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IndustryWeek Special Research Report
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The Future of Manufacturing: 2020 and Beyond

The management and
technology priorities
enabling global
competitiveness in
the years ahead



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Executive Summary

This joint research product between *IndustryWeek* Custom Research and Kronos shines a light on manufacturing strategy, management practices and investment priorities over the next five years and beyond.

While U.S. manufacturing employment has declined over the past 25 years, the future outlook is bright. Taken alone, the U.S. manufacturing sector would be the ninth-largest economy in the world, according to the National Association of Manufacturers.

As our research found, manufacturing leaders are overwhelmingly positive about their business growth prospects. Nine out of ten expect revenues to grow, and more than half expect revenues to grow 5% or more per year over the next five years.

The top challenges to meeting these strong growth expectations are market volatility, rising material costs, price reduction pressures and increasing labor costs. To thwart such threats, according to our research, manufacturers are pushing hard to improve performance across a range of capabilities, starting with improving production processes, strengthening customer relationships and finding people with the right skills and experience.

To achieve their growth targets, manufacturers are investing in areas that will improve productivity and speed responsiveness. Company leaders also are prioritizing investments that

will make it easier to collaborate with customers and suppliers, gather market intelligence and streamline customer communication. Topping the list of specific technology investments are quality management and lean manufacturing systems. To better align labor and production capability with daily demand, they're also budgeting for demand planning/forecasting systems, workforce/labor management systems and performance dashboards.

While innovation is always a strategic priority, a surprisingly large percentage of manufacturers (45%) have not yet set a specific goal for reducing new product development cycle times. Among those working to shorten product development cycles, they're trying to better understand customer and market needs, improve professional labor productivity and create prototypes faster.

To attract and retain people with the right skills and experience, manufacturers are primarily emphasizing leadership training, performance management and skills training. Not surprisingly, companies that are investing in new systems and equipment also are more likely to be investing in the personal growth and development of their people.

This research report details the leadership priorities and investments that U.S. manufacturers are making in new systems, equipment and people to remain globally competitive through 2020 and beyond.

Research Methodology

This report highlights the findings of the 2016 *IndustryWeek Future of Manufacturing: 2020 and Beyond* study, underwritten by Kronos. The purpose of this research was to explore the direction of manufacturing strategy, practices and technology in the foreseeable future. In March 2016, IW Custom Research e-mailed invitations to participate in the online survey to a selection of *IndustryWeek* subscribers. That invitation was followed by reminders to non-respondents. In total, we received and tabulated 153 completed surveys. This analysis and report is based on the views of these 153 mostly senior executives and managers. Response percentages do not always add up to 100 percent due to rounding and the allowance for multiple responses on some questions.

INTRODUCTION

Going for Growth

From catching a ride to dating, smart phones have transformed how people around the world communicate and live. In a similar way, the rapid evolution of production, information and operating technology is slowly transforming manufacturing.

With its skylights, white walls and floors, and red robots, that transformation can be striking to anyone visiting the new Tesla Factory in Fremont, California. Away from the media spotlight, the increasing sophistication, automation and efficiency of U.S. manufacturers is no less striking at food processors, mining operations, oil refineries and medical device makers.

Continuing the long-term push to replace inventory with data, U.S. manufacturers are producing more of what customers want and delivering it at a profitable price when and how they want it. Continuing the Tesla example, with strong demand for its electric vehicles the company is quickly ramping up output, and reportedly has thousands of applicants for every job opening. But Tesla isn't the only manufacturer that's buoyant about the future.

Respondents to the *IndustryWeek* Future of Manufacturing survey are resoundingly positive about the potential for both future sales and employment growth. While nine out of ten expect revenues to increase, within that cohort well over half (58%) anticipate strong growth of 5% or higher per year over the next five years. More than two thirds (70%) of manufacturers expect to increase the number of people that they employ over the next five years.

That outlook is somewhat striking considering the negative perception many people still have of U.S. industry. Such perceptions aren't surprising given the rapid decline in manufacturing employment that began in the early 2000s following the removal of global trade barriers. In actuality, in recent quarters the sector has hit all-time record highs in terms of output.

Is the industry shakeout over? Only time will tell, of course. But the fact is, any U.S. manufacturer and factory that has survived over the past several decades has to be globally competitive. They have no choice.

Setting Priorities for the Future

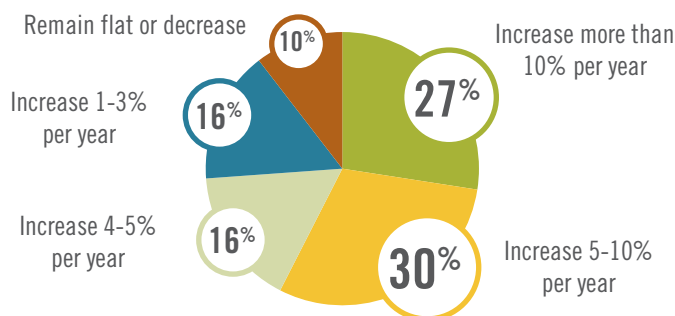
Today's markets are characterized by complexity, ambiguity and uncertainty. Fluctuating oil prices, raw material prices and currency exchange rates all can have a big impact on the profitability equation.

In addition to investing in new production and product technology, manufacturing companies of all types are managing this market volatility, price reduction pressures and increasing material costs by improving internal production processes and hiring people with the skills they need. Companies with more global operations, which tend to be larger (annual sales of \$1 billion and higher), are focusing more on improving demand responsiveness, annual cost reductions and supply chain performance. Companies that only have U.S. production operations, which tend to be smaller (annual sales of less than \$100 million), are focusing on strengthening customer relationships, improving productivity and quality.

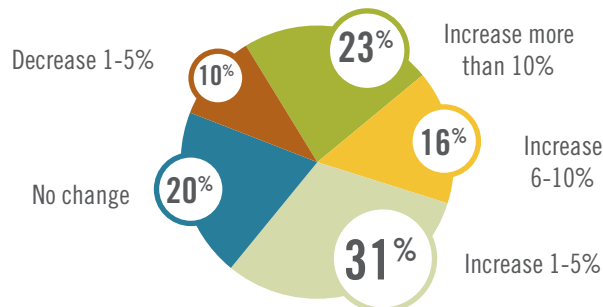
For a manufacturing company of any size to survive and thrive in this era, its operations have to be both lean (cost competitive and efficient) and agile (responsive to market demands). This research report explores the leadership strategy and tactics, as well as the technology and skill investments, that manufacturers are making to improve operational performance and profitability.

Manufacturers Have Strong Growth Expectations

Annual Revenue Growth



Employment Growth over Next Five Years



Among our survey respondents, senior leaders are slightly more optimistic than mid-level managers. Those at small (annual sales of less than \$100 million) and mid-sized (\$100-\$999 million) manufacturers are more bullish on the future than those at larger companies (\$1 billion plus).

Source: *IndustryWeek* Future of Manufacturing, 2020 and Beyond, May 2016. Forecasted percentage change in company's revenues on an annual basis over the next five years, n=153.

Source: *IndustryWeek* Future of Manufacturing, 2020 and Beyond, May 2016. Forecasted percentage change in number of employees over the next five years, n=145.

MARKET CHALLENGES

The Need for Speed

There's a reason why manufacturing leaders constantly talk about the need for improving agility. A powerful combination of speed, responsiveness, and business agility is essential for managing market volatility, which is the top challenge facing all respondents to our survey. It also can help address fluctuating raw material costs, manufacturers' number two challenge.

Looking at the market challenges by job position, C-level and other senior executives single out business regulations, labor costs and labor regulations, which can curtail long-term growth initiatives. On an operating level, lower-level manufacturing managers are more concerned about price reduction pressures, environmental regulations and transportation costs. Comparing results by annual revenues, rising labor costs are a higher concern for leaders at smaller firms. For larger companies, price reduction pressures and global competition are more pressing issues.

Of course, each of these challenges is different for every individual company. Unemployment rates vary by locality, for example, but are generally at their lowest level in eight years. While the retirement of highly paid baby boomers is a challenge in terms of lost expertise and knowhow, manufacturers in many cases are benefiting from new people entering the workforce at lower hourly wages.

Top Market Challenges



Top 5 Market Challenges by Annual Revenues (Common concerns for manufacturers of every size are highlighted.)

Less than \$100 million

- 1 Market volatility
- 2 Labor costs
- 3 Material costs
- 4 Business regulations
- 5 Environmental laws and regulations

\$100 million to \$999 million

- 1 Material costs
- 2 Price reduction pressures
- 3 Global competition
- 4 Market volatility
- 5 Transportation/logistics costs

\$1 billion or more

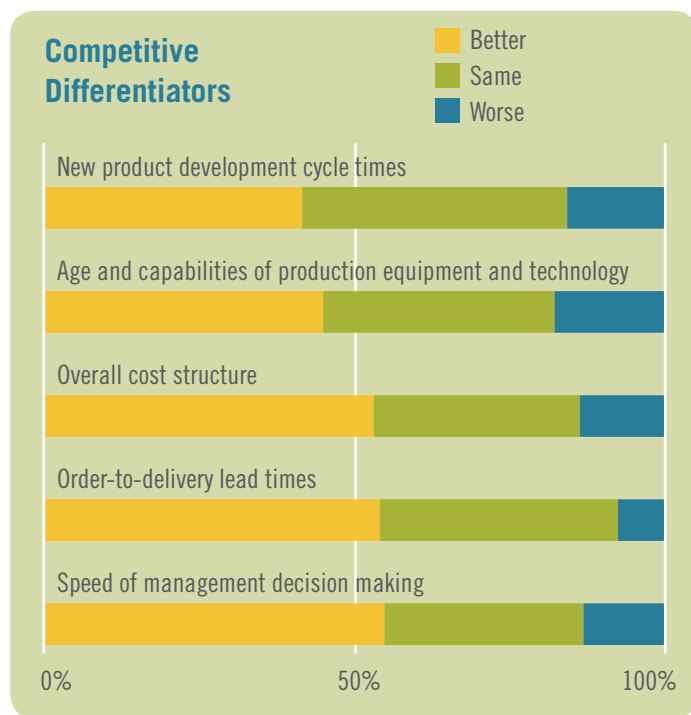
- 1 Market volatility
- 2 Material costs
- 3 Price reduction pressures
- 4 Environmental laws and regulations
- 5 Global competition

Converting Strategy to Execution

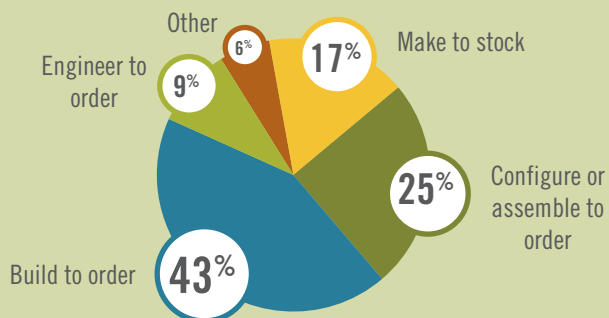
As any experienced business leader will tell you, there's never any shortage of opportunities. Leadership's responsibility is to identify the strategic opportunities that offer the greatest profit potential and best alignment with the company's core capabilities and competitive differentiators.

In a roundabout way, we asked manufacturers to identify these differentiators by comparing their current performance with the competition. The presumption being that leaders have decided to compete—and have made the necessary investments and resource allocations—where they feel they can establish and maintain a market advantage. After all, no business is really competing in areas where it's only keeping up with or falling behind the competition.

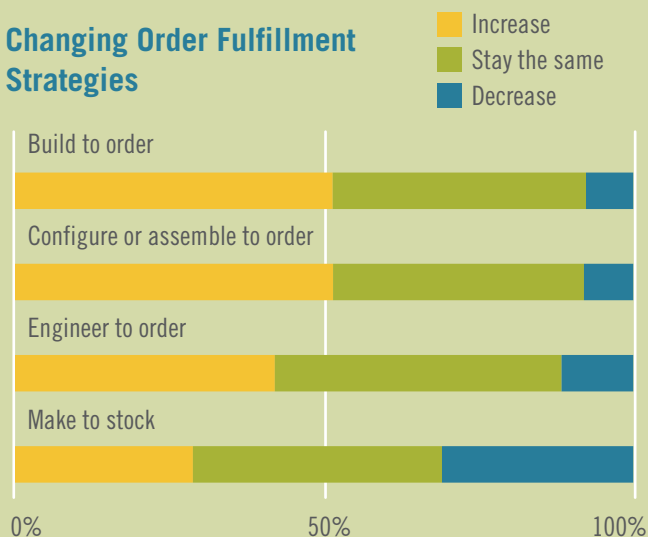
More than half of manufacturing executives feel that they match up well against their competitors in terms of cost structure, delivery times and decision-making speed. Pointing to a potential opportunity, fewer have decided to compete based on product development cycle times and equipment capabilities.



Primary Order Fulfillment Strategy Today



Changing Order Fulfillment Strategies



Over the next five years, manufacturers will continue to move away from make-to-stock and shift toward less inventory dependent build-, configure- and engineer-to-order fulfillment strategies.

Moving Forward on All Fronts

There's no single metric for measuring manufacturing agility. That's because the ability to sense customer and market needs, and respond quickly, has both tactical and strategic dimensions.

In terms of business strategy, agility is the ability to quickly shift attention and resources to mitigate risks and fully capitalize on growth opportunities. On a more tactical level, agility is about reacting quickly to customer requests and orders. Improving these day-to-day processes—increasing productivity by aligning labor resources with demand, for example—can drive hard business benefits and help achieve strategic objectives.

When we asked manufacturing leaders to rate their operational challenges, the responses were tightly grouped. This limited variation points to the fact that manufacturers are working hard to

achieve and maintain superior performance across a wide range of capabilities.

Manufacturers of all sizes share a common focus on 1) improving production processes, 2) strengthening customer relationships and 3) finding talented people. The leaders of smaller firms (less than \$100 million) are paying more attention to meeting customization demands and improving productivity. Interestingly, maximizing capacity utilization and achieving annual cost reductions, which are always a priority regardless of company size, become even more important as annual sales grow.

Top Operational Challenges

- 1 Improving internal production processes
- 2 Strengthening customer relationships
- 3 Finding enough people with the right skills and talent
- 4 Increasing labor productivity
- 5 Increasing demand responsiveness
- 6 Maximizing capacity and asset utilization
- 7 Meeting customer demands for product customization
- 8 Achieving annual cost reductions
- 9 Improving product and service quality
- 10 Responding to customer requests for quotes and proposals
- 11 Improving labor flexibility
- 12 Enhancing supply chain collaboration
- 13 Optimizing supply chain performance
- 14 Faster and more frequent new product releases and launches

Top 5 by Leadership Position

(Common concerns across both management levels are highlighted.)

Sr. Executive (Owner, Partner, President, C-Level)

- 1 Strengthening customer relationships
- 2 Finding enough people with the right skills and talent
- 3 Meeting customer demands for product customization
- 4 Increasing demand responsiveness
- 5 Increasing labor productivity

Vice President, Director, Manager (with direct reports)

- 1 Improving internal production processes
- 2 Increasing labor productivity
- 3 Strengthening customer relationships
- 4 Finding enough people with the right skills and talent
- 5 Maximizing capacity and asset utilization

Senior manufacturing executives are more focused on product customization capabilities and demand responsiveness when compared to lower-level managers, who are responsible for throughput, uptime and other KPIs that focus on efficiency.

TECHNOLOGY PRIORITIES

Investing for the Future

There's no doubt that by the year 2020 manufacturers in every industry will have invested billions of dollars in a wide array of advanced digital and fabrication technologies. That includes 3D printing and nano-manufacturing technology in addition to new capabilities ushered in by the widespread use of Internet-connected sensors and analytics.

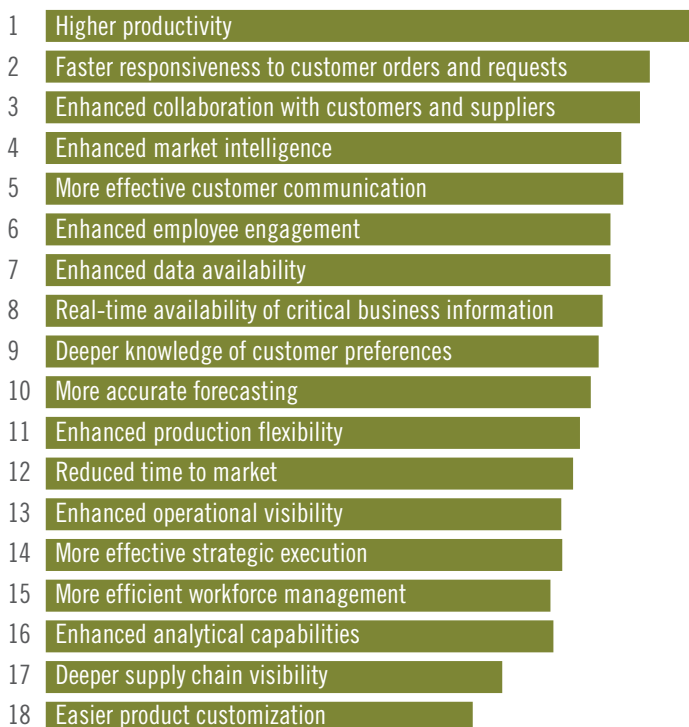
Decisions on where exactly to invest—or not—will depend upon leadership priorities and objectives, which are always subject to market conditions and forecasts. Every new capital equipment investment will be subject to a careful cost/benefit analysis. The results of this analysis and timing of any decisions will be different for every industry, every company and every factory.

Predictably enough, whether driven by new technology or process improvements, productivity gains top manufacturers' list of targeted benefits for any new investments. Beyond better productivity, there's not much variation between manufacturing leaders' highest and lowest priorities. They're essentially trying to push forward on all fronts.

Manufacturing leaders' other priorities reflect a broad drive for deeper market knowledge and enhanced internal visibility, which not coincidentally contribute to enhanced agility. These include: faster order responsiveness, improved collaboration, better market intelligence and more effective customer communication. All of these are enabled by stronger employee engagement, better data availability and deeper knowledge of customer preferences.

While senior executives' technology desires mirror respondents as a whole, mid-level managers again place greater weight on operational priorities, including more accurate forecasting and employee engagement. One interesting finding, when comparing manufacturers by annual revenues, the over-riding focus on improving productivity appears to decline as a company's sales increase; it's supplanted by a range of more customer-oriented priorities.

New Technology Investment Priorities



Top 5 Technology Priorities by Revenue Growth Expectations

(Common priorities across all anticipated growth rates are highlighted.)

High growth (more than 10%)	Moderate growth (4-10%)	Low to no growth
1 Enhanced data availability	1 Higher productivity	1 Higher productivity
2 Enhanced collaboration with customers and suppliers	2 More effective customer communication	2 Reduced time to market
3 Enhanced market intelligence	3 Enhanced employee engagement	3 Faster responsiveness to customer orders and requests
4 Higher productivity	4 Faster responsiveness to customer orders and requests	4 Enhanced production flexibility
5 Real-time availability of critical business information	5 More effective strategic execution	5 Deeper knowledge of customer preferences

Presumably because they're growing rapidly, and in a better financial position to make investments in the future, high-growth companies rate the potential business impact of new technology higher across the board. Compared to other manufacturers, the top priorities of fast growers currently revolve around data gathering and analysis.



Weighing a Multitude of Options

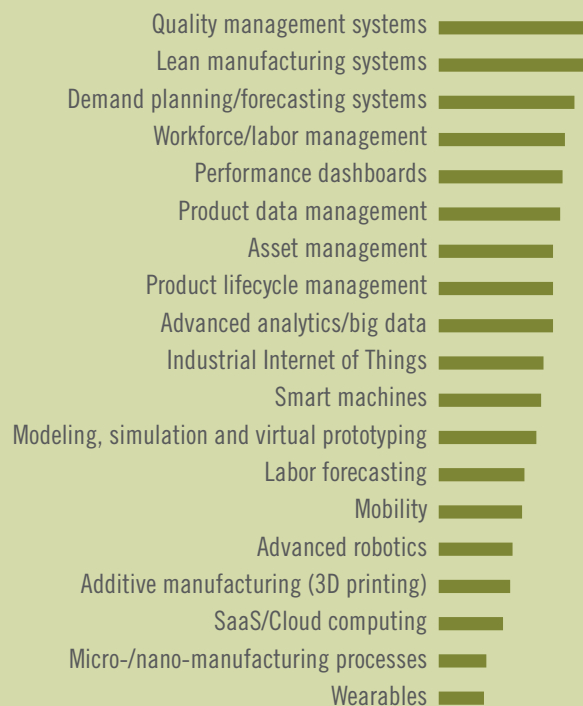
A wide range of potential technology investments compete for resources during every capital budgeting cycle. Based on what they know about each solution's ability to deliver the business benefits cited above, we asked manufacturing leaders to rate their importance to future success.

It's no wonder that quality management and lean manufacturing systems top the list. Quality is the price of admission for manufacturers in any market today. Lean systems and processes improve quality by supporting the transition to one-piece flow and incorporating error-proofing techniques. The next three priorities—demand planning/forecasting, workforce/labor management and performance dashboards—all have the potential to improve the alignment and monitoring of labor and equipment resources with daily demand requirements. This aligns with manufacturing leaders' concerns about labor costs as well as their productivity-improvement priorities cited above.

While the Industrial Internet of Things makes the top 10, other much-hyped technology developments—3D printing, wearables, nano-manufacturing, mobility, etc.—are much less important in the eyes of manufacturing leaders. This is probably because the ROI for these technologies is currently confined to niche applications.

Lower-level managers are again mostly focused on investments that can improve daily output. More senior executives are looking closely at modeling and virtual prototyping capabilities, as well as the potential business benefits of big data and advanced analytics.

Importance of Technology Advancements to Future Business Performance



Top 5 by Cost Position (Common priorities across cost positions are highlighted.)

Better overall cost structure than competitors

- 1 Quality management systems
- 2 Lean manufacturing systems
- 3 Demand planning/forecasting systems
- 4 Workforce/labor management
- 5 Advanced analytics/big data

The same or worse cost structure compared to competitors

- 1 Lean manufacturing systems
- 2 Quality management systems
- 3 Performance dashboards
- 4 Product data management
- 5 Demand planning/forecasting systems

When comparing manufacturers' assessments of their cost structure, it's not surprising that those on par with or falling behind their competitors would be more focused on dashboards and product data management in order to get a real-time view of performance.

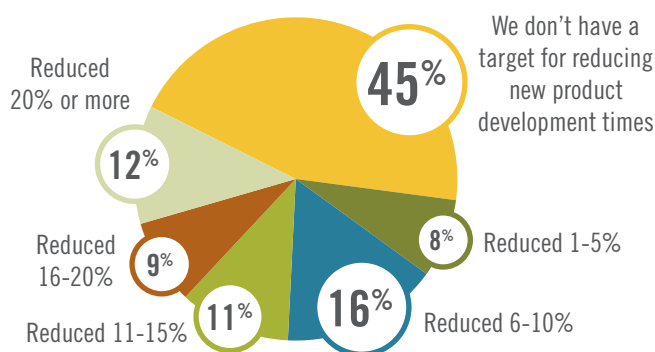
NEW PRODUCT DEVELOPMENT

Faster Speed to Market

The larger a company gets, the more bureaucratic it tends to become. While it is natural and necessary to establish controls and protocols to manage a larger organization as it grows, a previously fast and nimble manufacturer can slowly become less and less responsive to customer needs and market changes. Over time, fewer and fewer products hit scheduled stage gates or launch dates on time, which is frustrating for everyone in the organization, not to mention customers. This tendency could explain why larger manufacturing companies (annual sales of \$100 million and above) are more likely than smaller ones to be working on reducing their product development times.

As noted in a previous section of this report, the majority of manufacturers rate their new product development cycle times as the same or longer than their competitors. Because it's obviously not a strategic priority for so many companies, it's no surprise that a large percentage of manufacturers (45%) don't have a target for reducing development cycle times.

Product Development Cycle Time Reduction Targets



Source: Industryweek Future of Manufacturing: 2020 and Beyond, May 2016. Respondent companies' five-year new product development cycle time reduction target, n=152.

On Time and On Target

When promising new product releases fail to meet sales projections, the root cause can often be traced back to a failure to clearly understand customer wants and needs. Manufacturing leaders have clearly learned this lesson.

Of all the tactics for reducing development cycle times and improving success rates, company executives say that expanding their understanding of customer and market needs would have the greatest impact on their business. Improving the productivity of professional staff and faster prototyping would also have a significant impact. These three tactics remain at or near the top regardless of leadership perspective or company size.

Potential Business Impact of Product Development Time Reduction Tactics

Better understanding of customer/market needs

Improving professional labor productivity

Faster prototyping

Flexible automation

Advances in computer-aided design and simulation

Modular designs

Product lifecycle management applications

Virtual manufacturing capabilities

Top 5 by Revenue Growth Expectations (Common priorities across all anticipated growth rates are highlighted.)

High growth (more than 10% annually)

- 1 Better understanding of customer/market needs
- 2 Faster prototyping
- 3 Advances in computer-aided design and simulation
- 4 Improving professional labor productivity
- 5 Virtual manufacturing capabilities

Moderate growth (4% to 10%)

- 1 Better understanding of customer/market needs
- 2 Improving professional labor productivity
- 3 Faster prototyping
- 4 Flexible automation
- 5 Product lifecycle management applications

Low to no growth

- 1 Better understanding of customer/market needs
- 2 Improving professional labor productivity
- 3 Faster prototyping
- 4 Product lifecycle management applications
- 5 Modular designs

Even when comparing product development process priorities by anticipated revenue growth, there was very little variation. High growth manufacturers did rate the potential impact of every cycle-time reduction tactic significantly higher.

Source: Industryweek Future of Manufacturing: 2020 and Beyond, May 2016. Potential impact of strategies and tactics for reducing new product development cycle times, 1 (high impact) or 2 on a five-point scale, n=145.

TALENT MANAGEMENT

Attracting, Developing and Retaining Tomorrow's Leaders

Even in the immediate wake of the 2008-2009 Recession, when the national unemployment rate was hovering around 10%, manufacturing executives were concerned about not being able to find people with the right skills and experience to fill open positions. If anything, the situation is even more challenging today. According to our research, finding talented people is among manufacturing executives' top three operational priorities along with process improvement and strengthening customer relationships.

There's nothing surprising about the top three tactics that manufacturers are using to attract and retain people. The opportunity for learning in the form of leadership training, performance management and skills training, have long been recognized as key job motivators.

How Manufacturers Are Attracting, Developing and Retaining People

Leadership/management training

Performance management

Skills training

Employee recruitment

Compensation incentives

General business training

Partnerships with local community or vocational schools

Job support technology

Career mapping/planning

Non-compensation incentives



There is very little difference in human capital investment priorities by leadership position or company size. It should be noted that many of the technology investments noted in the bar chart—quality, production, labor and asset management systems—deepen employee engagement and directly support attraction and retention efforts. These same technology investments also tend to improve productivity, which is the number one targeted benefit of manufacturing decision makers.

Investing for the Future

To dig a little deeper into employee attraction and retention strategies, we divided our survey respondents into two groups. In the first, we placed those that are making significant investments (1 or 2 on a five-point scale) in at least six of the 10 areas listed in the bar chart to the left. We labeled these as “strong investors,” then classified everyone else as “moderate to low investors.”

As you would expect from manufacturers that are doing more to attract and retain people, they have somewhat higher expectations for future revenue and employment growth. There is a much more significant disparity, however, when we looked at how they rate their performance in comparison to competitors.

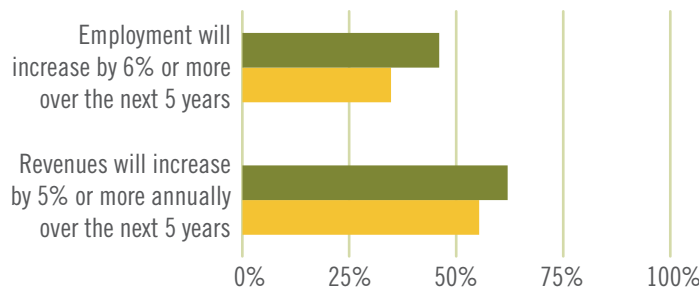
The gap between strong and moderate investors is largest when looking at the age and capabilities of their equipment. This points to a cultural difference as it suggests that manufacturers that are investing in new systems and equipment are also more likely to be investing in their businesses in general, and their people specifically. After all, tapping into people's experience and knowledge, giving them additional methodologies and tools, and empowering them to make changes is a powerful way to drive business improvement and innovation.



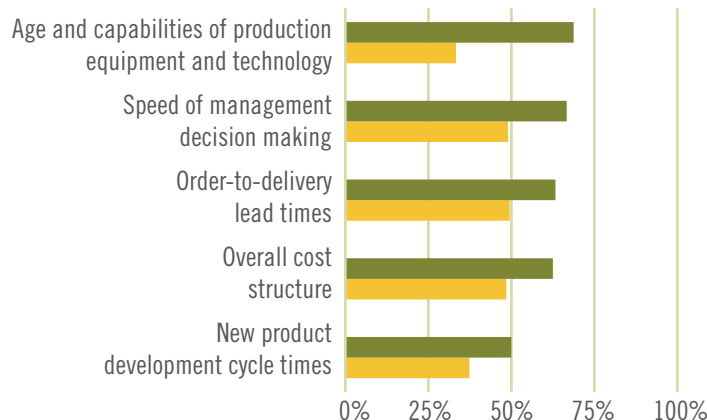
Strong vs. Moderate to Low Investors in Human Capital Development

Strong investor Moderate to low

By Revenue and Employment Growth Expectations



By Competitive Differentiators (Respondents rating their companies much or somewhat better than their competitors.)

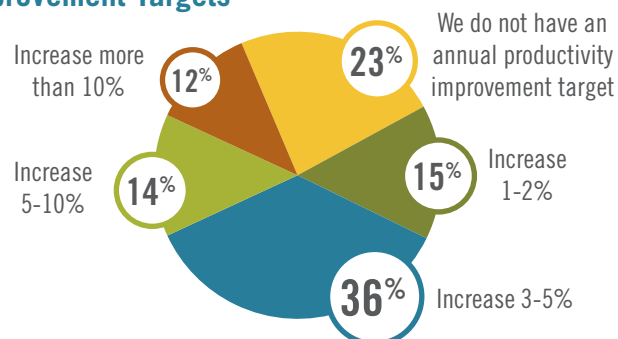


Increased Productivity Starts by Making it a Priority

Improved productivity is an executive's number one goal for every IT and equipment investment, as noted in the previous section on new technology priorities. You would think, because it's such a priority, that business leaders would set ambitious improvement targets. It's somewhat ironic, therefore, that one out of four manufacturers report that they don't have a specific annual productivity improvement objective. And a significant portion (15%) are only targeting a 1-2% yearly improvement, which barely keeps pace with inflation in these low inflationary times.

A majority of manufacturers with annual revenues greater than \$1 billion (55%) report that they aim for annual productivity improvement between 3-5%. Compared to other respondents, senior-level executives and smaller companies are less likely to be aware of or set annual productivity improvement targets.

Manufacturers' Annual Productivity Improvement Targets



CONCLUSION

The Future of U.S. Manufacturing Is Bright

There's a widespread belief that U.S. manufacturing is disappearing, and that the United States doesn't make things anymore. Such impressions are patently false. As noted in the introduction, real manufacturing output hit record highs in recent quarters, and is 75% higher than it was 25 years ago, according the U.S. Bureau of Labor Statistics.

It is true that manufacturing employment has declined significantly (by 28%) during that same period, as companies restructured and made the investments necessary to boost productivity and become more globally competitive. While the elimination of jobs has been painful for displaced workers and their families, U.S. manufacturers as a whole are bullish about their future economic prospects. That future will be characterized by even more extensive trade and movement of goods, faster information transfer and data analysis, and new technology that helps manufacturers maximize customer value and profitability.

We can't wait to see how the technology advancements will unfold. But as our research reveals, it's also exciting to see that manufacturers are making the necessary investments in their people to make sure their investments in new systems and equipment will pay off and enable them to compete globally through 2020 and beyond.



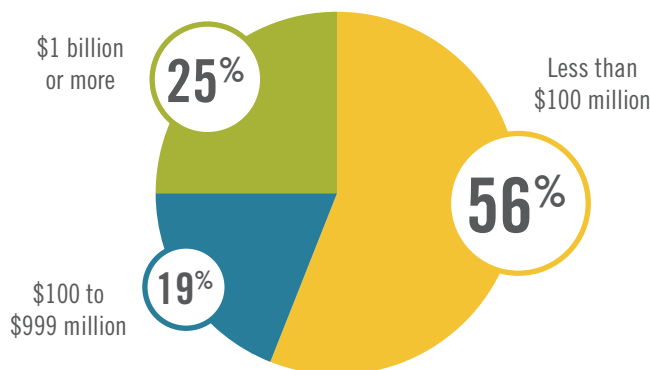
Respondent Demographics

The headquarters for nine out of ten survey respondents are located in the United States or Canada, which is where most of the companies' major production operations are located. But a significant proportion also operate plants in Asia/Pacific (28%), Europe (28%) and South America (19%). More than 80% of respondents occupy C-level, senior executive, vice president and other management positions. They primarily hold corporate management (34%) and operations/production (26%) roles and responsibilities.

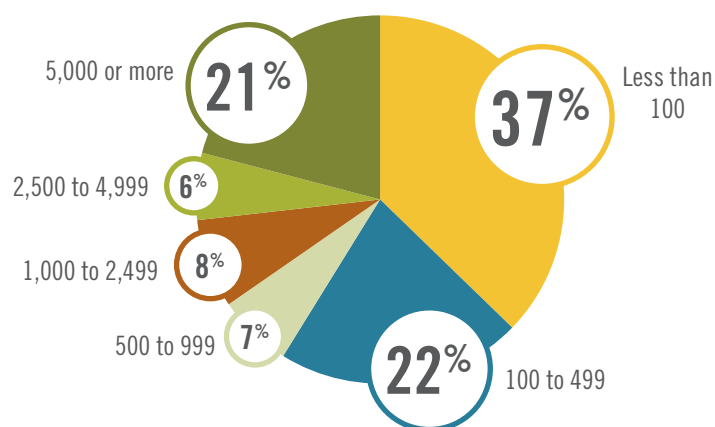
The top manufacturing sectors represented are industrial machinery (15%), metals (8%), electronics/computers (7%), food and beverage (6%), consumer goods/durables (5%), medical devices (5%), transportation vehicles (5%), and aerospace and defense (5%).

Looking at sales, a majority (56%) report annual revenues of less than \$100 million. One quarter of respondents (25%) report annual revenues of \$1 billion or more. And roughly one out of five (19%) have annual revenues between \$100 - \$999 million.

Annual Revenues



Number of Employees



Source: IndustryWeek Future of Manufacturing: 2020 and Beyond, May 2016, n=133.



About Kronos Incorporated

The *IndustryWeek* Future of Manufacturing: 2020 and Beyond research study was underwritten by Kronos Incorporated. Kronos is the global leader in delivering workforce management solutions in the cloud. Tens of thousands of organizations in more than 100 countries — including more than half of the Fortune 1000® — use Kronos to control labor costs, minimize compliance risk and improve workforce productivity. Learn more about Kronos industry-specific time and attendance, scheduling, absence management, HR and payroll, hiring and labor analytics applications at www.kronos.com. Kronos: Workforce Innovation That Works™.



About IW Custom Research

This research project was led by IW Custom Research, a unit of *IndustryWeek* magazine that provides insight into executive opinions and manufacturing trends. *IndustryWeek* connects decision makers within manufacturing enterprises to share ideas and tools that inspire action. In print, online and in person, the *IndustryWeek* community is the leading resource for manufacturing operations knowledge. *IndustryWeek* is a property of Penton Media Inc. For more information, go to www.industryweek.com.

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