	US Bureau of Labor Statistics (BLS)
Manufacturing Employment as percent of Total Employment (2016)	US Bureau of Labor Statistics (BLS)
Change in Real GDP per Capita (2011-2016)	US Bureau of Economic Analysis (BEA)
Change in Real Personal Income per Capita (2011-2016)	US Bureau of Economic Analysis (BEA)
Change in Real GDP chained 2009 dollars (2011-2016)	US Bureau of Economic Analysis (BEA)
Exports of Manufactured Goods percentage change (2015 - 2016)	US Census Bureau
Total Exports of Goods Per Capita (2016)	US Census Bureau
Manufacturing establishments total capital expenditures (\$millions) 2015	US Census Bureau
Manufacturing establishments total capital expenditures per manufacturing employee 2015	US Census Bureau
INNOVATION	
Technology Licenses and Options Executed from Universities (2015)	Association of University Technology Managers (AUTM)
Patents Issued (2010-2015)	US Patent & Trademark Office
Total Technology Industry Employment Growth (2011-2016)	Economic Modeling Specialists International (EMSI)
Total R&D % of GDP (2012)	National Science Foundation
Business Performed R&D - percent of Private Industry Output (2013)	National Science Foundation
Venture Capital Funding Per \$1 Million of GDP (2015)	National Venture Capital Association
Start-Up Firms per 1,000 Firms (2016)	Kauffman Index 2017

SOURCES:

SOURCES:	
WORKFORCE	
Percentage of Population With Adult Obesity (2016)	Center for Disease Control (CDC)
Persons age 18 to 24 not attending school, not working, and no degree beyond high school (2015)	US Census Bureau
High School Graduation Rate for all students (2014-15)	Department of Education
Labor Force Participation Rate (2016)	US Bureau of Labor Statistics (BLS)
Manufacturing Output Per Manufacturing Employee (2016)	US Bureau of Economic Analysis (BEA)
Change in Manufacturing Output Per Manufacturing Employee (2010-2016)	US Bureau of Economic Analysis (BEA)
Age 25-44 Population Growth (2011-2016)	US Census Bureau
Completed Tech & STEM Education Programs Per 1,000 Enrolled Students (2015)	Economic Modeling Specialists International (EMSI)
Percent Change in Tech & STEM Education Program Completions (2010-2015)	Economic Modeling Specialists International (EMSI)
Average 8th Grade Reading Score (2015)	National Center for Education Statistics
Average 8th Grade Math Score (2015)	National Center for Education Statistics
Veteran Unemployment Rate (2015)	US Census Bureau
Veteran % share of total population (2015)	US Census Bureau
Total number of sub-baccalaureate occupational credentials in manufacturing (2013)	National Center for Education Statistics
Sub-baccalaureate occupational credentials in manufacturing as % of total credentials (2013)	National Center for Education Statistics
BUSINESS CLIMATE	
Manufacturing Industry Health Scorecard (Conexus Indiana) (2016)	Conexus Indiana Manufacturing Scorecard
Top marginal corporate tax rate (2017)	Tax Foundation
Legal Climate Rankings (2015)	Institute for Legal Reform
Air Quality -Average Exposure to PM2.5 (2015)	Center for Disease Control (CDC)
Workers Comp insurance premium per \$100/payroll (2016)	Oregon Department of Consumer and Business Services
State and Local Tax Costs for Capital- Intensive Manufacturing (2014)	Tax Foundation
State and Local Tax Costs for Labor- Intensive Manufacturing (2014)	Tax Foundation
Value of \$100 (2016)	Wall Street 24/7
Greenhouse Gas Emissions Per Capita (Metric Tons of CO2) (2014)	Environmental Protection Agency (EPA)

SOURCES:

INFRASTRUCTURE

Total State Spending on Transportation Per Capita (FY2016)	National Association of State Budget Officers
Average Retail Electricity Price for Industrial Customers, Cents Per Kwh (Feb 2017)	Energy Information Administration (EIA)
Percentage structurally deficient bridges (2016)	Federal Highway Administration
Percentage growth in Freight Shipments tons (thousands) (2007-2012)	US Department of Transportation
Miles of Interstate highways per 10,000 population (2015)	Federal Highway Administration
Percentage growth in Freight Shipments \$\$ (millions) (2007-2012)	US Department of Transportation
Average Retail Natural Gas Price for Industrial Customers, \$ per thousand cubic feet (Feb 2017)	US Energy Information Administration
State Transportation Expenditures as percent of Total Expenditures (FY2015)	National Association of State Budget Officers
Percentage of Population Without 25 Mbps/3 Mbps Broadband Access - All Areas (2015)	Federal Communications Commission