2018 Indiana Manufacturing Survey:

Industry 4.0 Has Arrived

KSM KATZ SAPPER & MILLER

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Foreword

In 2017, the results of our annual manufacturing survey – now in its 12th year – concluded that, although workforce development issues continued to concern Hoosier manufacturers, many companies were strategically shifting their attention toward upgrading automation and expanding facilities for growth. If last year's shift in favor of automation and facilities was a growing wave, then this year's results seem more like a tsunami. In 2018, a record 58% of Hoosier manufacturers reported that investing in facilities, machinery, and related information technologies was their top concern, while the percentage of manufacturers ranking workforce development as their highest priority shrank to its lowest level in a decade.

Since before the Great Recession, never-ending stories have been told about the manufacturing industry's skills gap and talent attraction problems. But the dawn of Industry 4.0 has arrived, and it appears the manufacturing industry is beginning to embrace it as a solution to these issues.

Plainly speaking, Industry 4.0 (a.k.a. "digital manufacturing" or "smart manufacturing") is simply the best of traditional manufacturing carefully blended with the most advanced and capable new technologies.

When asked about the effect of new technologies and automation on jobs, about half of all respondents indicate they expect it to increase the demand for skilled workers in manufacturing but reduce demand for unskilled positions. Equally as interesting, the percentage of employers that believe they must take responsibility for their own workforce development has increased to 61% in 2018, up from 51% in 2017.

When asked in our 2018 survey, "How is digital technology or advanced 'smart' manufacturing currently perceived within your company," 41% of respondents stated it was a positive investment for growth, while another 31% considered it a necessity to remain competitive. Conversely, just 28% of Hoosier manufacturers said that Industry 4.0 was not yet a top priority. In short, after years of anticipating its arrival, with our 2018 report we can conclude that Industry 4.0 has firmly taken root here in Indiana. Indeed, this year's results suggest that roughly one in three Hoosier manufacturers are already headed down the path of implementing Industry 4.0. Not surprisingly, many of those same manufacturers are also reaping the benefits in areas such as cost and delivery performance as well as revenue and profitability growth.

For those manufacturers wary of this new, smart, and automated territory, this year's report helps identify eight critical characteristics of organizations successfully navigating it. Please consider these eight dimensions part of the framework around which to craft a leading-edge manufacturing strategy. True, the heart and soul of Hoosier manufacturing will always be people, but without Industry 4.0's strategic direction, Indiana will be hard-pressed to stay in front of the competition.

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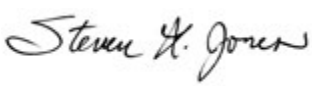

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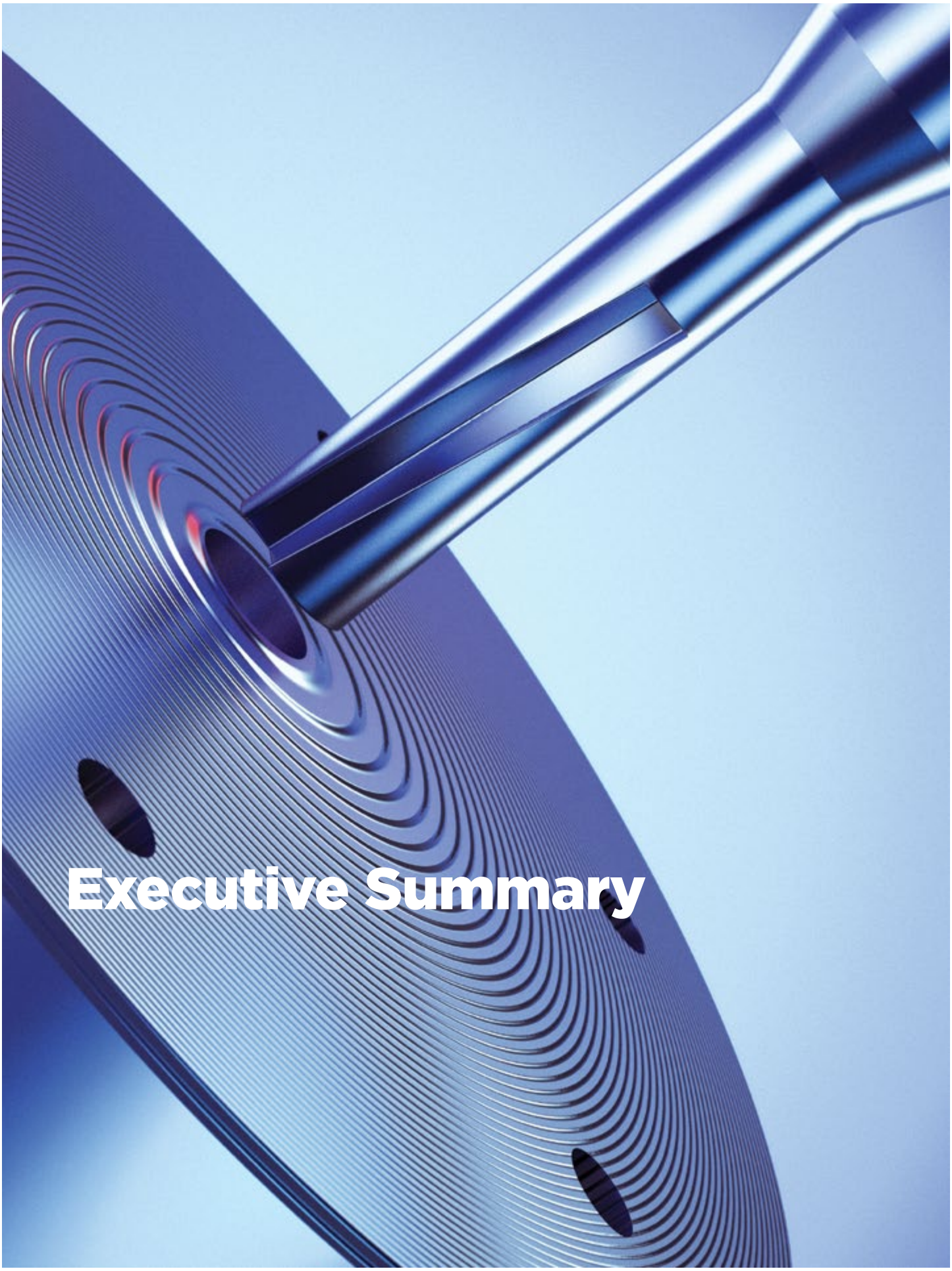


Executive Summary

The 2018 survey suggests that the Hoosier manufacturing sector overall remains very strong, although some regulatory and workforce challenges continue to cast uncertainty over the distant horizon. Notably, as in previous years, growth in sales revenues and profit margins are higher year-over-year from 2017 to 2018, and they seem destined to continue their strong upward trend. Likewise, the percentage of businesses making major capital investments continues to trend upward as manufacturers make major capital investments in advanced automation and increasingly efficient factories.

As with our previous reports, this year's study also offers insights into how to more effectively recruit young people into careers in manufacturing. As with the findings in last year's report regarding trade, a plurality of respondents still wanted to see the North American Free Trade Agreement (NAFTA) renegotiated. Also as in previous years, respondents remain concerned over healthcare regulations and corporate taxes, although now concern over the latter focuses on its permanency.

Calls to Action for 2018: Indiana Manufacturers

While most Hoosier manufacturers appear once again to be very healthy based on our 2018 survey findings, improving operations through investments in technology and automation, as well as workforce development, remains indispensable to competitiveness. Important elements of this overall strategy include:

- **Join the Industry 4.0 revolution already underway.** As advanced technologies become more affordable and capable, manufacturers need to keep investing in these to stay competitive.
- **Develop the workforce of the future.** With every step forward in advanced manufacturing technologies, manufacturers also need to train and "upskill" their workforces. Similarly, manufacturers need to continue aggressively recruiting high school students into the field.
- **Remind others why manufacturing matters.** Manufacturing stands tall as a pillar of Indiana's economy. Whenever you get a chance to interact with others in education and government, don't forget to remind them of just how vital manufacturers are to our state's current and future economy.

Calls to Action for 2018: Government Policy Makers

To help promote economic growth and foster job creation, government at all levels needs to work with the manufacturing sector to:

- **Reinforce our manufacturing base.** Every new regulation (and tariff) needs to be evaluated in terms of its potential impact(s) on Hoosier manufacturers, including the business cost of compliance.
- **Reform healthcare … again.** Healthcare has been the top regulatory concern of manufacturers across this decade. Previous efforts to resolve the issue are having little to no positive effect on the industry.
- **Address the workforce shortage.** As one respondent suggested, "Provide skills training in middle school and high school and involve local businesspeople as examples of work opportunities."

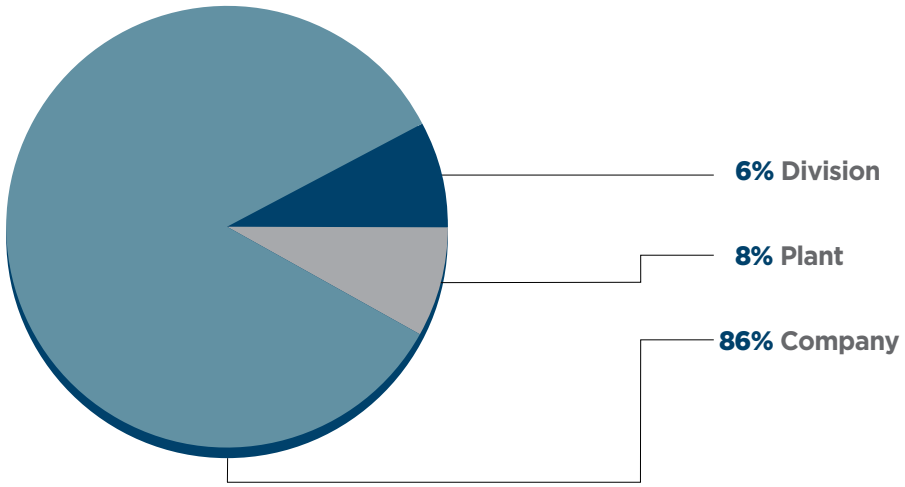
Tomorrow's Prospects

While the skills gap, worker shortages, and some regulations continue to impede Hoosier manufacturing, there is much to be optimistic about for the future. Trends in financial metrics remain strong, and capital investments continue to grow. Equally important, many Hoosier manufacturers are now moving forward in terms of Industry 4.0. As you read this report, it's hard to find in the following pages any truly bad news. That, of course, is truly good news for not only our manufacturers but also our entire state!

I. Company Demographics

Echoing past years, the typical participant in the *2018 Indiana Manufacturing Survey* reported results at the company level (86%), while fewer respondents represented divisions of larger organizations (6%) or individual plants (8%). The average number of direct or full-time employees per respondent is 632, with the largest employing more than 24,000. Additionally, the average number of contract workers and temporary workers per respondent is 3 and 33, respectively.

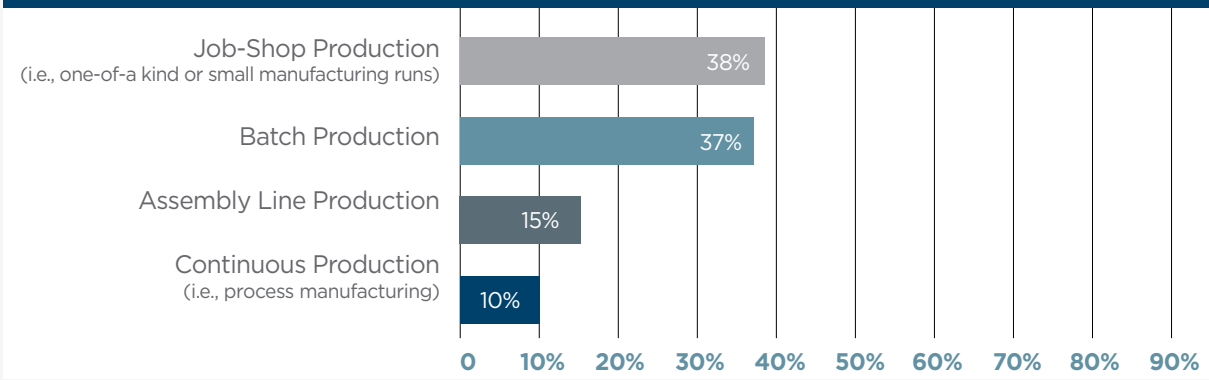
TYPES OF ORGANIZATIONAL UNITS



NUMBER OF EMPLOYEES

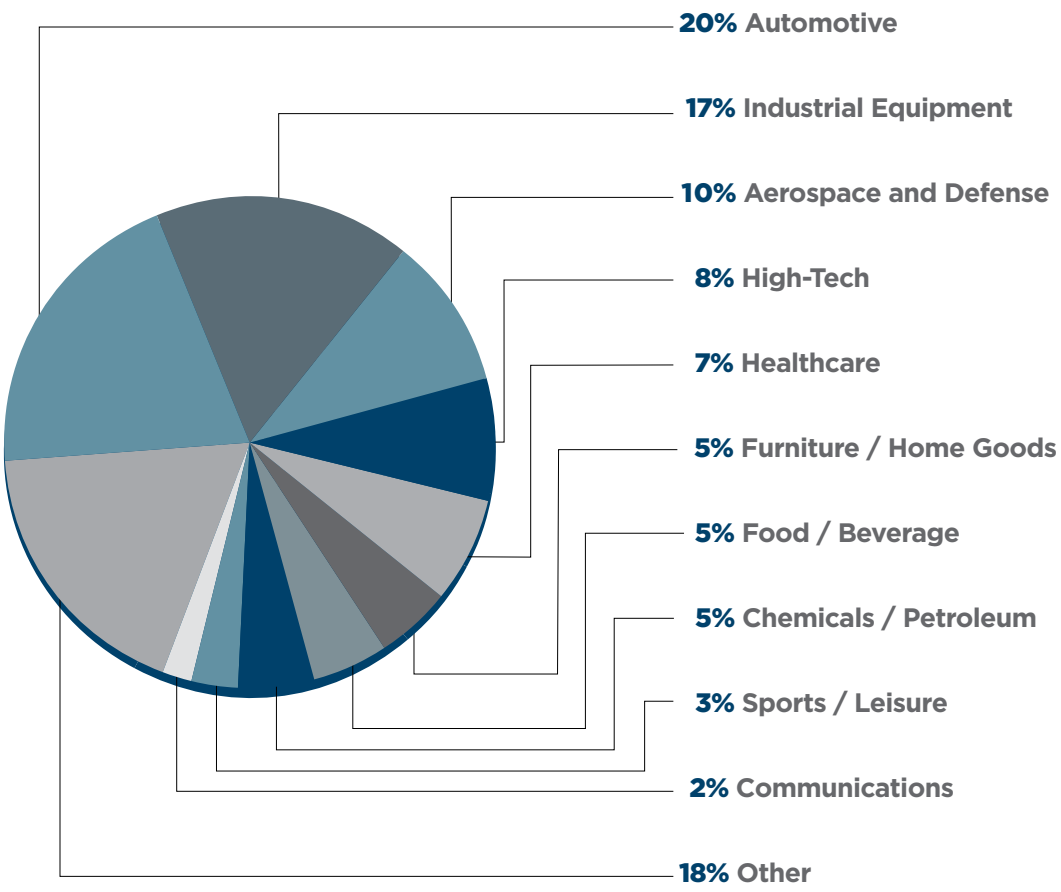
	Direct / Full-Time Workers	Contract Workers	Temporary Workers
Mean	632	3	33
Maximum	24,000	45	1,000

TYPES OF PRODUCTION PROCESSES



In terms of production processes represented in this 2018 survey, similar to previous years, job-shop production (38%) and batch production (37%) comprise the large majority of respondents, with assembly lines and continuous production accounting for the remaining 15% and 10%, respectively.

INDUSTRY TYPES

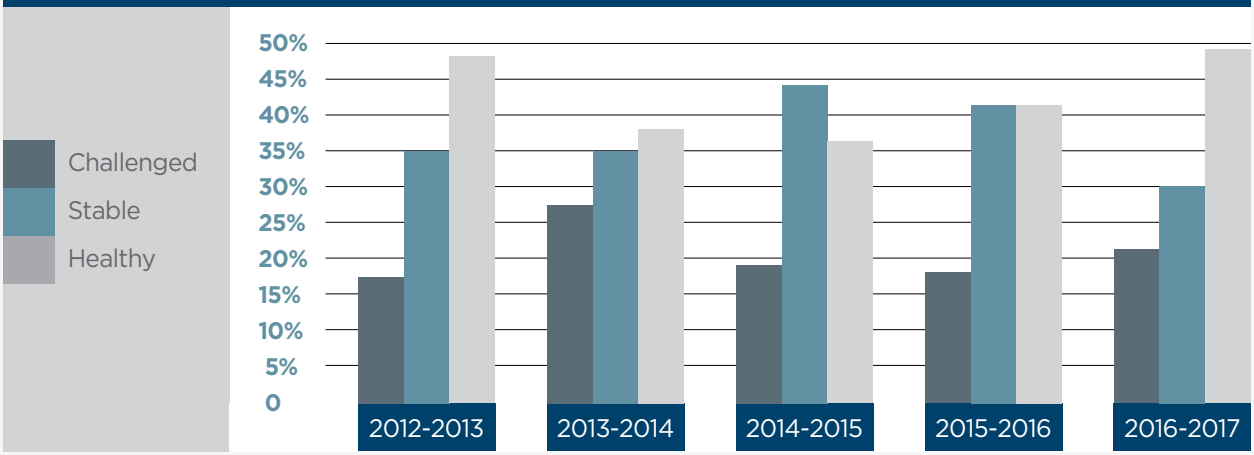


As with our previous studies, the 2018 sample reflects a balanced assortment of Indiana's most significant manufacturing industries. The three industry groups with the most survey respondents are automotive (20%), industrial equipment (17%), and aerospace and defense (10%). Another 25% of respondents are distributed between high-tech (8%), healthcare (7%), furniture/home goods (5%) and food/beverage (5%). Companies in the "other" category (18%) include construction materials, pet/animal products, commercial marine vessels, vending equipment, office products, and plastics.

II. Overall Economic and Financial Performance

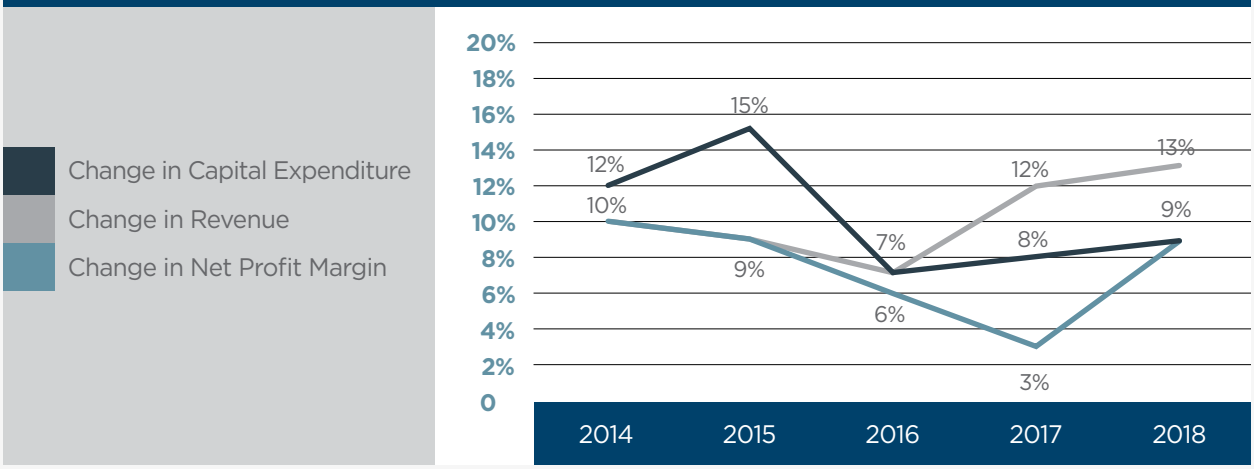
We asked survey participants to rate their general financial performance over the past two years as either "healthy," "stable," or "challenged." Forty-nine percent of respondents replied "healthy," a record high since before the financial crisis began a decade ago, albeit the percent replying "challenged" ticked up slightly from the previous couple surveys. These results reflect the strong economic growth of the last few years that has benefited manufacturing, in particular, but also strengthened the competitive environment. The results also confirm that the recovery from the Great Recession is showing no signs of slowing.

FINANCIAL PERFORMANCE



Looking forward, Hoosier manufacturers' expectations for specific measures of financial performances in 2018 are strong. Most notably, the expected percentage increase in profitably has jumped from 3% in 2017 to 9% in 2018. Capital expenditures in 2018 are expected to grow at 9%, up from 8% in 2017, and revenues are expected to increase by 13%, up from 12% in 2017. And while these expectations for growth in capital expenditures and revenues are only marginally higher for 2018, over 2017, the results are still very impressive in that they represent the continuation of dramatic rates of growth.

PERCENTAGE CHANGE IN FINANCIAL METRICS



Also impressive is that an overwhelming and increasing proportion of manufacturers (91%) expect revenues to increase in 2018. Likewise, the percentages expecting increases in profit margins (83%) and capital expenditures (88%) are also up materially in 2018 over 2017 and prior years. These results indicate that a very broad range of survey participants are experiencing improvements in financial performance.

FINANCIAL METRICS				
% Change	**Min % Value**	**Max % Value**	**Avg % Value**	**% Positive**
2018 Survey				
Revenue for 2018 Over 2017	-31	77	13	91
Net Profit Margin for 2018 Over 2017	-45	57	9	83
Capital Expenditures for 2018 Over 2017	-100	100	9	88
2017 Survey				
Revenue for 2017 Over 2016	-30	77	12	88
Net Profit Margin for 2017 Over 2016	-64	40	3	72
Capital Expenditures for 2017 Over 2016	-92	100	8	75
2016 Survey*				
Revenue for 2016 Over 2015	-40	61	7	79
Net Profit Margin for 2016 Over 2015	-83	60	6	76
Capital Expenditures for 2016 Over 2015	-72	100	7	83
2015 Survey				
Revenue for 2014 Over 2013	-83	100	9	78
Net Profit Margin for 2014 Over 2013	-97	100	9	74
Capital Expenditures for 2014 Over 2013	-79	100	15	72

*Note: Beginning with the 2016 survey, these questions were changed to ask about what is expected for the current year, as opposed to what actually occurred in the prior year.

While expectations for revenues, profits, and capital expenditures in 2018 forecast a continuation of the general four-year trend of increasing financial strength for Hoosier manufacturers, there are always challenges in this highly competitive sector. When asked, **"What was your worst manufacturing decision in the past year,"** various respondents highlighted a range of concerns with financials implications, including:.

"Buying new machines without properly trained employees to run them."

"Not increasing prices fast enough on non-core customers."

"Not upgrading the tools and processes for inspection and final assembly operations."

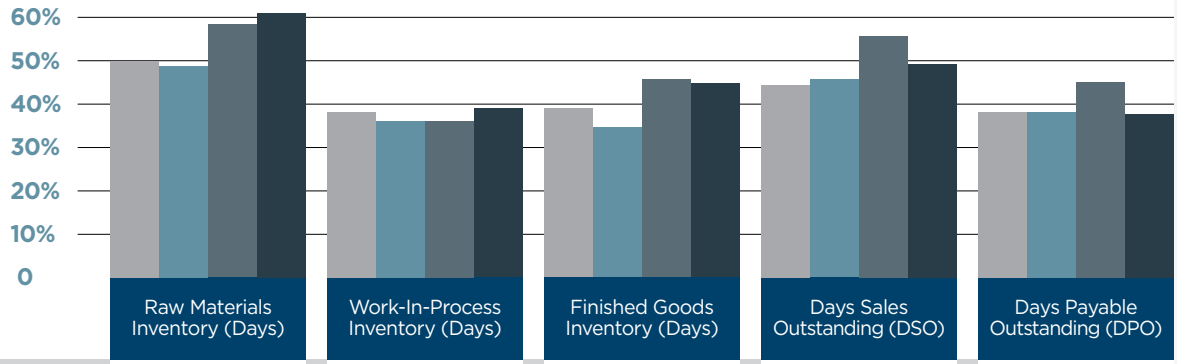
"Delaying the implementation of capturing machine data to improve our productivity."

"Underestimating the time to get repairs done on new, critical machinery."

"Using overtime scheduling to address throughput shortages."

In regard to working capital, the mean days of inventory for raw materials and work-in-process increased slightly in 2018 to 61 and 39 days, respectively. Meanwhile, average reported finished goods inventory decreased by just one day, from 46 in 2017 to 45 in 2018. Together, these inventory levels are consistent with the previously mentioned expectations for significantly higher sales in 2018. Also reflective of general financial strength are the decreases of one week in days sales outstanding (DSO), from 56 to 49, and days payable outstanding (DPO) from 45 to 38, indicating more timely payments and thus healthier cash flows across these supply chains. Given the increase in raw material and work-in-process inventories, the mean cash conversion cycle (i.e., average days inventory plus days receivable minus days payable) is expected to increase by one day in 2017-2018 to 59, versus 58 days in 2016-2017.

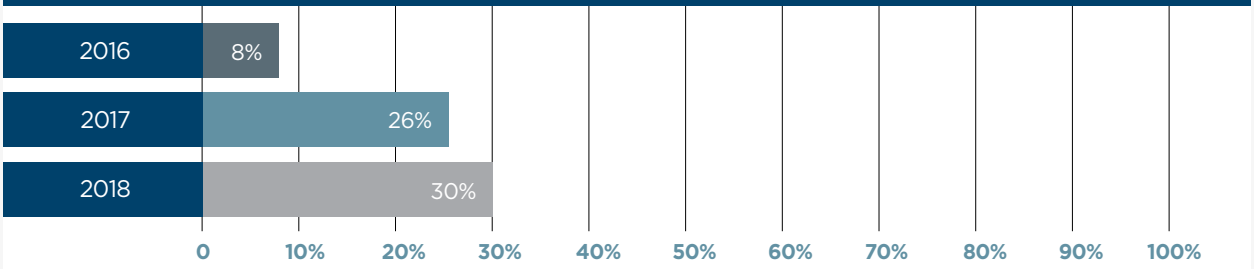
WORKING CAPITAL AND CASH FLOW METRICS (MEAN)



	Raw Materials Inventory (Days)	Work-In-Process Inventory (Days)	Finished Goods Inventory (Days)	Days Sales Outstanding (DSO)	Days Payable Outstanding (DPO)
2014-15	50	38	39	44	38
2015-16	48	36	34	46	38
2016-17	58	36	46	56	45
2017-18	61	39	45	49	38

In terms of the respondents' expectations for growth in their product markets, optimism has ramped up even further in 2018, with 30% anticipating rapid growth in their markets over the next three to five years (2020-2022). This reinforces the material increase observed in 2017, when 26% of respondents predicted rapid growth in their markets over the three to five years (2019-2021), compared to the only 8% in 2016 that forecasted such growth in their markets over the next three to five years (2018-2020). Again, these results confirm that expectations for future growth continue unabated even though we are nearly a decade into the recovery.

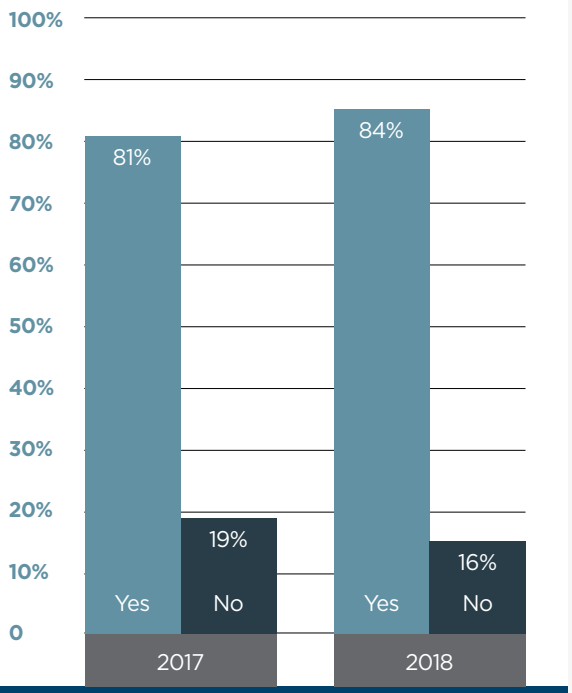
EXPECTING RAPID MARKET GROWTH



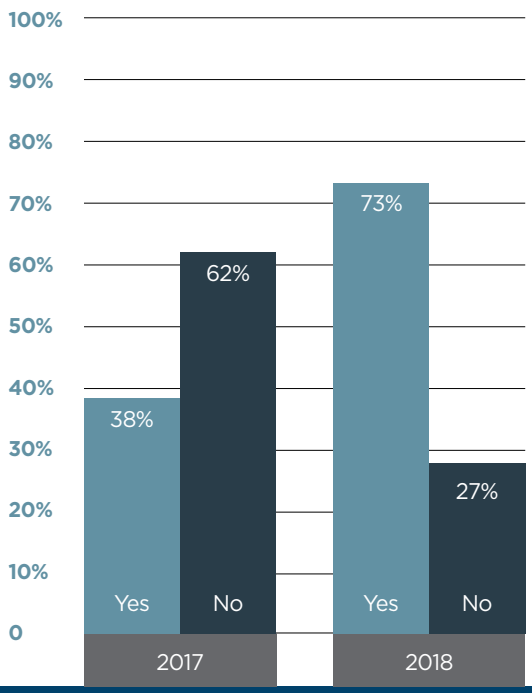
III. Regulatory and Trade Concerns

As in past years, we surveyed participants on their opinions about how the policies of the federal and Indiana state governments are supporting the manufacturing sector. In 2018, an overwhelming 84% of respondents indicated they believe that Indiana's state government is doing a good job in this regard. This is up slightly from 81% in 2017 and is consistent with the highly favorable responses to this question reported in recent prior years of this survey. In contrast, respondents' opinions about how the federal government is doing in this regard have lagged in recent years, with only 38% responding favorably in 2017. However, responses to this question have turned in 2018 with 73% now opining that the federal government is doing a good job of supporting the manufacturing sector.

HOW WELL IS MANUFACTURING SUPPORTED BY GOVERNMENT?



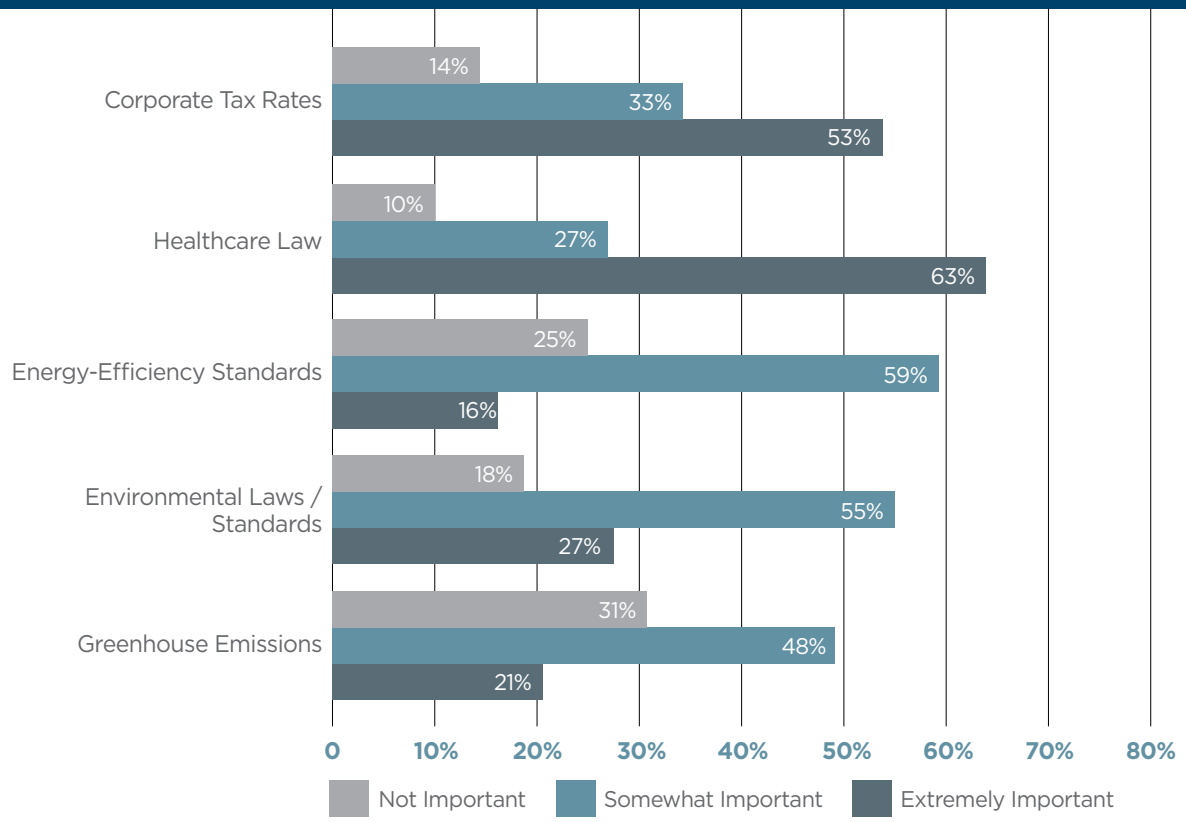
Do you think Indiana's state government is doing a good job supporting Hoosier manufacturing?



Do you think Washington, D.C., is doing a good job of supporting American manufacturing?

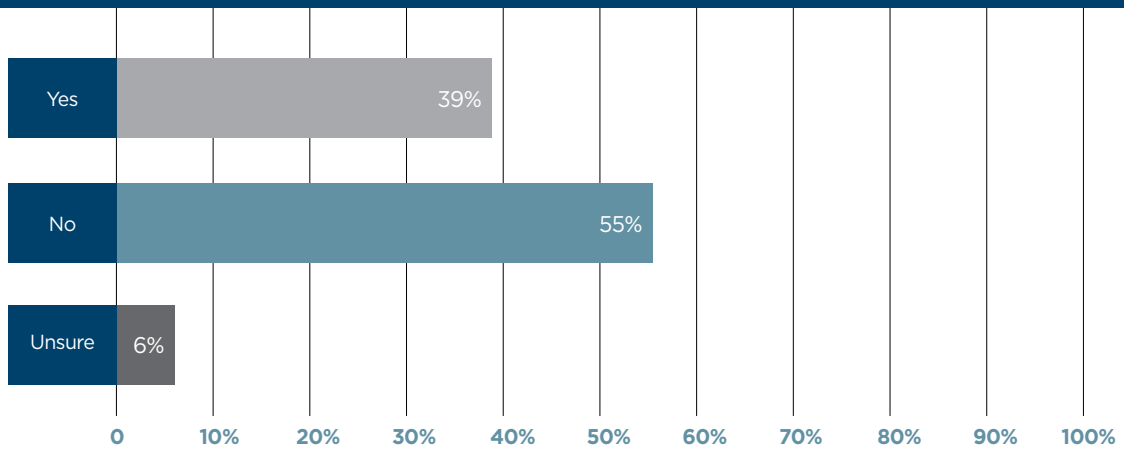
When asked about what is most critical in terms of regulatory concerns to their companies, respondents indicate that healthcare is again, as in the past several survey years, considered most important (63%), with corporate tax rates close behind (53%). However, concern over corporate tax rates now appears to be about whether the recent Tax Cut and Jobs Act (TCJA) of 2017 will survive, rather than the concern from previous years about rates being too high. When survey participants were asked to rate their confidence in the permanency of the TCJA on a scale of 1-10 (1 = low confidence and 10 = high confidence), the average response was a very guarded 5.34, with approximately two-thirds of the responses between 3.0 and 7.5.

IMPORTANCE OF REGULATORY CONCERNS TO INDIANA MANUFACTURING



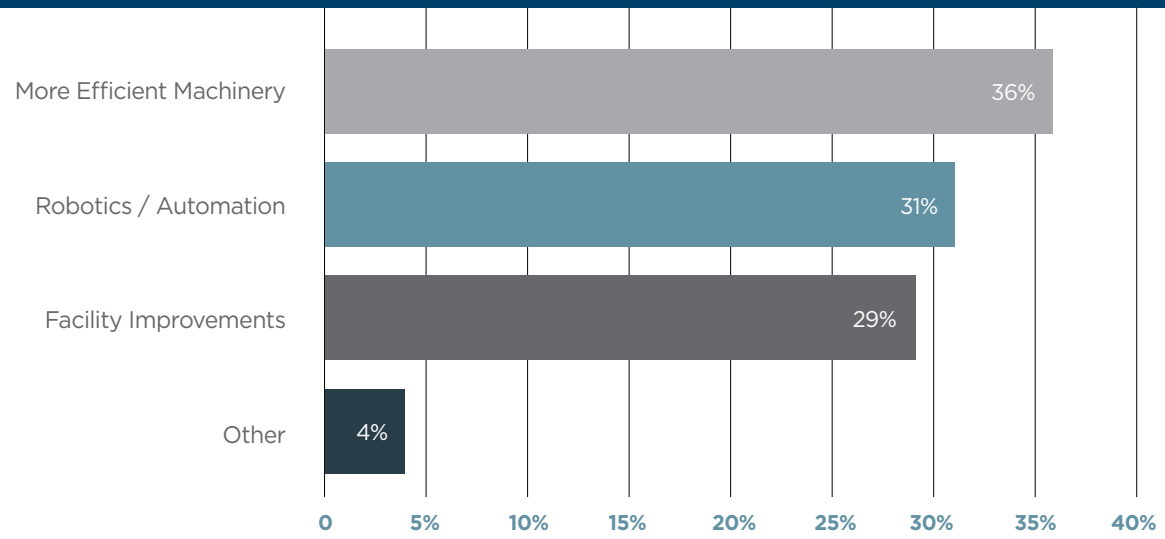
Given that the TCJA lowered the corporate rate and changed the treatment of income from pass-through entities, we asked, "Has the change in personal and corporate tax rates caused you to reconsider your current business structure?" Although the majority of respondents (55%) replied "no," a substantial 39% responded "yes," while 6% were "unsure" of whether they should consider a change.

HAS THE CHANGE IN TAX RATES CAUSED YOU TO RECONSIDER YOUR BUSINESS STRUCTURE?



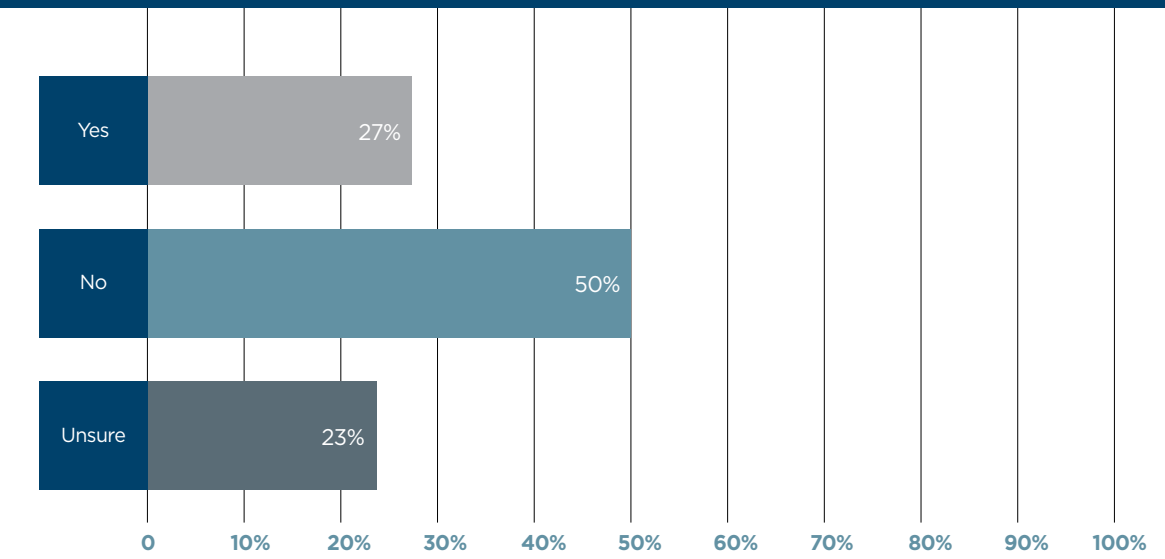
We also inquired how tax reform influenced investment decisions. About two-thirds of respondents indicated that tax reform influenced them to make new investments, and, of these new investments, 36% were for more efficient machinery, 31% involved acquiring robotics and automation, and 29% went toward facilities improvements.

HAS TAX REFORM INFLUENCED YOUR DECISIONS TO INVEST IN ANY OF THE FOLLOWING?



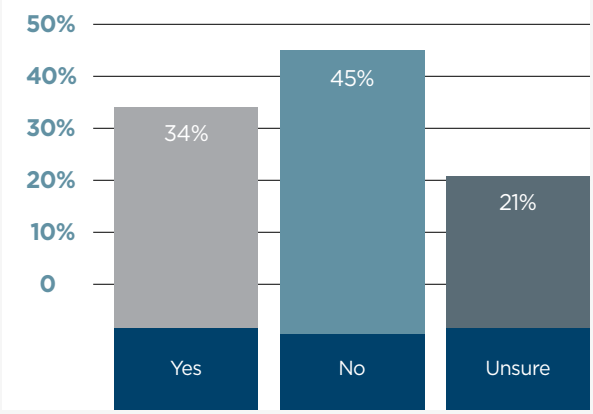
Turning to the often-contentious topic of international trade, 50% of respondents think that the terms of trade between the U.S. and the foreign country/countries where their products are sold are unfair, 27% think the terms are fair, and 23% are unsure.

DO YOU THINK THE TERMS OF TRADE BETWEEN THE U.S. AND FOREIGN COUNTRIES ARE FAIR?

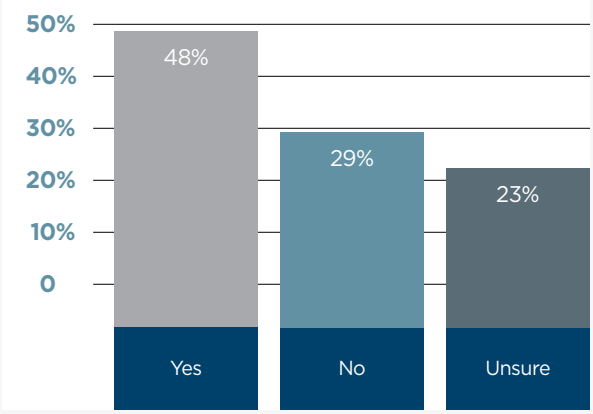


Amid growing uncertainty earlier this year about the future of the North American Fair Trade Agreement (NAFTA)*, we asked the 2018 survey respondents if the effect of NAFTA with Canada and Mexico was a net benefit to their company. Interestingly, only about one-third (34%) said "yes," and nearly one-half (45%) said "no," with the rest unsure. In addition, about one-half (48%) wanted to see NAFTA renegotiated, and less than one-third (29%) opposed renegotiation.

IS NAFTA A NET BENEFIT TO YOUR COMPANY?

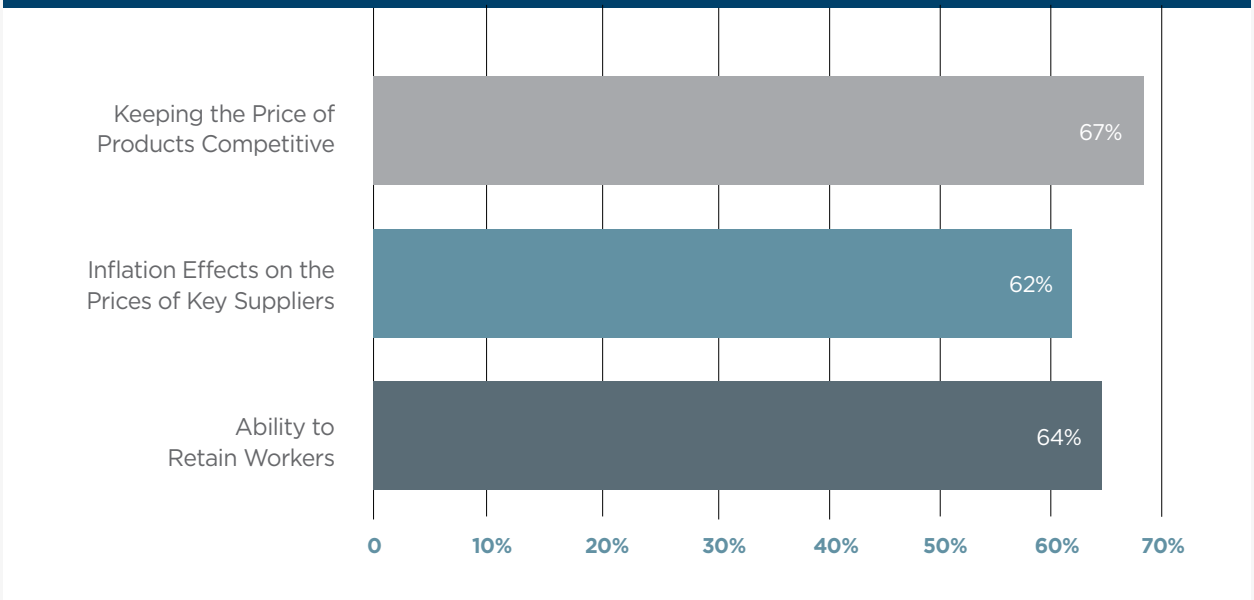


SHOULD THE U.S. RENEGOTIATE NAFTA?



We also asked survey participants for their thoughts on the strengthening economy with respect to upward pressure on their company's own prices, their suppliers' prices, and employee wages (i.e., "wage-push" inflation). Not surprisingly, the respondents were moderately concerned (on a scale of 0 = no concern to 100 = critical concern) in terms of keeping the prices of their own product competitive, the effects of inflation on key suppliers' prices, and their ability to retain workers.

CONCERN OVER UPWARD PRESSURE ON WAGES AND INFLATION



*Survey responses reported prior to the negotiation of the United States-Mexico-Canada Agreement (USMCA).

To follow up on regulatory and trade concerns in the broadest sense possible, we asked **"What regulatory issue is having the biggest negative impact on your business?"** Representative comments included:

"Air permitting has become so onerous that we have delayed new equipment purchases until we can better understand the laws."

"Department of Labor interpretation of laws."

"Healthcare reform. The current government actions are creating uncertainty."

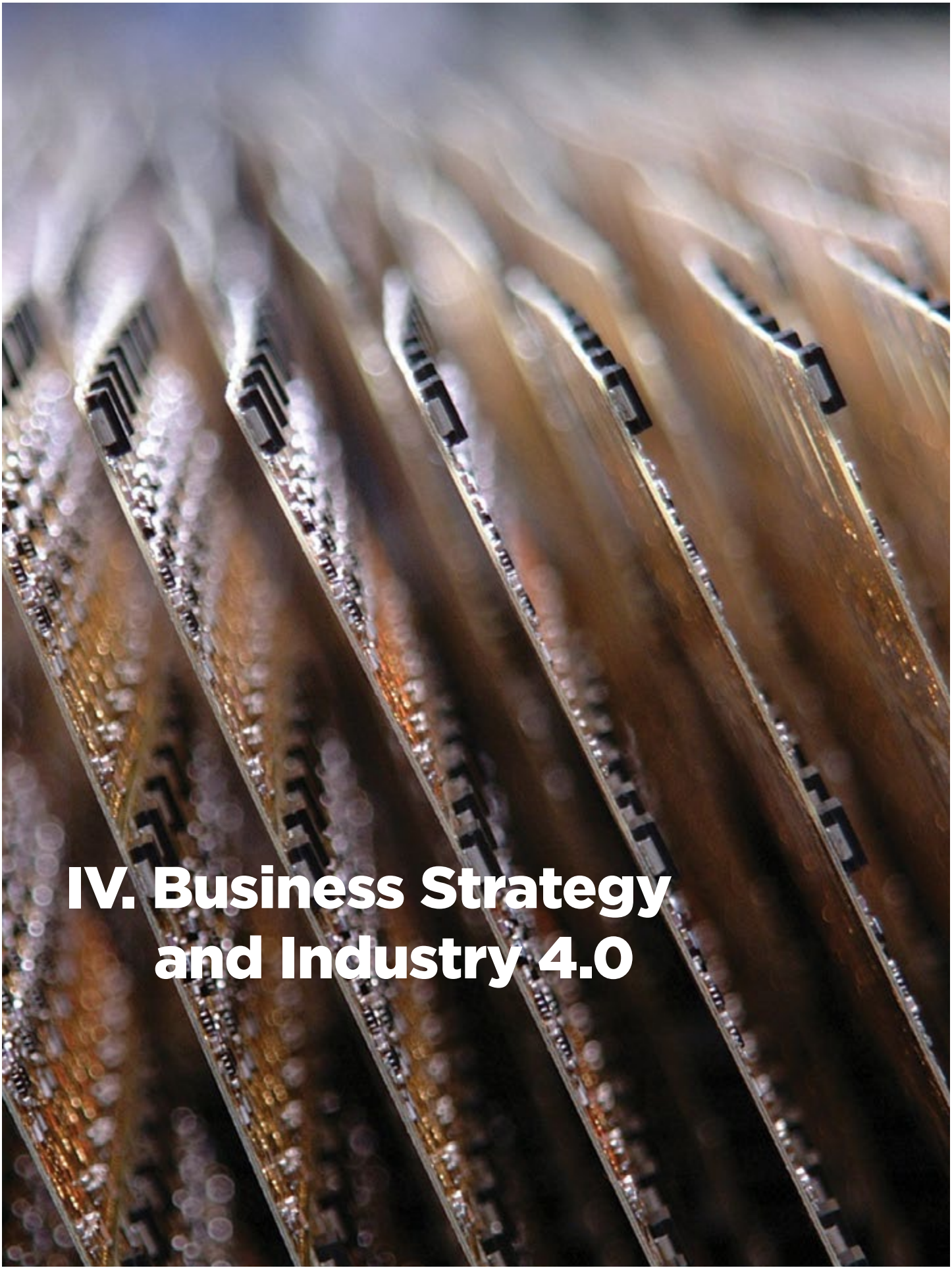
"Immediate impact: Tariffs. Long-term impact: Healthcare."

"Tax and other regulatory filings are a major time sink."

"Taxes and healthcare."

"The cost of healthcare and regulatory compliance with the Affordable Care Act."

"Steel tariff considerations have increased the cost of our raw materials."



IV. Business Strategy and Industry 4.0

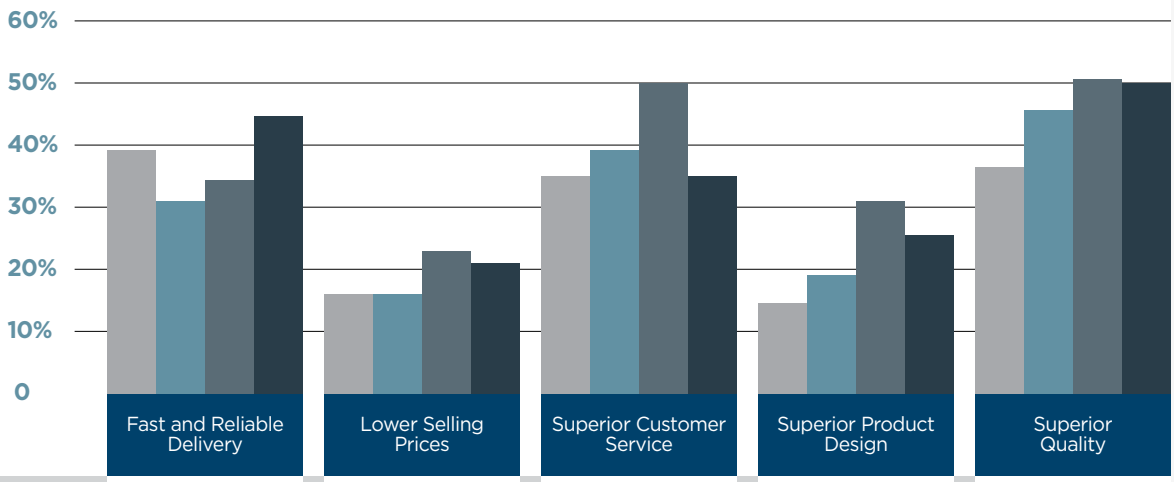
An important strategic business decision every manufacturer makes is how to win customers' orders based upon the traditional competitive priorities of delivery, price, service, design, and quality. Though these business strategies have remained highly constant from 2015-2018, superior quality, fast and reliable delivery, and superior customer service are ranked as most important. Similarly, lower selling prices and superior product design have been relatively less important capabilities.

HOW TO WIN ORDERS: COMPETITIVE PRIORITIES (MEAN)

	2018 Survey	2017 Survey	2016 Survey	2015 Survey
Fast and Reliable Delivery	4.09	4.03	4.17	4.17
Lower Selling Prices	3.30	3.50	3.53	3.49
Superior Customer Service	4.05	4.09	4.19	4.00
Superior Product Design	3.47	3.56	3.73	3.57
Superior Quality	4.10	4.16	4.33	4.33

In past years, most survey participants have ranked "superior quality" as the more important of these competitive priorities. However, in 2018, 39% of Hoosier manufacturers ranked "fast and reliable delivery" as the single most "extremely important" competitive priority, while "superior quality" nevertheless came in a close second at 37%.

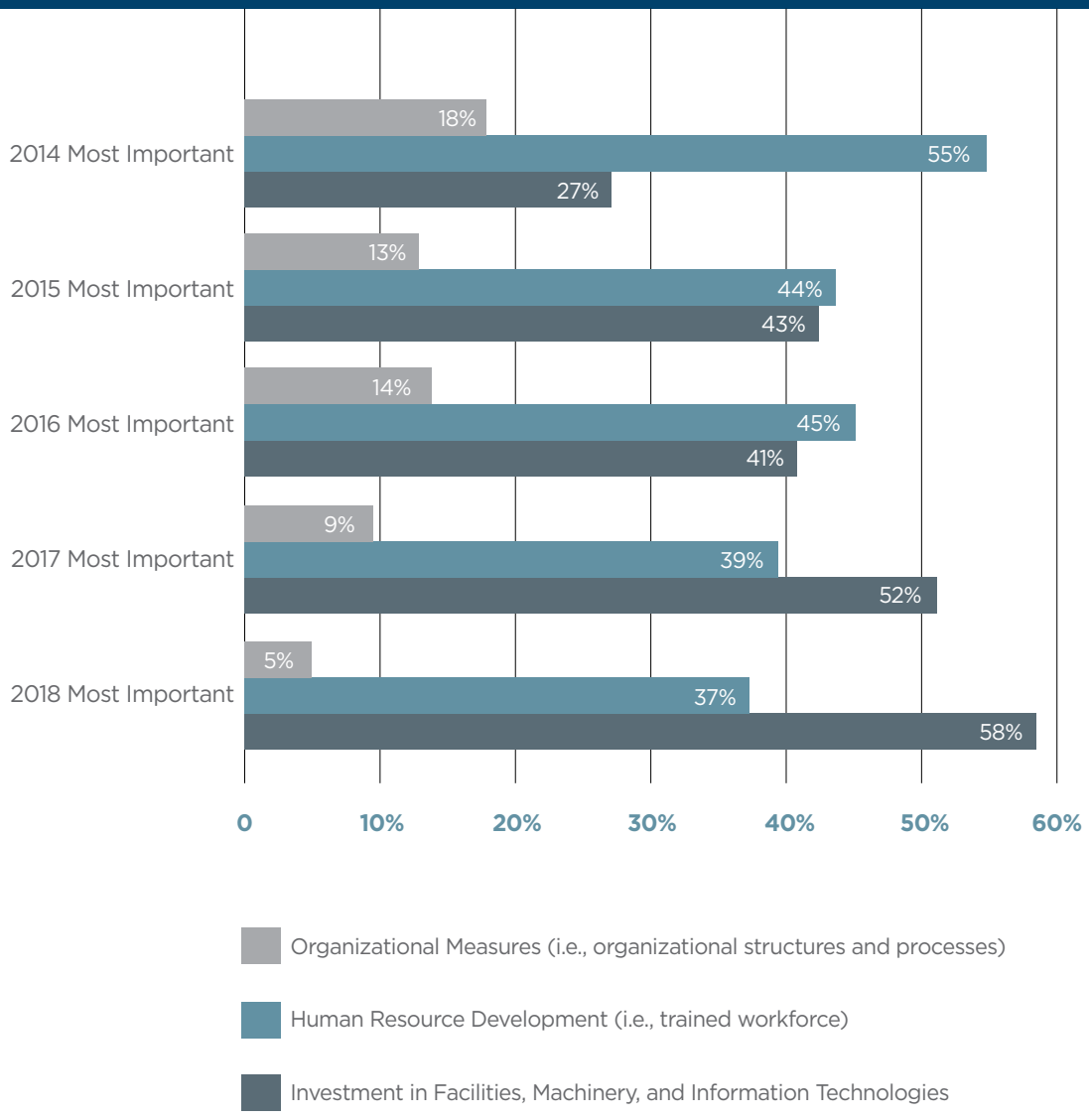
HOW TO WIN ORDERS: COMPETITIVE PRIORITIES CONSIDERED "EXTREMELY IMPORTANT"



	Fast and Reliable Delivery	Lower Selling Prices	Superior Customer Service	Superior Product Design	Superior Quality
2018	39%	16%	35%	14%	37%
2017	31%	16%	39%	19%	45%
2016	34%	23%	50%	31%	51%
2015	44%	21%	35%	26%	50%

Since the Great Recession, we have tracked major areas of concern for manufacturing in terms of modernization. In 2014, human resource development (i.e., trained workforce) peaked as the most important concern among 55% of respondents. In 2015 (44%) and 2016 (45%), human resource development again edged out investment in facilities, machinery, and information technologies as the top priority for manufacturing modernization. That changed in 2017, with facilities, machinery, and information technologies emerging as the top priority in terms of modernization among 52% of respondents, while human resource development was considered most important by 39%. In 2018, this new trend continued with facilities, machinery, and information technologies now rated as the top priority by 58% of respondents, while human resource development has again declined, albeit slightly, with 37% now rating it as most important.

MANUFACTURING MODERNIZATION PRIORITIES



To capture other possible sources of operational improvement, **we asked survey participants what they believe to be their best manufacturing decisions in the past year.** A majority of comments relate to modernizing manufacturing through capital investment, as would be expected given the previously-reported findings of strong growth in capital expenditures, but several comments also reflect the importance of human resource initiatives.

Best Decisions

"Adding new production lines."

"Buying a new CNC machining center."

"Creating internal career development plans for selected individuals where we have skill shortages."

"Hiring a director of operations who is in charge of implementing Lean manufacturing principles."

"Moving to a larger facility and adding much needed automation."

"Investing in production aids that reduced training time and increased each worker's productivity."

"Adding collaborative robots to our operation as well as mechanical equipment in our manufacturing operation."

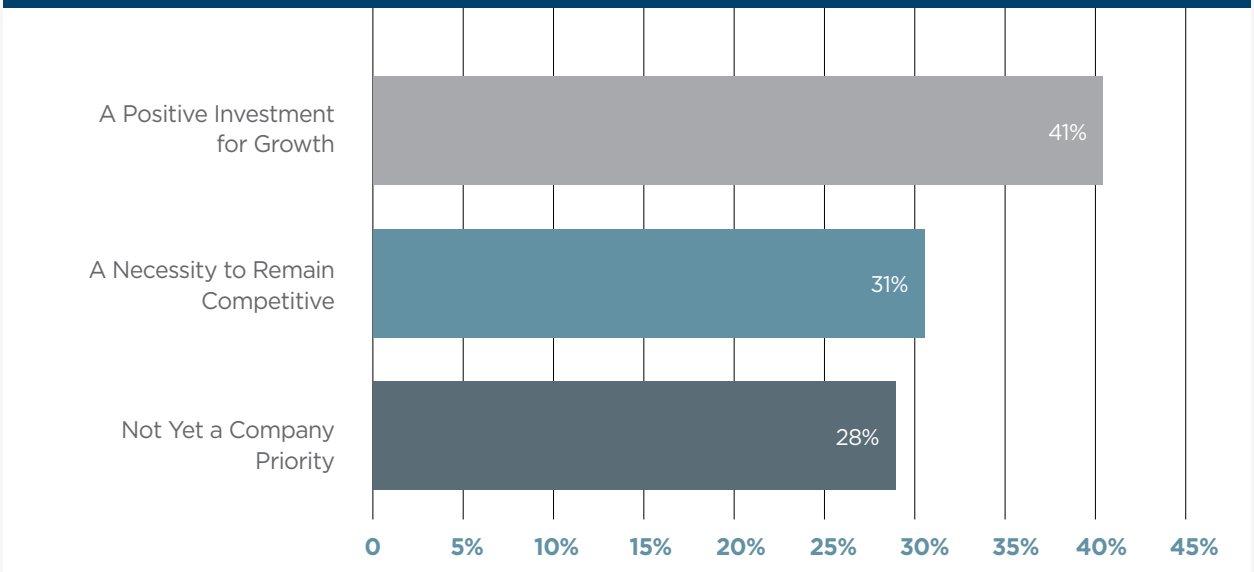
"Building new fixtures to speed up processes for production runs. Also buying support equipment that can be used to build fixtures and make repairs while production is running."

In recent years our study has steadily observed the rising tide of what is now widely called "Industry 4.0." *Forbes* recently explained Industry 4.0 as follows:

> *First came steam and the first machines that mechanized some of the work our ancestors did. Next was electricity, the assembly line, and the birth of mass production. The third era of industry came about with the advent of computers and the beginnings of automation, when robots and machines began to replace human workers on those assembly lines. And now we enter Industry 4.0, in which computers and automation will come together in an entirely new way, with robotics connected remotely to computer systems equipped with machine learning algorithms that can learn and control the robotics with very little input from human operators. Industry 4.0 introduces what has been called the "smart factory," in which cyber-physical systems monitor the physical processes of the factory and make decentralized decisions. The physical systems become Internet of Things, communicating and cooperating both with each other and with humans in real time via the wireless web.*

After years of anticipating its arrival, these 2018 survey results lead us to conclude that Industry 4.0 is now taking root in Indiana. When asked, "How is digital technology or advanced 'smart' manufacturing currently perceived within your company," 41% described it as a positive investment for growth, while another 31% consider it a necessity to remain competitive, and only 28% do not yet view it as a priority for their company.

HOW IS ADVANCED "SMART" MANUFACTURING CURRENTLY PERCEIVED WITHIN YOUR COMPANY?



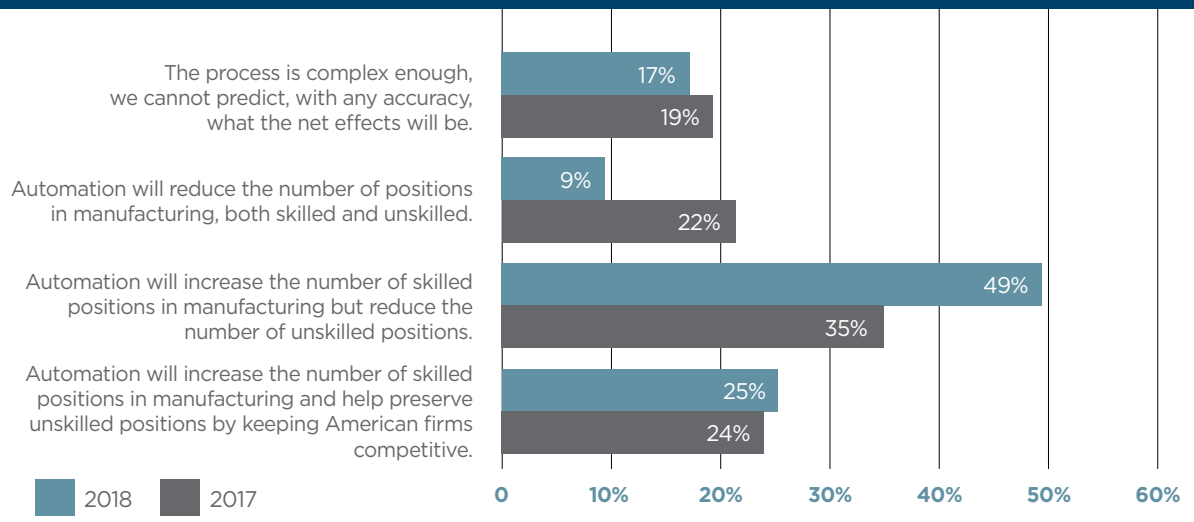
As in prior years, 2018's survey asked about the use of a variety of advanced manufacturing technologies and programs using a scale of 1-5, with 1 being "No Use" and 5 being "Very High Use." In general, the use of almost all advanced manufacturing technologies and philosophies, such as Lean manufacturing, has increased in recent years. Of particular note, apprenticeship programs for training workers have rapidly expanded in recent years, with 92% of respondents presently using these in their businesses.

2018 SURVEY Manufacturing Technologies	No Use	Limited Use	Some Use	High Use	Very High Use	Mean
Automated Guided Vehicles (AGVs)	94%	4%	2%	0%	0%	1.08
Automatic Storage / Retrieval Systems (AS / RS)	82%	10%	4%	4%	0%	1.31
CNC Machines	24%	8%	20%	22%	26%	3.18
Computer-Aided Design / Engineering (CAD-CAE)	16%	10%	12%	20%	42%	3.62
Computerized / Video Assembly Instructions	49%	24%	10%	9%	8%	2.02
Coordinate-Measuring Machine (CMM) Inspection	49%	16%	14%	12%	9%	2.14
Flexible Manufacturing Systems (FMS)	45%	17%	15%	21%	2%	2.19
Laser as a Tool (e.g., cutting, welding, forming)	45%	15%	22%	12%	6%	2.20
Novel Materials (e.g., composite or renewable raw)	56%	23%	5%	6%	10%	1.92
Rapid Prototyping or Tooling (e.g., stereo lithography)	46%	22%	18%	10%	4%	2.04
RFID Product / Part Tracking	61%	16%	7%	10%	6%	1.84
RFID Tool Control	73%	14%	8%	3%	2%	1.45
Advanced Manufacturing Programs						
Apprenticeship Programs for Training New Workers	8%	31%	31%	18%	12%	2.96
Lean Manufacturing	19%	11%	28%	31%	11%	3.04
Six Sigma	30%	27%	28%	11%	4%	2.32
Work Cells / Cellular Manufacturing	28%	17%	25%	23%	7%	2.64

2017 SURVEY Manufacturing Technologies	No Use	Limited Use	Some Use	High Use	Very High Use	Mean
Automated Guided Vehicles (AGVs)	92%	3%	4%	0%	1%	1. 17
Automatic Storage / Retrieval Systems (AS/RS)	81%	7%	11%	0%	1%	1.35
CNC Machines	32%	6%	10%	12%	40%	3.24
Computer-Aided Design / Engineering (CAD-CAE)	15%	7%	14%	28%	36%	3.63
Computerized / Video Assembly Instructions	57%	19%	17%	7%	0%	1.74
Coordinate-Measuring Machine (CMM) Inspection	40%	7%	20%	18%	15%	2.61
Flexible Manufacturing Systems (FMS)	47%	14%	28%	11%	0%	2.03
Laser as a Tool (e.g., cutting, welding, forming)	68%	6%	10%	9%	7%	1.79
Novel Materials (e.g., composite or renewable raw)	54%	19%	16%	6%	5%	1.85
Rapid Prototyping or Tooling (e.g., stereo lithography)	53%	26%	13%	6%	2%	1.74
RFID Product / Part Tracking	73%	10%	4%	9%	4%	1.61
RFID Tool Control	81%	7%	7%	5%	0%	1.33
Advanced Manufacturing Programs						
Apprenticeship Programs for Training New Workers	9%	12%	28%	38%	13%	3.35
Lean Manufacturing	7%	13%	37%	25%	18%	3.32
Six Sigma	26%	29%	27%	15%	3%	2.38
Work Cells / Cellular Manufacturing	31%	10%	26%	21%	12%	2.72

In this 2018 survey, as well as the 2017 survey, we asked respondents about their expectations for the effects of automation on the future demand for manufacturing employees by skill level. In 2017, 35% of respondents said they expect automation will increase the number of skilled positions in manufacturing but reduce the number of unskilled positions. The percentage with this opinion jumped to 49% in 2018, while the percentage anticipating that automation will reduce the number of skilled and unskilled positions dropped from 22% in 2017 to 9% in 2018. The proportion of respondents expecting automation to increase skilled positions and help preserve unskilled positions in manufacturing remained steady at about one-quarter.

EFFECT OF AUTOMATION ON THE NUMBER AND SKILL LEVEL OF JOBS IN MANUFACTURING



Two of the newest processes and information innovations in the toolbox of Industry 4.0 are additive manufacturing (3D printing) and data analytics. Starting with the 2016 study, we began tracking the uptake of both of these by Hoosier manufacturers. Data analytics, in particular, is increasingly deployed in a host of manufacturing-related areas. It is also worth noting that additive manufacturing is beginning to be used more and more in fabricating spare parts, finished goods, and subassemblies, as well as shop floor tools such as fixtures and jigs.

2018 ADDITIVE MANUFACTURING / 3D PRINTING	No Use	Some Degree	High Degree
In Fabricating Component Parts and Subassemblies	81%	17%	2%
In Fabricating Standardized Finished Goods (e.g., regular production)	89%	9%	2%
In Fabricating Customized Finished Goods (e.g., mass customization)	87%	9%	4%
In Fabricating Spare Parts (e.g., OEM replacement parts)	91%	7%	2%
In Fabricating Shop Floor Tools (e.g., fixture and jig fabrication)	81%	6%	13%

2017 ADDITIVE MANUFACTURING / 3D PRINTING	No Use	Some Degree	High Degree
In Fabricating Component Parts and Subassemblies	90%	9%	1%
In Fabricating Standardized Finished Goods (e.g., regular production)	93%	6%	1%
In Fabricating Customized Finished Goods (e.g., mass customization)	93%	6%	1%
In Fabricating Spare Parts (e.g., OEM replacement parts)	90%	9%	1%
In Fabricating Shop Floor Tools (e.g., fixture and jig fabrication)	84%	13%	3%

2018 DATA ANALYTICS	No Use	Some Degree	High Degree
Product Design (e.g., engineering)	49%	45%	6%
Advertising and Selling Products (e.g., sales and marketing)	53%	32%	15%
Planning and Scheduling Production (e.g., forecasting, production planning, and control)	34%	55%	11%
Managing Raw Materials and Finished Goods Inventory (e.g., purchasing, inventory, and warehouse management)	30%	59%	11%
Managing Shop Floor Production (e.g., line / manufacturing management)	32%	55%	13%
Planning and Coordinating Inbound and Outbound Supply Chains (e.g., transportation management)	51%	47%	2%

2017 DATA ANALYTICS	No Use	Some Degree	High Degree
Product Design (e.g., engineering)	56%	35%	9%
Advertising and Selling Products (e.g., sales and marketing)	47%	47%	6%
Planning and Scheduling Production (e.g., forecasting, production planning, and control)	29%	47%	24%
Managing Raw Materials and Finished Goods Inventory (e.g., purchasing, inventory, and warehouse management)	27%	54%	19%
Managing Shop Floor Production (e.g., line / manufacturing management)	26%	56%	18%
Planning and Coordinating Inbound and Outbound Supply Chains (e.g., transportation management)	40%	51%	9%

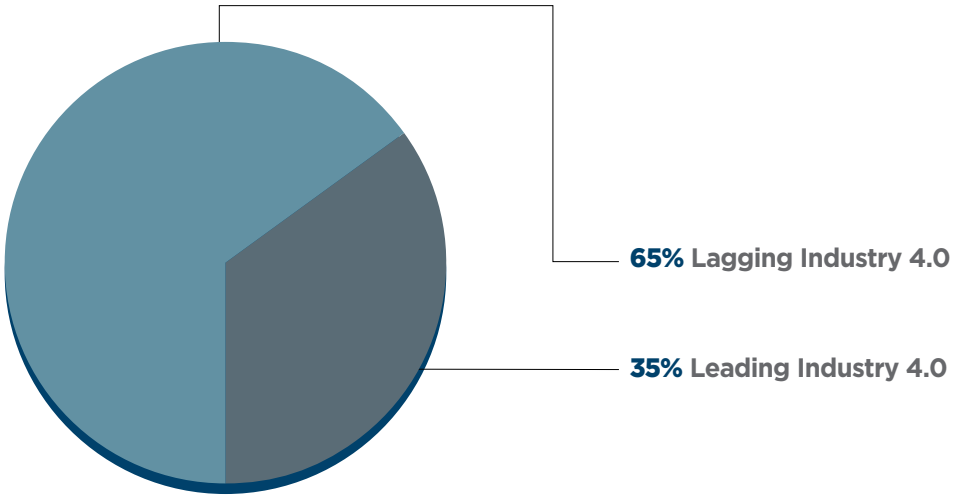
To expand further on Industry 4.0 strategy and performance, we analyzed the 2018 survey results in detail to identify the unique characteristics of manufacturers leading this fourth industrial revolution.

Notably, the strategic dimensions or elements of Industry 4.0 include high levels of sophistication in the following eight critical categories:

- *Traditional advanced manufacturing technologies (e.g., CNC machines)*
- *Advanced manufacturing philosophies (e.g., Lean)*
- *Adaptive/flexible manufacturing systems (FMS)*
- *Automated material handling (e.g., automated guided vehicles)*
- *Novel materials (e.g., composites)*
- *Additive manufacturing (3D printing)*
- *Data analytics in planning and control*
- *Data analytics in engineering/product design*

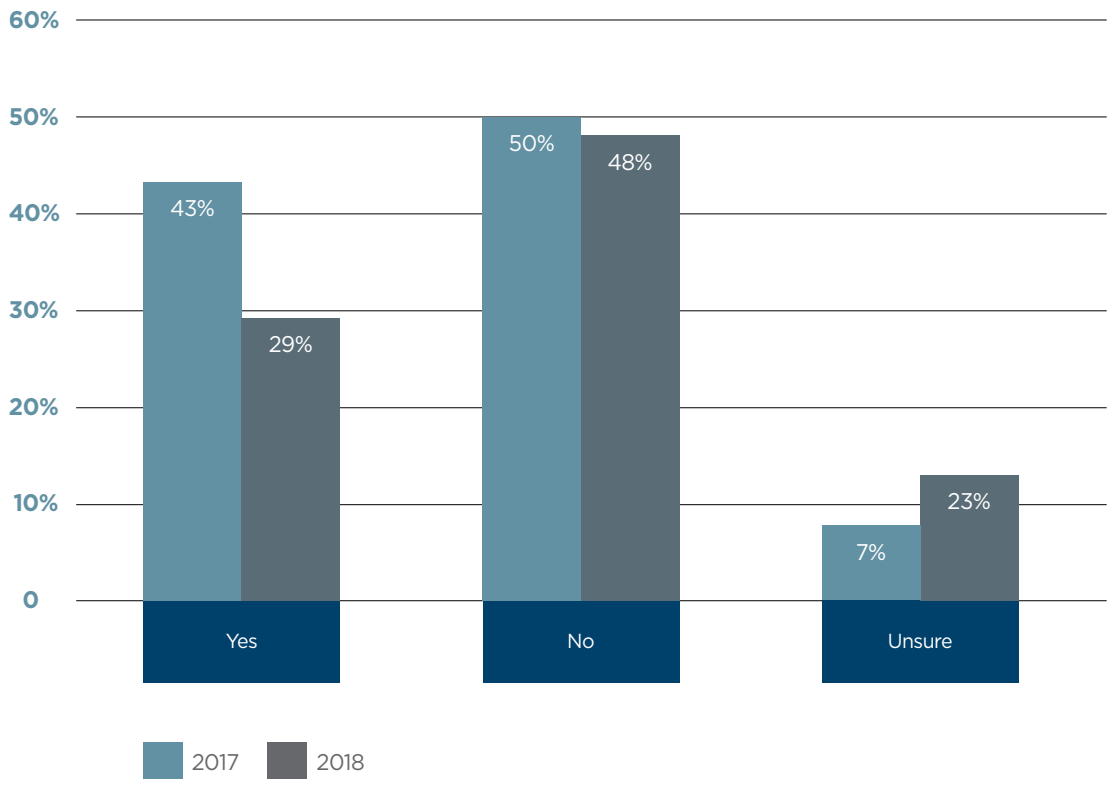
We then sorted our 2018 respondents based upon their reported scores in the above eight dimensions and found that 35% of the respondents are leaders in terms of Industry 4.0, while 65% were laggards. We then analyzed their reported performance and found, not surprisingly, that **the leaders experienced much better performance in terms of not only their speed and reliability of deliveries but also their capacity utilization, productivity, and costs.**

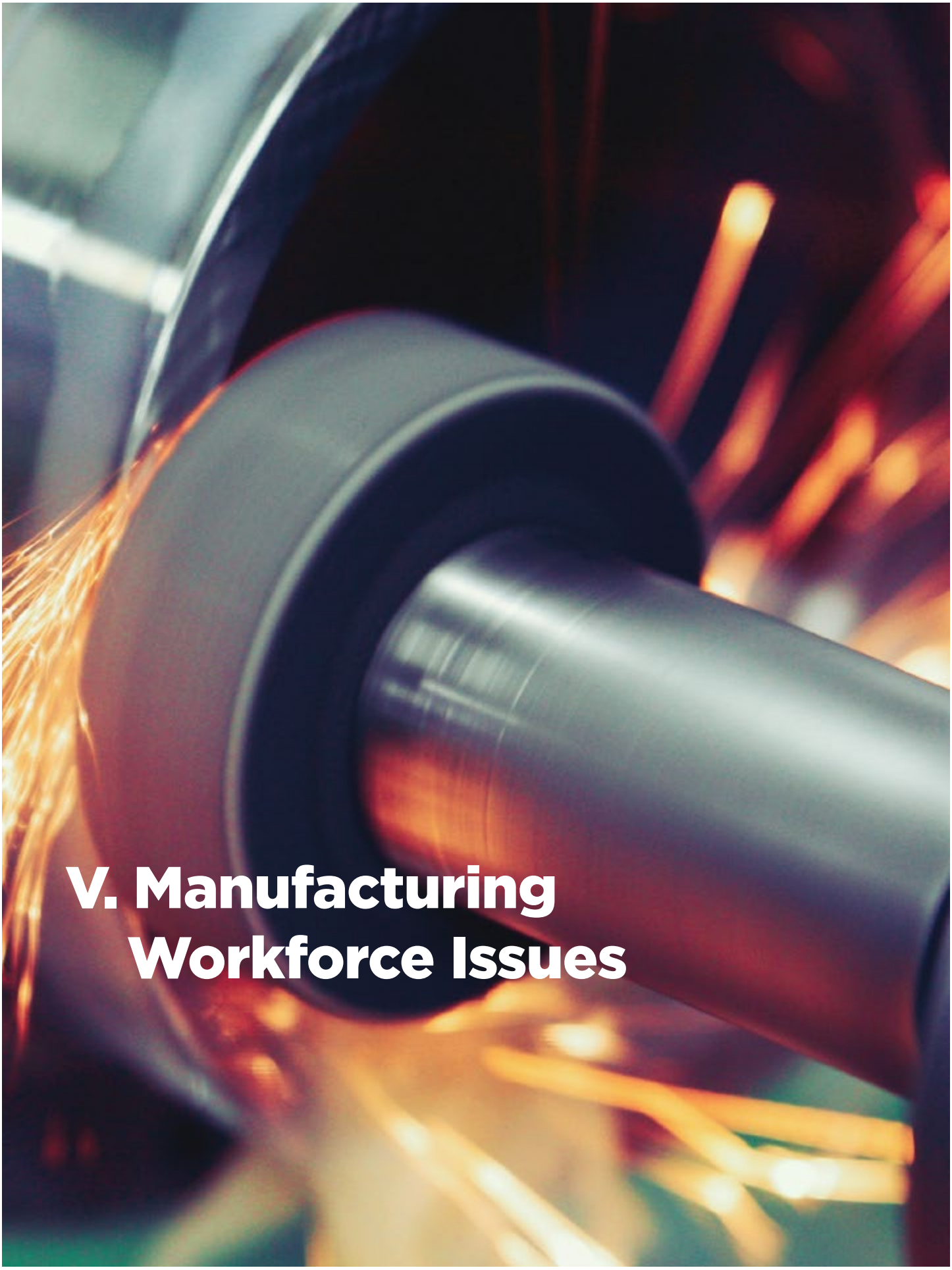
HOOSIER MANUFACTURERS LEADING AND LAGGING IN INDUSTRY 4.0



The performance benefits of the Industry 4.0 digital manufacturing revolution also bring, unfortunately, a host of potential threats in the area of cybersecurity. In the 2017 and 2018 surveys, we asked respondents how big a problem cybersecurity is. In the 2018 survey, the percentage reporting it as a problem declined from 43% in 2017 to 29% in 2018, while about one-half of respondents indicated that it is not a problem. Somewhat surprisingly, the percentage that is unsure whether it is a problem increased from 7% in 2017 to 23% in 2018. One interpretation of these findings is that more firms have invested in cybersecurity, but many are still unsure as to whether those investments have truly solved the problem.

IS CYBERSECURITY A PROBLEM IN YOUR MANUFACTURING OPERATIONS?

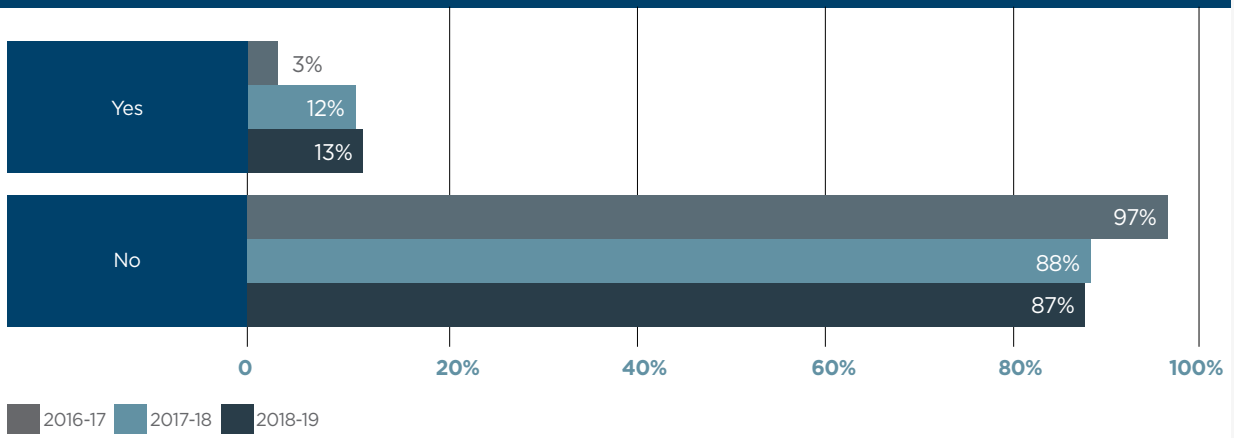




V. Manufacturing Workforce Issues

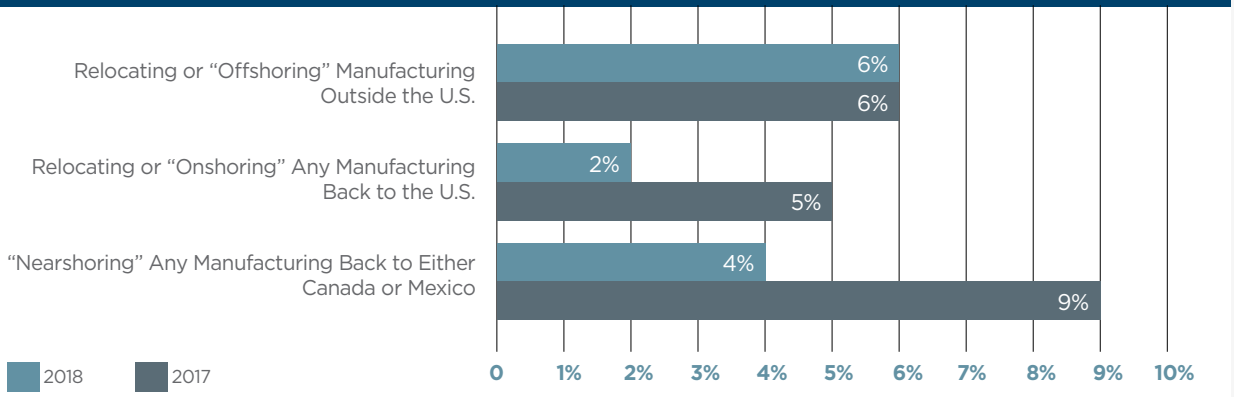
When participants in the 2016 survey were asked whether they plan to open a new manufacturing facility in Indiana sometime in the next two years, only 3% responded "yes." But in the 2017 survey, that number jumped to 12%, and this year, it has edged up further to 13%. These most recent results are encouraging and reinforce the previously reported findings of increased optimism about future product market growth for both 2017 and 2018.

OPENING A NEW MANUFACTURING FACILITY IN INDIANA IN THE NEXT TWO YEARS?



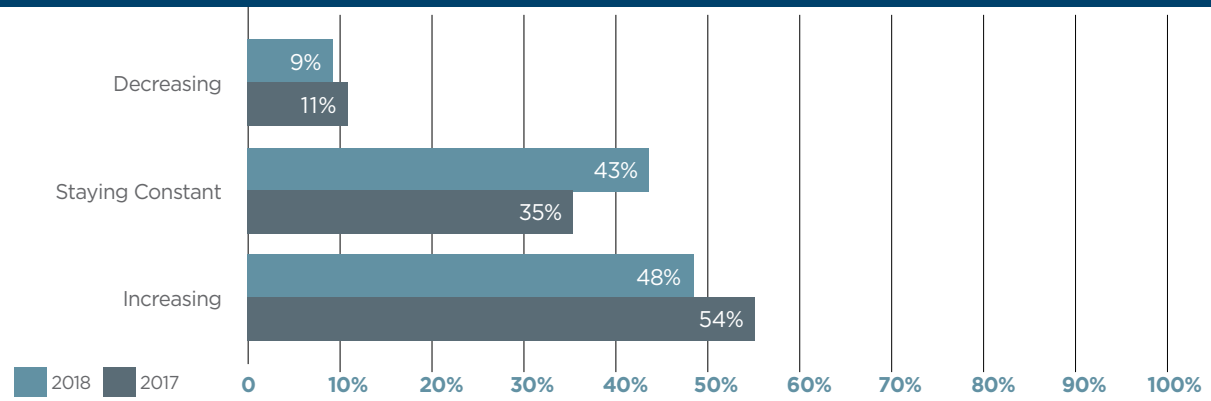
In recent surveys, we have asked respondents if they expect to "onshore" any manufacturing back to the U.S., "nearshore" it to Canada or Mexico, or, alternatively, relocate or "offshore" any production outside the country. In 2017, 9% intended to nearshore, 5% intended to onshore, and 6% intended to offshore some manufacturing. For 2018, 6% still intend to offshore some manufacturing, but only 2% and 4%, respectively, were planning on either onshoring or nearshoring some of their manufacturing.

2018 VS 2017 OFFSHORING, ONSHORING, AND NEARSHORING



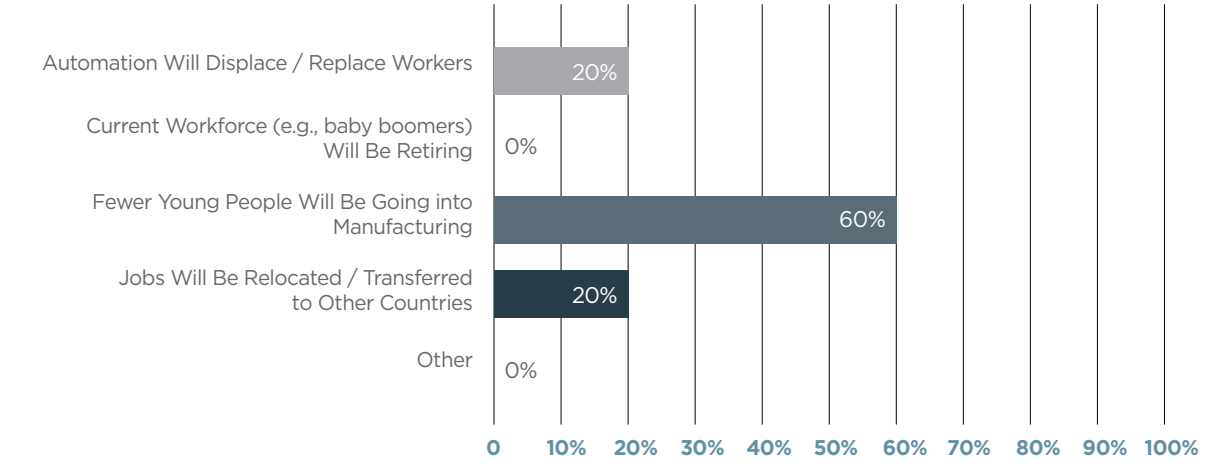
Recently, there has been a lot of speculation on whether the number of jobs in manufacturing is increasing, declining, or remaining the same. In the 2017 survey, 54% of the respondents indicated the number of manufacturing jobs in their business was increasing, 35% said the number was remaining constant, and only 11% replied that the number of jobs was decreasing. The results are similar for this 2018 survey, with 48% reporting that the number of manufacturing jobs in their business is increasing, 43% indicating that the number is staying constant, and only 9% reporting that it is decreasing.

HOW ARE THE NUMBER OF MANUFACTURING JOBS IN YOUR BUSINESS CHANGING?



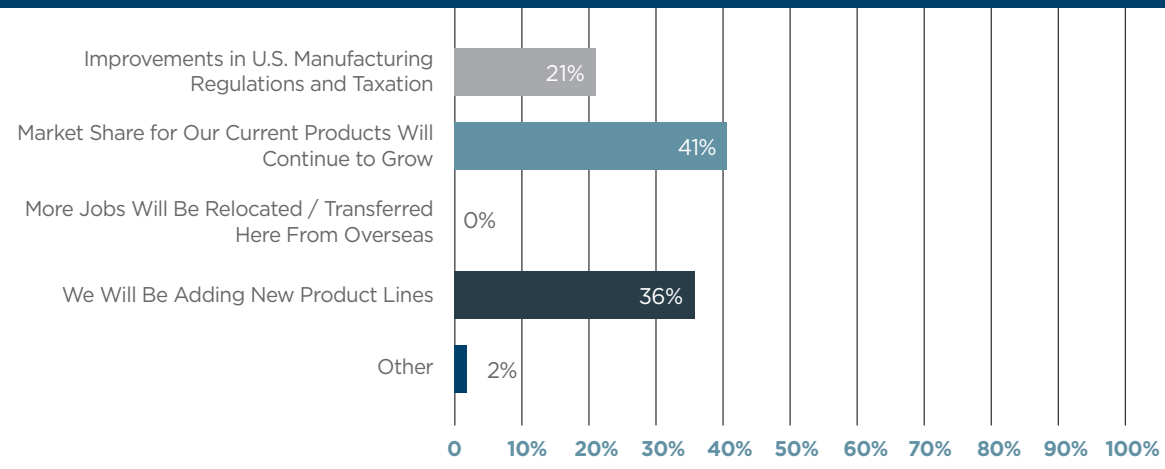
For any respondents that indicate that the number of jobs is "decreasing" in the question above, we then asked them for reasons why. In the 2017 survey results (not shown in the bar chart below), half of respondents attributed the decrease to either automation (25%) or jobs transferred to other countries (25%). Nineteen percent attributed the decrease to more retirements by baby boomers, and another 19% thought that manufacturing jobs would decrease in number because fewer young people were seeking employment in manufacturing. For 2018, this last reason received much more of the blame, with a majority (60%) attributing the decreases to fewer young people going into manufacturing, as shown in the bar chart below, while the remaining 40% broke down between automation (20%) and jobs transferred to other countries (20%).

REASONS THAT MANUFACTURING JOBS WILL BE DECREASING



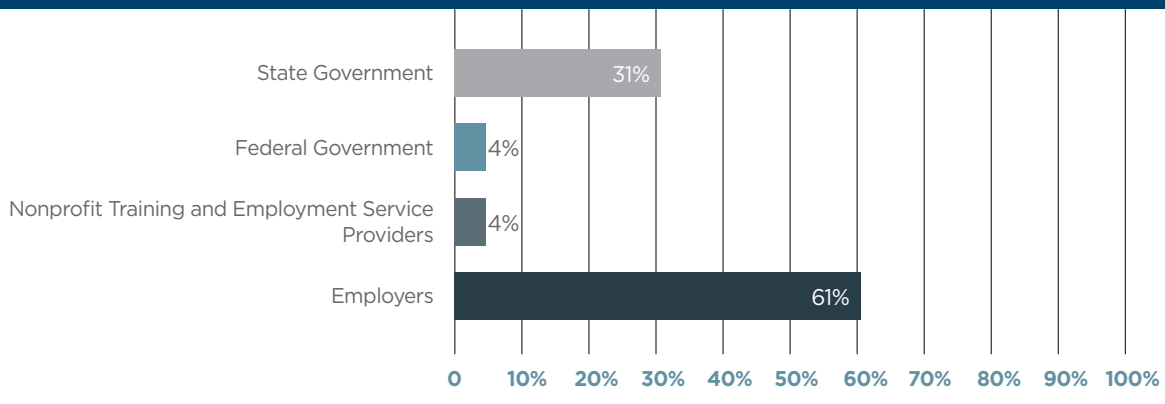
Alternatively, for those respondents that reported the number of jobs is "increasing," we also asked them why. Forty-one percent attribute the increase to growth in their market share (up from 37% in 2017), 36% indicate it is due to the addition of new product lines (up from 27% in 2017), and 21% believe that improvements in the regulatory and tax environment will result in an increase in manufacturing jobs (up from 19% in 2017). Interestingly, no respondents expect employment to grow due to positions being relocated / transferred back to the U.S. from overseas (down from 11% in 2017).

REASONS THAT MANUFACTURING JOBS WILL BE INCREASING

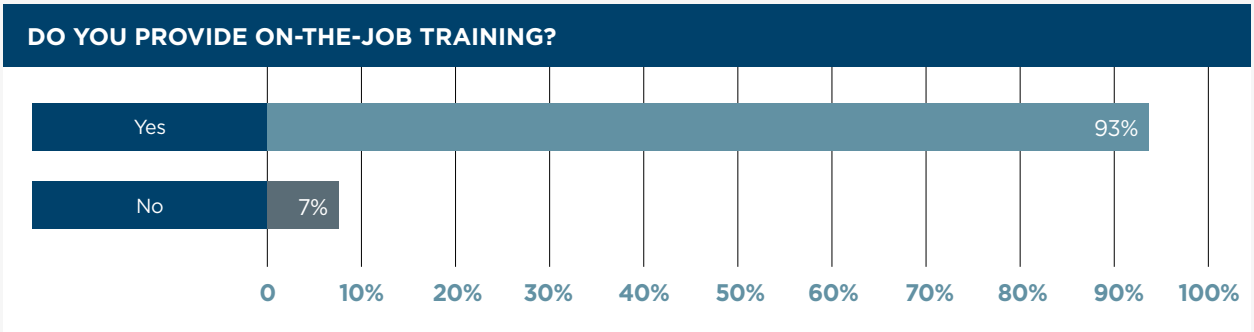


Turning to workforce development, in this 2018 survey, 61% believe that employers (i.e., manufacturers) should be responsible for workforce development (up from 51% in 2017), while 31% think it should be driven by state government (down from 41% in 2017). The percentages in 2018 that believe workforce development should be the responsibility of the federal government (4%) or nonprofit training and employment service providers (4%) remained low, just as in 2017.

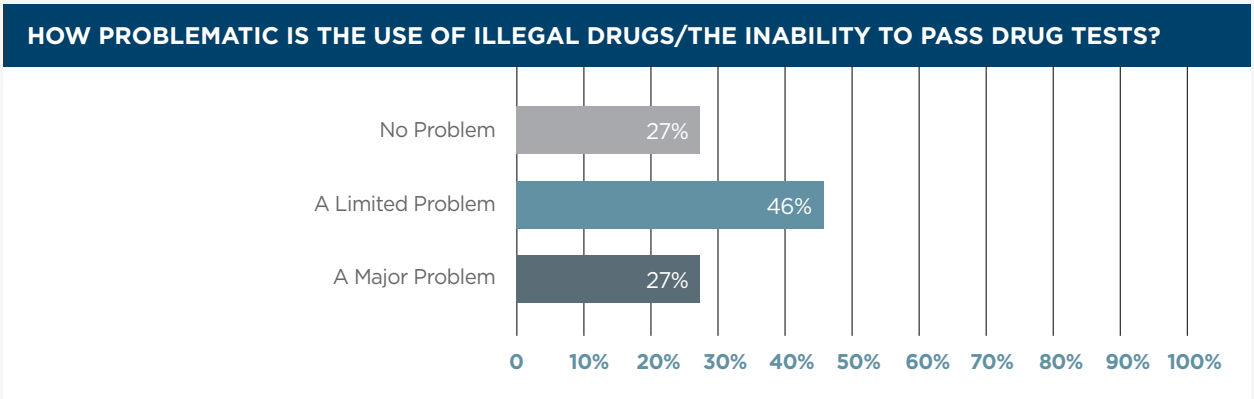
WHO SHOULD BE THE DRIVER OF MANUFACTURING WORKFORCE DEVELOPMENT?



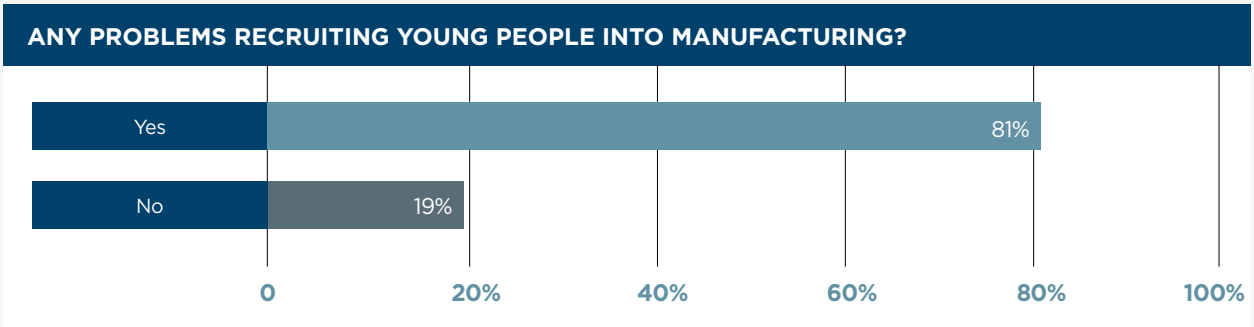
In 2018, the overwhelming majority of respondents (93%) have some type of on-the-job workforce training program, consistent with our findings for the 2017 survey.



In recent surveys, we have included a question about problems related to the use of illegal drugs and workers' inability to pass drug screening tests. The 2017 results (not shown in the bar chart below) indicated that 19% of respondents viewed this is a major issue, while 49% saw it as a "limited" problem, and 32% experienced no such problems. For 2018, the percentage of respondents that view this as a major problem has, unfortunately, increased to 27%, as shown below, while the percentages experiencing a "limited" or "no problem" have dropped to 46% and 27%, respectively.



In 2017, we decided to include more questions focused around attracting young people into careers in manufacturing. Notably, 87% of the respondents reported that they had problems recruiting young people into the field in 2017. In 2018, 81% replied that recruiting young people was still a challenge.



We also gave respondents an opportunity to **share any advice they had for young people interested in a career in manufacturing**. Practically every respondent had something to tell young people about manufacturing, and below is just a short list of their cumulative thoughts.

"Manufacturing is a path to build a middle-class life without taking on the debt associated with college."

"Keep options open and consider all aspects of careers. There are more manufacturing jobs in this country than any other business segment, and subsequently, more opportunities."

"Improve technical skills and improve communication skills."

"Find a job that gives you experience in a field in which you want to work. Pay is secondary initially."

"Match your skills and beliefs with a company and commit to them; refrain from job-hopping."

"Visit as many companies as you can."

"Machinist is no longer a dirty job but a high-tech job with great pay possible."

"Don't just look at 'large' manufacturers. Look at small and mid-size manufacturers as well."

"Stay in one place until you learn everything they have to offer. Don't stay somewhere that doesn't invest in you!"

"Get a skill then a job. Then work your way up."

"Look at internship and apprenticeship opportunities with local companies."

"Tour facilities, talk to trained professionals, watch and read as much information is available on the Internet to learn outside of your current skill set."

Finally, we also gave our 2018 survey participants an opportunity to **share any ideas that they had on how to better promote careers in manufacturing** to young people. Almost everyone had thoughts on this important issue. Below are some of their suggestions.

"Promote manufacturing in junior high and high schools. Teach blueprint reading."

"Start with the parents and then K-12. It can be high-paying and satisfying. "

"We are doing all we can: Manufacturing Day, job fairs, etc."

"Start young, at middle school levels, and continue career awareness throughout high school to promote more than higher education to students."

"High school guidance counselors should not be so focused on post-high school education for everyone."

"State/federal subsidized paid internships at employers that include training, and fund programs that encourage students to get involved with the field."

"Encourage trades in middle schools and high schools. Give classes to introduce trades to students."

"We employ student interns from the local high school manufacturing technology program. Many become employees after graduation."

"Pay them more and do not treat them like human robots."

"Provide skills training in middle school and high school and involve local business people as examples of work opportunities."

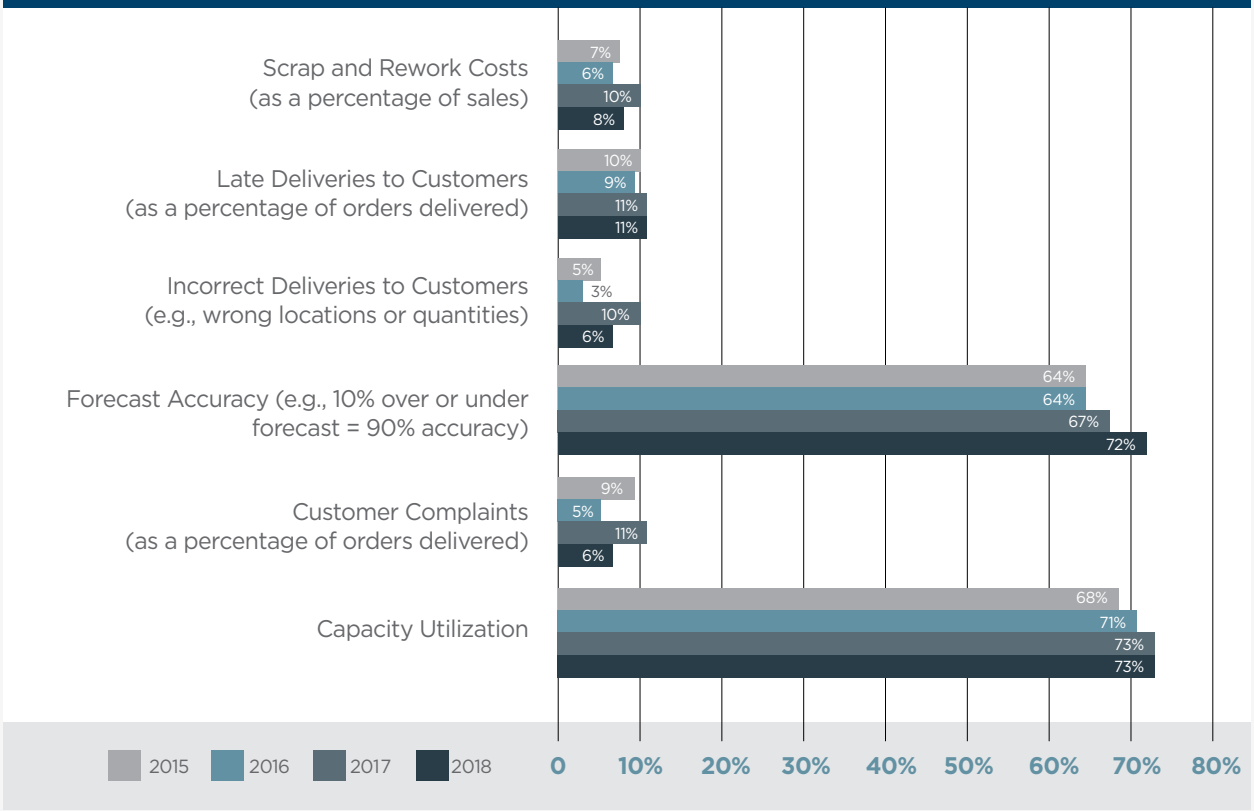
"Manufacturing Day has been a boon for many employers."

"Encourage teachers to tour modern manufacturing plants and stop steering students away from these fields."

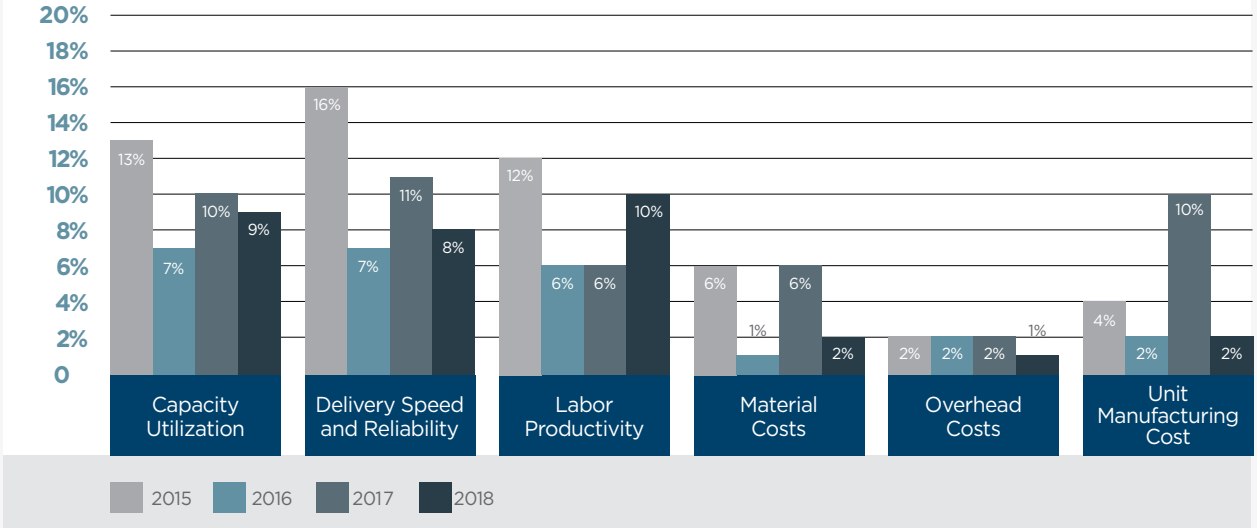
Appendix: Benchmarking Indiana's Manufacturing

The following data are averages for an array of performance metrics over the last four surveys.

WHAT WAS YOUR BUSINESS UNIT'S APPROXIMATE PERFORMANCE LEVEL FOR THE FOLLOWING?



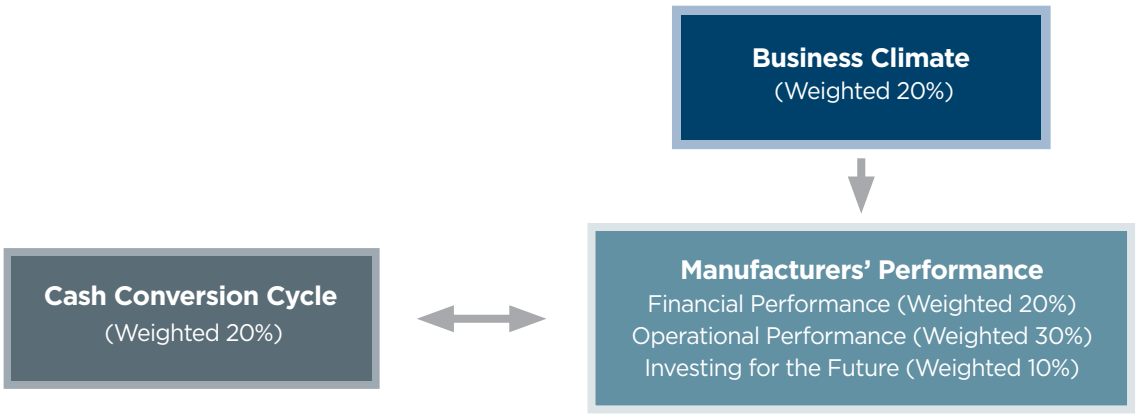
BY WHAT PERCENTAGE HAS YOUR BUSINESS UNIT'S OPERATIONAL PERFORMANCE IMPROVED, STAYED THE SAME, OR DECLINED IN THE PAST THREE YEARS FOR THE FOLLOWING?



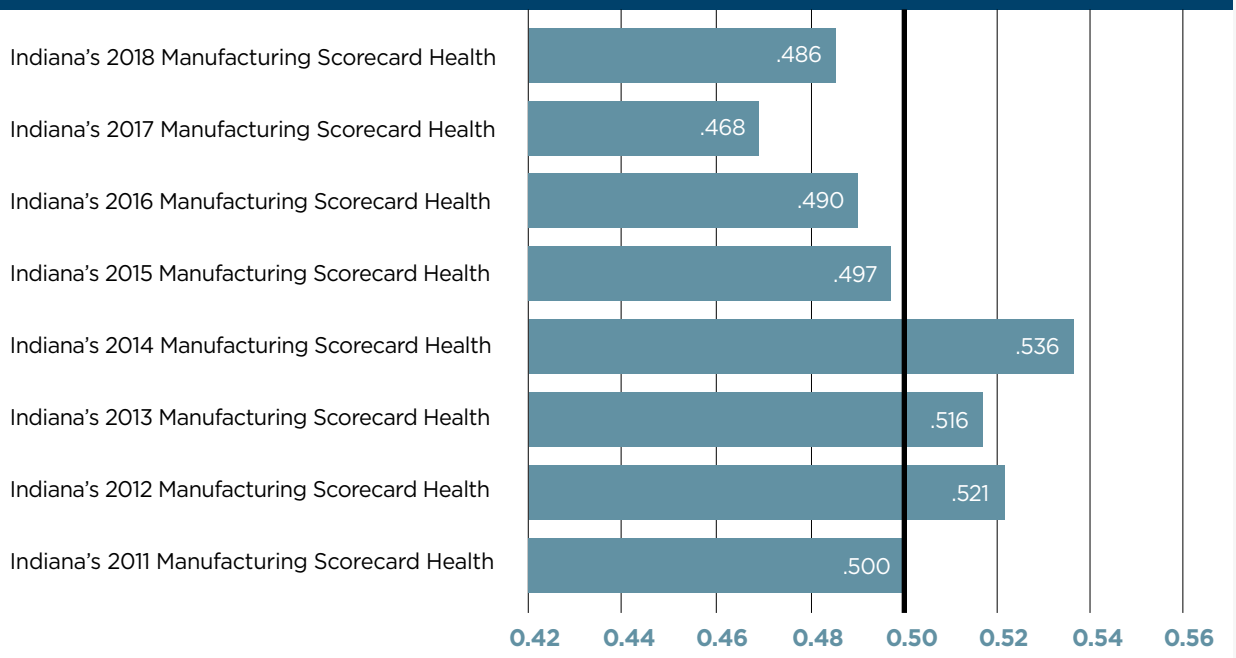
INDIANA'S MANUFACTURING SCORECARD

As with our previous reports, this year's report includes a composite scorecard compiled using 16 different critical measures covering the business climate, cash-conversion cycle, and manufacturers' performance in order to track the overall health of Indiana's manufacturing industry. Using the 2011 study as a reference point, we set that year's score at an even "par" index baseline of .500. From there, annual scores greater than .500 indicate Indiana's manufacturing sector is getting stronger, while scores below .500 suggest Hoosier manufacturers are weaker. This year's score of .486 is the fourth time in a row over the past eight years that the index has been below .500.

INDIANA'S MANUFACTURING HEALTH SCORECARD: CRITICAL AREAS AND WEIGHTS



INDIANA'S EIGHT-YEAR MANUFACTURING HEALTH



ABOUT KATZ, SAPPER & MILLER

Founded in 1942, Katz, Sapper & Miller (KSM) is the largest Indianapolis-based CPA firm. Today, an employee-owned company with 45 partners and more than 400 staff, KSM is widely recognized as one of the country's preeminent accounting firms. Our mission is simple: Inspiring great people to do great things.

KSM has long believed the manufacturing and distribution industry is both key for Indiana and strategic for our firm. Accordingly, we have made a strategic commitment to this practice area. We consistently dedicate substantial resources, including our top talent, to ensure we stay on top of emerging industry issues and provide the highest level of service to our clients. As a result, our Manufacturing and Distribution Services Group is one of our largest practice areas.

The professionals of KSM's Manufacturing and Distribution Services Group are dedicated to providing practical and innovative solutions for the unique needs of manufacturers and distributors. The group is comprised of a cross-functional team of specialists with extensive industry experience who provide services ranging from mergers and acquisitions; process and operational improvement consulting; accounting, tax, and audit services; technology and human resources consulting; strategic planning; and more.

For more information, please visit ksmcpa.com/manufacturing-distribution.

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ABOUT THE RESEARCHERS

The research study was conducted in conjunction with faculty from Indiana University's Kelley School of Business Indianapolis.

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D.B.A. Boston University 1998

Dr. Frohlich's research interests are in manufacturing and supply chain strategy, and he currently serves as the director of the IU Kelley School Center for Excellence in Manufacturing. His research has won numerous awards, including best papers of the year and best operations management case study. He was identified as one of the most cited authors in the field by the Journal of Operations Management. He has likewise won IU's *Trustees Teaching Award* multiple times and, through executive education, had the opportunity to teach on four continents in more than a dozen countries. He also serves on APICS' Research, Innovation, and Strategy Committee (RISC) and chairs their research subcommittee.

PROFESSOR STEVE JONES
Ph.D. Purdue University 1989

Dr. Jones' research interests are in financial management and strategy, including how financial decision making interacts with capital market conditions. He has been published in the top scholarly journals in finance, including the Journal of Financial Economics, the Journal of Finance, the Journal of Business, Financial Management, and the Journal of Corporate Finance. He also serves as director of the school's Finance Education Enterprise. He teaches courses in financial management, financial markets and investment analysis, and he is a four-time winner of a Kelley School teaching excellence award.

For more information regarding Indiana University's Kelley School of Business at IUPUI, please visit kelley.iupui.edu.

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