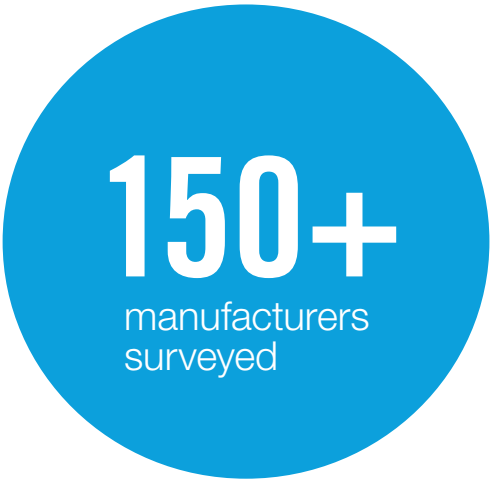
4th ANNUAL STATE OF Manufacturing Technology Report

EARLY ADOPTERS OF THE RIGHT TECHNOLOGIES ARE POISED FOR SUCCESS

PLEX
THE MANUFACTURING CLOUD



Manufacturing technology, and its impact on business success, is reaching a tipping point. Most manufacturers today invest in some type of technology to run their businesses, whether it is new equipment, robotics, software, or business intelligence tools. This year's survey gathered insights from approximately 150 global manufacturers. We found that those who invested in technologies that enabled a connected environment are more resilient and optimistic about the challenges ahead. They are more prepared to tap into the wealth of benefits provided by Industry 4.0 and the resulting Industrial Internet of Things (IIoT). And, they're better positioned to empower their workforce—from CEO to plant manager—to make better business decisions.

Based on the results, one thing is clear: it will be extremely difficult for manufacturers to thrive in the future without leveraging manufacturing technology to improve operations—and early adopters who focus on connectivity are poised to achieve greater success.

STATE OF MANUFACTURING TECHNOLOGY SURVEY DEMOGRAPHICS

99.1% NORTH AMERICA

1/3 in North America have facilities in Mexico.

51.3% 2-5 FACILITIES

32.2% 1 FACILITY

9.6% 8-10 FACILITIES

7% 11+ FACILITIES

COMPANY SIZES REPRESENTED

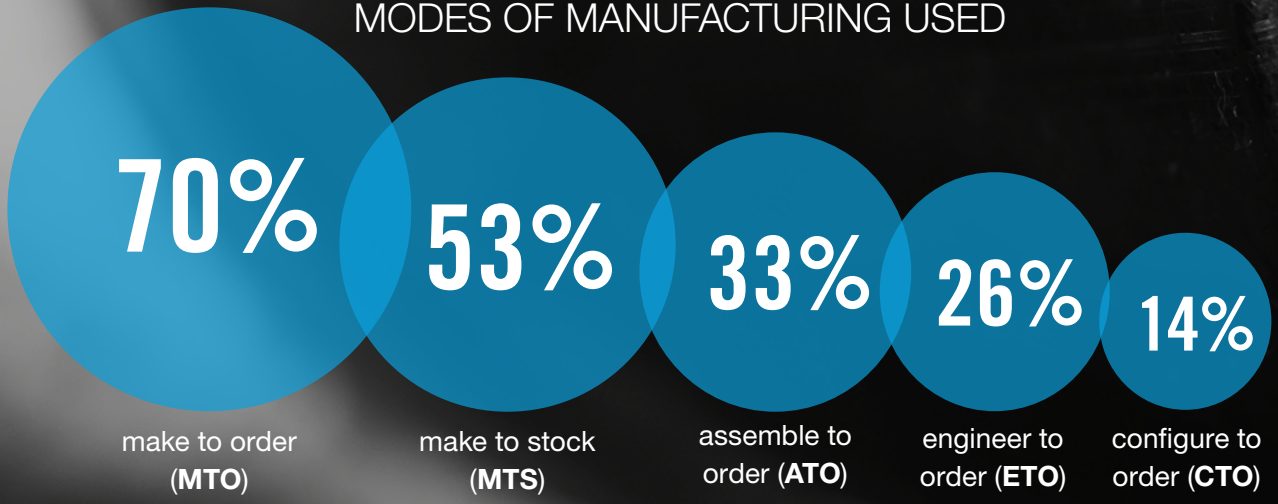
ROLE IN MAKING TECHNOLOGY PURCHASES

47% influence purchasing but do not make the final decision.

37% key decision makers.

16% represent end-users or other groups.

MODES OF MANUFACTURING USED



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GROWTH MEANS POSITIVITY WITHIN THE MANUFACTURING INDUSTRY

Manufacturers are generally optimistic about the future. Respondents are either somewhat or very confident in their company's projected revenue growth over the next 12 months: 55 percent somewhat confident and 30 percent very confident. The numbers provided by others in the industry confirm this; as of December 2018, the National Association of Manufacturers (NAM) survey reports positive numbers: 93 percent of manufacturers report a positive outlook for their companies and the economy as a result of tax reforms—a near-record level of optimism.[1] With the uptick in the health of the U.S. economy, enthusiasm is also evident in the supply chain. The Institute for Supply Management (ISM) supports this in a December 2018 report citing that the Manufacturing Purchasing Manager's Index (PMI) grew for the last 27 consecutive months.[2]

From our survey results, it also appears that the strong manufacturing economy that persisted through the last quarter of 2017 also set the stage for future growth. When asked what is currently driving growth within the organization, 50 percent said overall market growth, 32 percent cited organic growth, and 31 percent responded that it was increased capacity. Fewer than one in five respondents stated a shortage of capital was an obstacle to growth.

However, as of the end of 2018, a possible downturn in the economy looms over the horizon due to foreign trade, tariffs, and the stock market losing much of the ground gained in 2018, which could mean manufacturers need to prepare for instability.

are very confident in growth over the next 12 months.

say overall market expansion is driving growth.

[1] *Source: National Association of Manufacturers, NAM Manufacturers' Outlook Survey, December 2018.* https://www.nam.org/outlook/

[2] *Source: Logistics Management. ISM Monthly Report, December 2018.* https://www.logisticsmgmt.com/article/november_manufacturing_output_is_solid_reports_ism

Overall, these findings paint an interesting picture: for the most part, manufacturers' positivity and confidence is dependent on a thriving economy. This implies that manufacturers' success has been somewhat outside of their control.

However, when we take a closer look, what's more interesting is what manufacturers are doing. Outside of external factors, manufacturers are increasing capacity, due to investments in the business and business processes. This movement appears to be the biggest differentiator for companies who are looking for long-term growth and stability, and this is where manufacturing technology plays its most important role.

"Making and hiring close to customer demand has long been a common practice in global trade. With the biggest and strongest economy in the world, it is no surprise that the U.S. is seeing significant interest in making and hiring more here. That is translating to plenty of greenfield and brownfield manufacturing capacity. The myth was U.S. manufacturing had died. It had not, but now, it has turned vibrant and that's great to see."

- **VINNIE MIRCHANDANI**
CEO, Deal Architect
Technology Analyst, Advisor and Author

WITH GROWTH COMES SOME PAIN: KEY FACTORS DRIVING TECHNOLOGY DECISIONS

Rapid industry growth hasn't come without its challenges for manufacturers. As businesses scramble to meet increased market demand, filling open positions becomes even more critical, with the skilled worker shortage continuing to be a major hurdle to overcome. Concerns about the potential impact tariffs will have on the industry is another named challenge to growth, indicating that the uncertainty is starting to impact the bottom line. Manufacturers also list lower-priced competitors in their top three challenges, but new market competitors don't necessarily concern them.

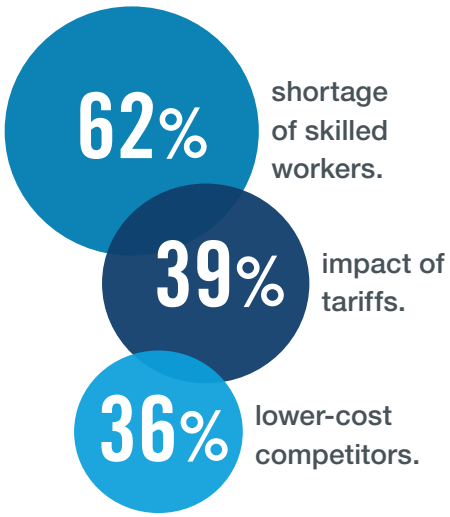
When it comes to what manufacturers believe their company lacks in order to respond to competition, top responses were skilled workers, strategy, and technology. Technology use topped both the list of challenges to growth and what they believed their company lacks to respond to competition, which highlights the critical role technology plays in how and how much companies grow, as well as how well the business manages challenges.

Skilled-labor shortage continues to be a top challenge—even more so with growth.

With the U.S. experiencing historically low levels of unemployment, finding and keeping skilled workers continues to be a thorn in the side of manufacturers. Sixty-two percent of respondents cited shortages in skilled workers as their top challenge to growth. Add to this the recent increase in demand, and the challenge becomes more daunting.

Baby Boomers aged 55 and over are retiring at a rate of 10,000 per day, and an estimated 25 percent of manufacturing employees are 55 and over. This means a lot of skilled people are leaving the workforce, resulting in both a numbers and knowledge drain problem.[3] To put this gap into perspective, over the next decade, nearly 3.5 million manufacturing jobs will likely be needed, and 2 million are expected to go unfilled due to the skills gap. Nearly 80 percent of manufacturers report a moderate or serious shortage of qualified applicants for skilled and highly-skilled production positions.[4]

At the current pace, it seems impossible to hire enough people to meet manufacturing needs. This does not include ramp-up time for new employees, many of whom will turn over for more competitive offers rather than stay, which sets the stage for constant churn within the industry. It also appears that automation won't really help in the near future either. According to a 2018 Deloitte study, automation is largely serving as a complement to, rather than a replacement for, people.[5]



[3] *Source: IndustryWeek, The Perfect Storm for the Manufacturing Workforce, July 11, 2018.* https://www.industryweek.com/leadership/perfect-storm-manufacturing-workforce

[4] *Source: Deloitte and Manufacturing Institute, "The Skills Gap in U.S. Manufacturing 2015 and Beyond."* https://www2.deloitte.com/us/en/pages/manufacturing/articles/skills-gap-manufacturing-survey-report.html

[5] *Source: Deloitte, 2018 Skills Gap in Manufacturing Study.* https://www2.deloitte.com/us/en/pages/manufacturing/articles/future-of-manufacturing-skills-gap-study.html

Fears that tariffs could put a damper on growth are, in some cases, being realized.

In March 2018, new tariffs of 25 percent on steel and 10 percent on aluminum were announced under Section 233. Soon after, additional tariffs were proposed against 1,300 initial products from China under section 301—and more are being threatened as of the writing of this survey. The response from our survey shows that 39 percent of respondents say that tariffs are a potential threat to growth. This seems to be in line with the overall outlook by economists and the industry that tariffs have the potential to be a negative rather than a positive impact long-term.

We're seeing responses from the industry that prove this as well. In November 2018, IndustryWeek published a letter from automotive, equipment, food and beverage, and metal fabrication manufacturing associations to U.S. trade officials that essentially requested the removal of Section 233 tariffs.[6] The uncertainty of the potential effects means manufacturers will need to squeeze even more efficiency out of production to weather any resulting price increases in materials.

Lack of the right technology to face lower-cost competitors is a concern.

Another challenge manufacturers face with growth is being outpriced by lower-cost competitors—36 percent of respondents reported this as a concern. One-fifth of respondents believe they lack the right technology to outpace the competition and nearly one-quarter feel their inability to take advantage of new technology is going to hamper growth. Considering the other two major challenges identified both require resources of time and money to recruit and retain as well as invest in inventory, when factoring in this third concern there's no question that the pressure is on for today's manufacturers, despite a generally positive outlook.

SCALING TO MEET INCREASED DEMAND MORE CHALLENGING FOR SMALL TO MID-SIZED MANUFACTURERS

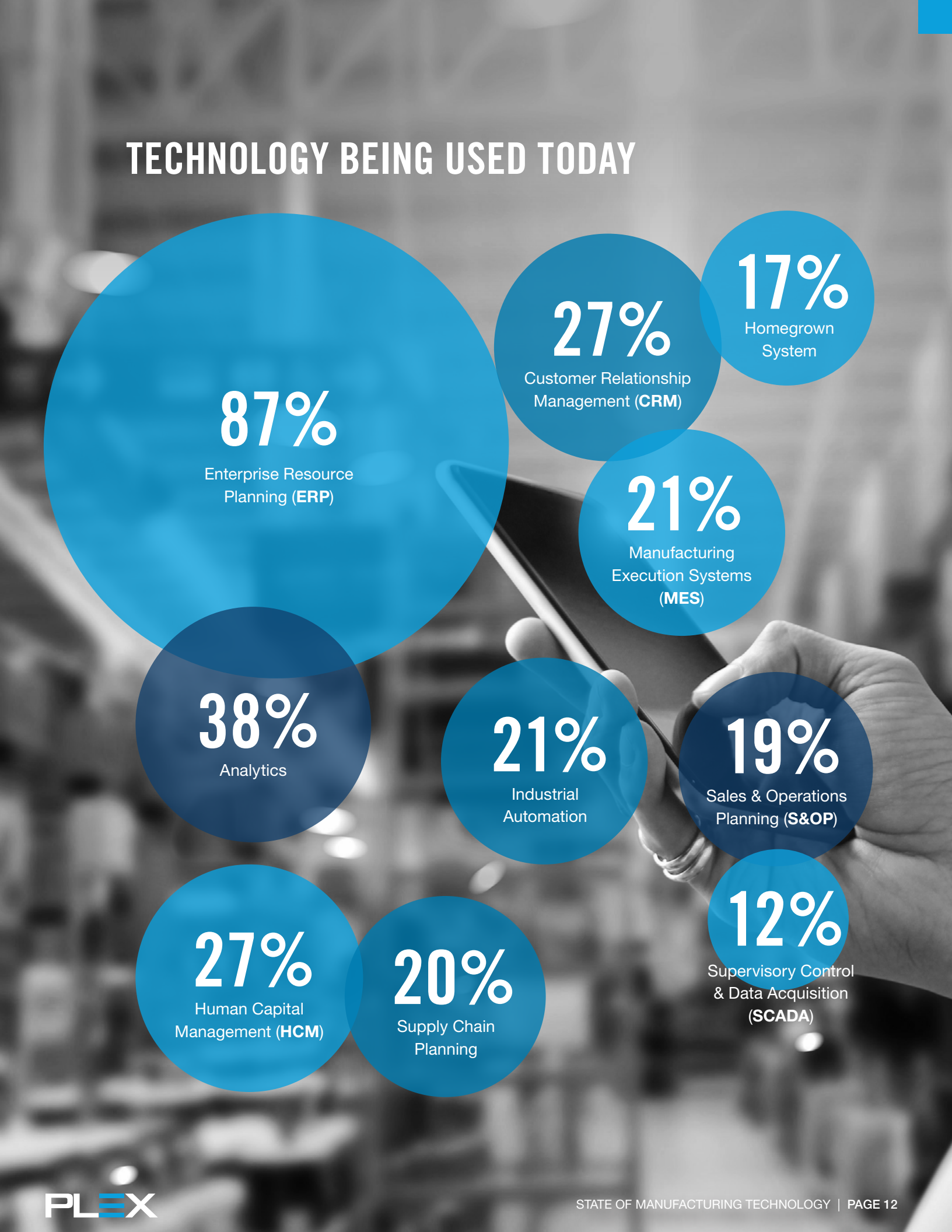
In the U.S., the vast majority of manufacturing companies are small businesses with fewer than 500 employees.[7] The challenge with rapid growth, particularly for small businesses (representing approximately 50 percent of respondents in our survey) is scalability. With an influx in demand, the ability to ramp up supply chains, systems, and output fast enough is difficult, forcing some companies to increase prices or turn away new business. The imperative then becomes determining what investments or upgrades should take priority in order to scale fast enough to meet economic demand. Since the market is cyclical, these companies should plan to balance reaction to an upturn with flexibility for natural downturns.

[6] *Source: IndustryWeek, Trade Letter: Tariffs Have Caused 'Significant Harm to Manufacturers,' November 20, 2018.* https://www.industryweek.com/economy/trade-letter-tariffs-have-caused-significant-harm-manufacturers

[7] *Source: National Association of Manufacturing, Top 20 Facts About Manufacturing.* https://www.nam.org/Newsroom/Top-20-Facts-About-Manufacturing/

HOW TECHNOLOGY IS BEING USED TO SOLVE THE INDUSTRY'S BIGGEST CHALLENGES—TODAY

TECHNOLOGY BEING USED TODAY



CLOUD CREATES A LEVEL PLAYING FIELD FOR SMALLER MANUFACTURERS

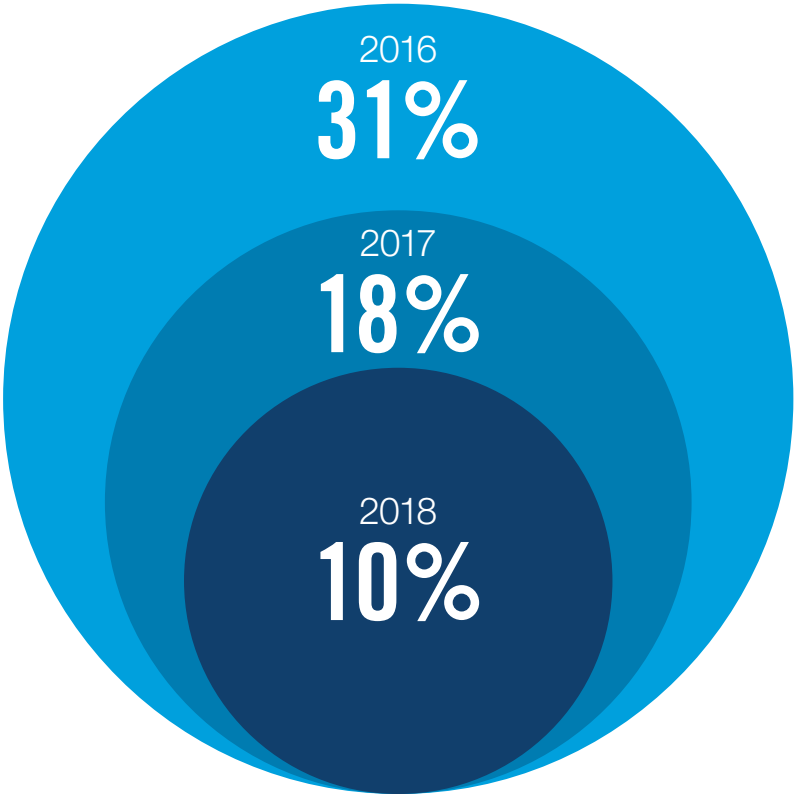
36% of manufacturers with <50 employees are most likely to use all cloud-based solutions.

That's because true cloud systems:

- Require little or no upfront hardware or software investments: they are much easier to implement than traditional on-premise software.
- Are subscription-based, new locations and users are simple to add, promoting more effective scale.
- Offer same capabilities that were once traditionally only available to large enterprises.

COMPARED TO PAST YEARS, THERE HAS BEEN A DROP IN COMPLETELY ON-PREMISE SOLUTIONS OVERALL:

- In 2018, 10% of respondents said they were mostly on-premise.
- In 2017, 18% of respondents didn't use any cloud technologies.
- In 2016, 31% said they didn't use any cloud technologies.



Manufacturers are resourceful and pragmatic, so they often take a sensible approach in dealing with the challenges growth presents, as well as the issues they face every day in running a business—from meeting delivery requirements to quality standards. This is also true when it comes to investing in and using technology. Each investment must yield positive outcomes for production, or it's not necessary.

Before we dive into the future of technology, it's important to see where leaders stand today given the current state of the industry.

In looking at the responses to the survey on how technology solves industry problems, we see that cloud technology helps manufacturers connect their enterprises, enabling employees to have more information to do their jobs more effectively. This connectivity also delivers supply chain visibility for anticipating changes in customer demand. That said, while more supply chain and production data is delivered, respondents are still grappling to find the right analytics to process that data and provide insight for making strategic business decisions particularly at the shop floor level.

Cloud-based systems more readily allow for integration and connectivity across the enterprise.

Compared to the past three SoMT surveys, more manufacturers today realize that cloud is essential for cost-effective connectivity, improved plant visibility, and collaboration among operations and management personnel. Forty-four percent of respondents are mostly on cloud systems and 31 percent are on all-cloud systems—a whopping 75 percent of total respondents. As far as integration between systems at plants, 71 percent said there was a moderate to strong improvement with the cloud.

For those respondents who had all-cloud systems, 57 percent cited strong improvements in plant integration. Fifty-six percent saw strong improvement in integration between operations (shop floor) and business management (top floor)—with all-cloud systems providing a higher level of improvement at 38 percent. Another 32 percent cited moderate to strong improvement with other enterprise applications (HCM, CRM, PLM). Finally, 55 percent saw moderate to strong improvement in mobile device integration, helping leaders manage plant issues far outside the four walls of the shop.

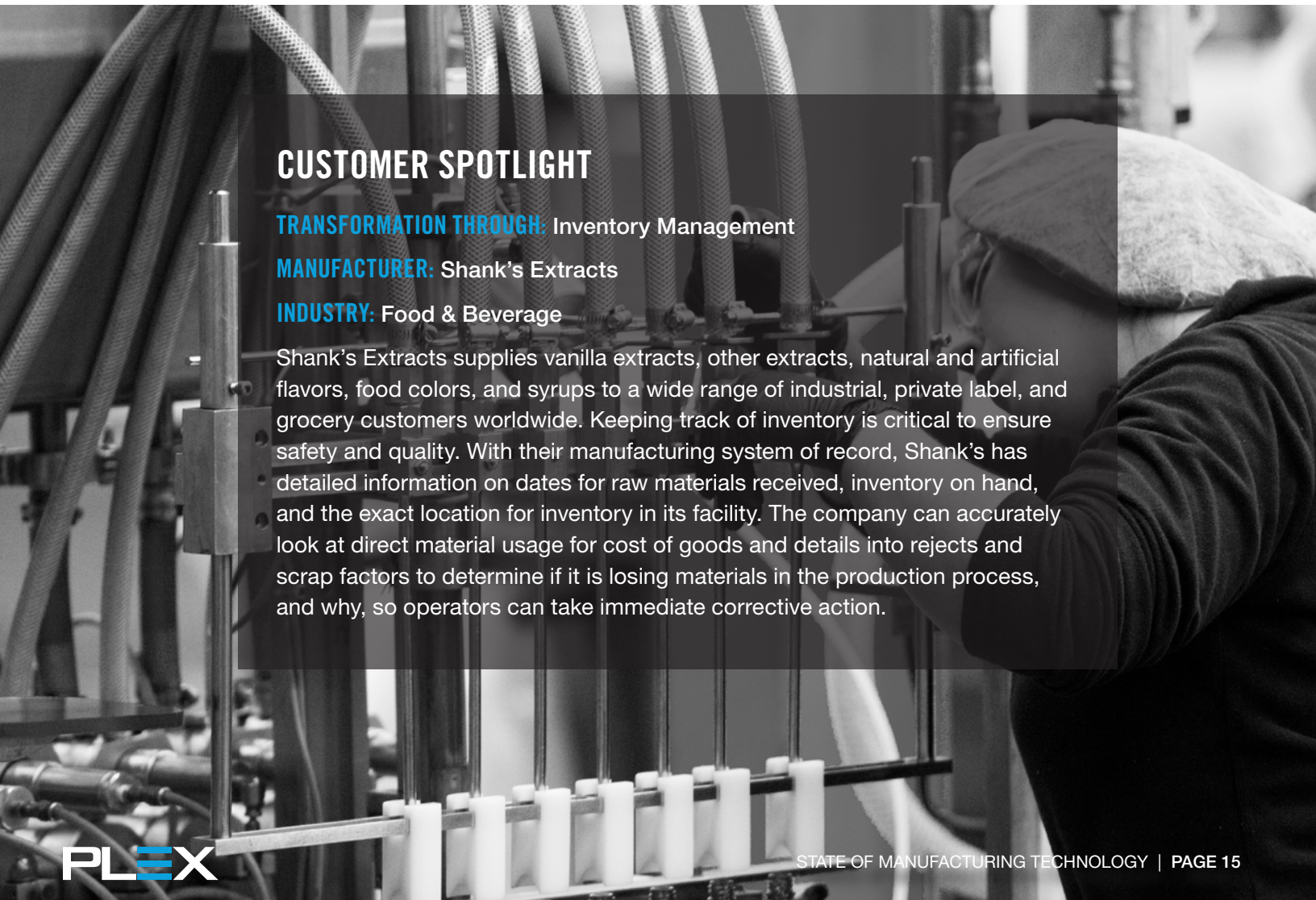
Gartner, Inc. predicts that "by 2020, 60 percent of large enterprises with systems up for replacement will switch from traditional on-premises licenses to cloud deployments."[8]

[8] *Source: Gartner, "Magic Quadrant for Cloud ERP for Product-Centric Mid-Size Companies," by Mike Guay, John Van Decker, Christian Hestermann, Nigel Montgomery, Duy Nguyen, Denis Torii, Paul Saunders, Paul Schenck, Tim Faith, October 31, 2018*

Connectivity through the supply chain is critical for responding to demand.

To ensure that there is enough inventory to cover orders, many manufacturers end up with capital tied up in overstock or scrap. Better visibility and supply chain planning means matching inventory to actual demand. Connectivity between systems enables more visibility throughout the supply chain—from order to delivery and everywhere in between. Nineteen percent cited strong improvement in supply chain collaboration as a result of connecting systems, and 65 percent cited moderate to strong improvement. We see a steady uptick in supply chain management interest and investment: supply chain disruption was in the top ten biggest obstacles to company growth respondents cited (18 percent).

Connectivity within four walls of a company as well as extending beyond is critical for better control throughout the supply chain. This will be especially important as manufacturers respond to tariffs. While many companies are resorting to stockpiling, changing suppliers, or raising prices, those manufacturers with visibility can better mitigate these risks and be more proactive in planning inventory to meet demand. This approach is also a huge advantage for controlling costs tied to inventory.



CUSTOMER SPOTLIGHT

TRANSFORMATION THROUGH: Inventory Management

MANUFACTURER: Shank's Extracts

INDUSTRY: Food & Beverage

Shank's Extracts supplies vanilla extracts, other extracts, natural and artificial flavors, food colors, and syrups to a wide range of industrial, private label, and grocery customers worldwide. Keeping track of inventory is critical to ensure safety and quality. With their manufacturing system of record, Shank's has detailed information on dates for raw materials received, inventory on hand, and the exact location for inventory in its facility. The company can accurately look at direct material usage for cost of goods and details into rejects and scrap factors to determine if it is losing materials in the production process, and why, so operators can take immediate corrective action.

Analytics give more insight to management—and there's a big opportunity to tie it all the way to the shop floor.

One in three respondents said they are already using analytics today, and of those who use it (31 percent), they focus on traditional applications such as management dashboards (78 percent) and sales analytics (67 percent). When asked to complete the sentence, "My company lacks…," 17 percent stated they lacked ability to leverage data, and 11 percent say they lacked ability to access data. Only 26 percent are actively evaluating analytics and 13 percent do not currently use analytics and have no plans to do so. In 2017, 48 percent did not have any big data analytics plans; in 2016, 61 percent did not have big data plans; and in 2015, 62 percent did not have big data plans.

The use of analytics is expected to grow by 20 percent in comparison to what respondents use today and what they plan to use in the next five years. And while many manufacturers are already using analytics for management insight (78 percent), there still seems to be a lag in using shop floor data to improve operations. It's clear that manufacturers see the value in analytics both through what they currently and plan to invest in for business management. The huge opportunity is to really leverage the data coming from the shop floor to give insight into operations.

Traditionally, analytics have been seen as a separate system or add-on to existing solutions. Add all the industry buzz about big data and manufacturers may think of only huge predictive analytic systems like IBM Watson, which isn't feasible or realistic. Cloud ERP systems however, enable manufacturing companies to "turn on" operational analytics as a component of their system on record. With this system, those manufacturers can integrate operational analytics more deeply to machines and enable access to non-data scientists so operations managers, quality managers, and plant managers can leverage dashboards to drive efficiency like management does on the business side today. Those manufacturers who take advantage of this huge opportunity will find themselves way ahead of companies still trying to figure out connectivity between the shop floor and the top floor.

Using technology to help address the skills gap.

There is some opportunity for manufacturers to leverage technology to help address the skills gap. Some manufacturers have looked inside of the company to make changes—instead of trying to hire their way out of this, they've repurposed key employees to take on new, higher value roles.[9] Repetitive tasks like manual cycle counting, inventory management, software/server maintenance, or running business and production reports are managed in a more effective and efficient way.

The right cloud solution can automate or eliminate the need to allocate people to these activities. But it's not just reallocating people to new jobs, it's giving more of them better access to critical business data and actions, and that means having more users with more access to more of the information that runs the business. Manufacturers can create new opportunities for existing employees and can stave off employee churn, but there is still the need for a pipeline of new, fresh employees as older employees look to retire.

[9] *Source: Mint Jutras, Cloud ERP Transforms IT Teams, September 6, 2016.* https://www.plex.com/blogs/cloud-erp-technology-transforms-it.html

Today's young talent grew up as digital natives. The applications they use are largely run in the cloud—from gaming to email—and they think mobility first. The new generation of manufacturing employees is not going to accept green screens and archaic user experiences. Modern, visual systems will help attract this younger talent pool and also decrease ramp-up time for any new employee, which gives manufacturers a faster path to revenue and employee efficiency.

"Our owner asked us to break down how we were spending our time. He was shocked when I told him that I spent 85 percent of my time doing data entry—he probably figured I was spending 60 to 70 percent of my time on the shop floor. Nowadays, I spend about 30 percent of my time driving continuous improvements for us in Plex, but those are all value-added activities—and I've eliminated all the data entry I used to do."[10]

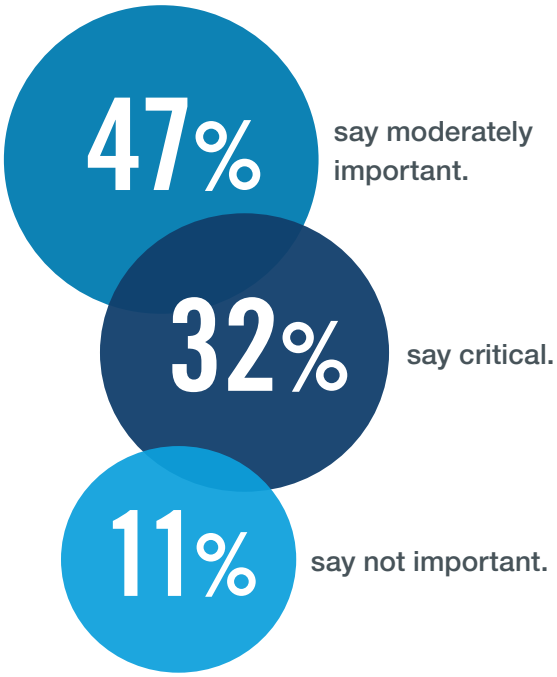
- **SCOTT HANKAMP**
Operations Manager for A&K Finishing

[10] *Source: Plex Systems, A&K Finishing Customer Success Story*
https://www.plex.com/customers/just-in-time-manufacturing-example.html

FUTURE TECHNOLOGY TO DRIVE OPERATIONAL EXCELLENCE

Manufacturers are focused on operational excellence. As stated previously, manufacturers require that any technology investments, either now or in the future, must have a direct impact on the company's ability to keep production moving efficiently. It makes sense then that future technologies not yet proven in smaller to mid-sized production environments are likely to not be adopted as fast. When manufacturers look at the specific initiatives they'll undertake into 2023 with the help of technology, operational efficiency (67 percent), enhanced plant floor automation and integration (60 percent), and enhanced quality program (49 percent) are the top three.

The importance of a system of record to the company's ability to innovate:



CUSTOMER SPOTLIGHT

TRANSFORMATION THROUGH: Quality Management

MANUFACTURER: A&K Finishing

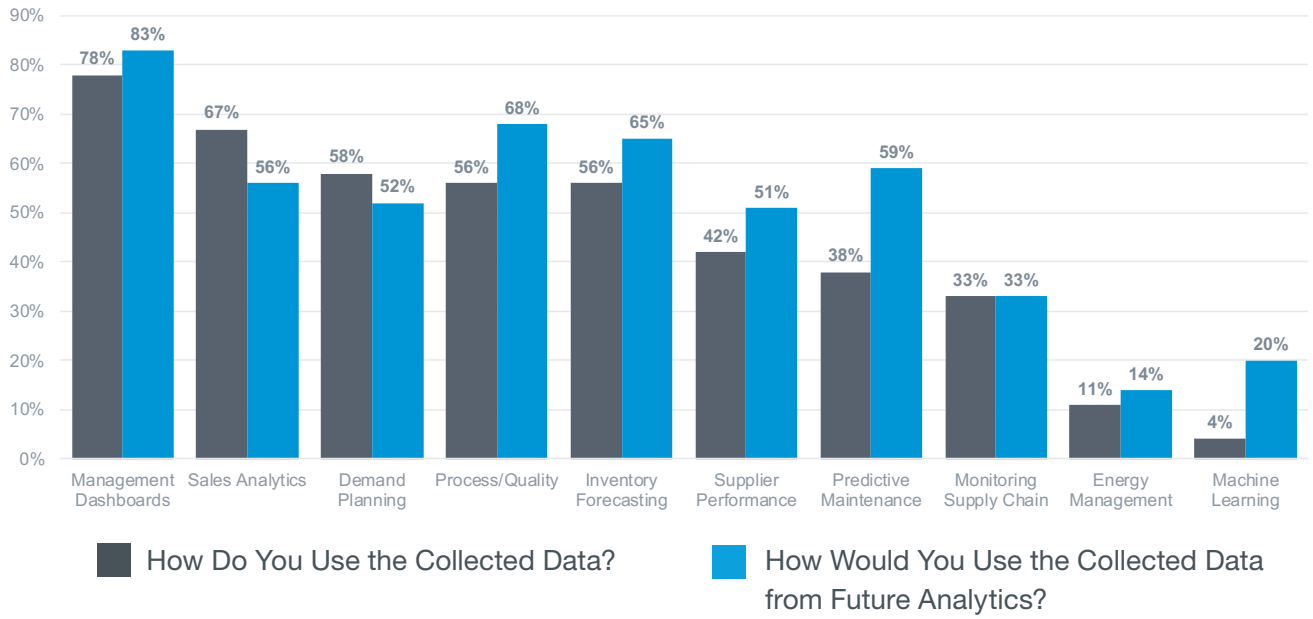
INDUSTRY: Plastic Paint Solutions

Quality is important to A&K Finishing because that's what keeps customers coming back. Prior to implementing a cloud ERP manufacturing system of record, quality management was done manually by paper. The company provides plastic paint solutions for the automotive, electronics, and commercial industries. Now operators on the shop floor use a single sign-in to record production data. When a customer calls in with a question, support staff can easily get status information to provide an update or drill down to a specific problem. The system also helps the company enforce its own product quality standards. Alerts are automatically sent to operators when specifications don't meet quality standards so a technician can take prompt corrective action. This greater discipline has contributed to a reduction in scrap rates.

What's compelling about this is that despite the broad range of external factors manufacturers face—shrinking skilled workforce, tariffs and low-cost competitors—they are not necessarily investing in changing those external factors, but instead are focusing on ways to make the business better equipped to respond to the uncertainty they represent. For instance, improved quality can help edge out lower-cost competitors, while better integration can reduce the need to hire for personnel roles like EDI specialists.

While many manufacturers in our survey do not have immediate plans to move forward with production analytics, the opportunity to leverage insights to improve operations is ripe and expected to emerge in the next five years. Respondents indicate that how they're using analytics today is mainly for management (78 percent), sales (67 percent), and demand planning (58 percent). When compared to how they want to use analytics in the future, we see that the need for operational insight is more apparent: management (83 percent), process/quality (68 percent), and inventory forecasting (65 percent). We also see that supply chain management is an area where manufacturers are looking to make more technology investments over the next few years.

Comparing software usage between what respondents use today and what they plan to use in the next five years, they expect a 20 percent increase in analytics, a 16 percent increase in CRM, a 42 percent increase in industrial automation (nearly doubling from 21 percent), and a 22 percent increase in supply chain management. When we make comparisons of emerging technology use to previous years, we see higher levels of adoption of technology once considered "hype." There is a 24 percent year-over-year increase in the use of prescriptive/predictive analytics, 23 percent increase in machine learning, 10 percent increase in IIoT/IoT, 10 percent increase in Bluetooth use, and eight percent increase in the use of cobots.



Connected devices provide cost-effective connectivity in the cloud.

Wireless access enables manufacturers to easily use consumer mobile devices without additional hardware costs to the company. Cloud environments provide the cost-effective foundation that make it easy to scale and enable more people to be tied to the system of record via mobile devices so everyone has access to real-time data.

Eighty-four percent of respondents use handheld scanners, 80 percent use consumer mobile devices, 38 percent use IP-enabled tools and machines, 34 percent use optical quality scanners, and 29 percent use sensors. Not surprisingly, we found that those who run their systems mostly in the cloud are much more likely to be using connected devices. They are also the most likely group to leverage consumer mobile devices (89 percent) and handheld scanners (94 percent) and pass the significance test for IP-enabled tools and machines.

CUSTOMER SPOTLIGHT

TRANSFORMATION THROUGH: Sales & Operations Planning (S&OP)

MANUFACTURER: TCHO

INDUSTRY: Food & Beverage

TCHO is a maker of premium chocolates based in Berkeley, California. Founded in 2005, the company has built a loyal following for sustainably-created unique chocolates, known for their high quality and unique flavor profiles. TCHO's artisan chocolates encompass a broad range of products and SKUs—everything from chocolate nibs used in baked goods, coffee, beer, and ice cream to specialty bars sold to grocery chains, restaurants, and direct to consumers online. It can take more than a year for TCHO to receive manufacture-ready cacao beans from growers once it places an order, so it needs the ability to plan its supply chain well in advance. Not just for sourcing, but for every step from bean to packaged chocolates. Short production schedules were causing stockouts and lower service levels, which TCHO proactively addressed by revamping their planning processes and implementing agile, end-to-end supply chain planning software to facilitate more effective inventory planning against forecasts. As a result, the company has reduced critical out-of-stock items four-fold and finished goods' days of supply (DOS) by 63 percent.

Supply chain planning across the extended enterprise is important for minimizing risk.

Supply chain planning and S&OP were also in the top ten software being used today. And, of the data being collected within manufacturing companies today, 58 percent are using it for demand planning, 42 percent for supplier performance, and 33 percent to monitor supply chain risk.

With possible uncertainty due to tariffs and the economy, supply chain sales and operational planning becomes more important to stay proactive and minimize risks. Manufacturers need the right system that offers flexibility in communications across the supply chain. The methods of communication from customer to supplier can vary depending on the level of their relationship with the manufacturer, so business leaders must select supply chain management systems that offer a variety of options such as electronic data interchange (EDI), customer and supplier portals, and direct integration via APIs. We expect to see significant results for those manufacturers investing in cloud-based S&OP since many respondents this year reported improved supply chain collaboration through connectivity.

Slow adoption of emerging technologies due to uncertain ROI.

While there is a massive amount of emerging technology hitting the manufacturing space, adoption rates have plenty of room to grow—even for technologies that have high adoption in consumer markets, such as voice technology and smart wearables. Top emerging technologies in use today include 27 percent Bluetooth devices, 24 percent 3D printing/additive manufacturing, and 14 percent IIoT. The more interesting number is the 44 percent who say they are not investing in emerging technologies at this time.

Emerging technologies are also often challenging to finance because historically it's difficult to spend money on something that doesn't have an immediate impact on operational efficiency or return on investment (ROI). That said, companies like Kamco Industries, provider of sheet molded and formed fiber felt products for the automotive industry, could turn that around. Kamco uses Microsoft HoloLens very practically to save on travel. When an operator runs into an issue during production and a supervisor isn't available, the operator can use Skype with HoloLens to work through the issue—saving the company on travel costs since engineers often have to travel for the programs they are working on.

> There is both an art and science to supply chain planning and when done effectively can fuel company growth by freeing up cash for expansion initiatives. Advanced supply chain planning software solutions help planners become organizational heroes armed with data-driven insights and operational agility that enables them to plan for the unexpected and optimize what matters most to the business."
>
> - **TOM NESSEN**
> General Manager, DemandCaster

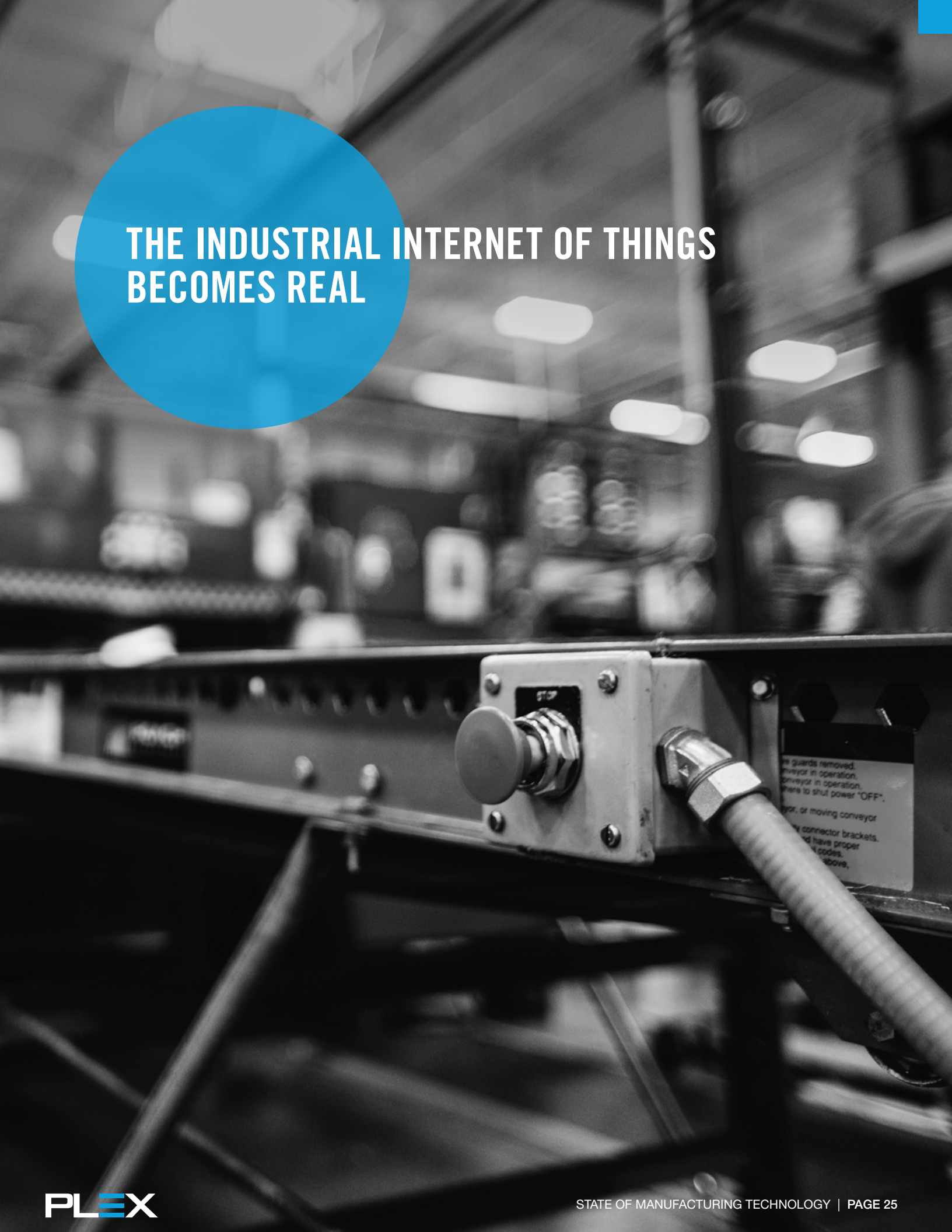
"Manufacturers today have more options than ever to invest in technology, thanks to ongoing innovations in wearables, robotics, machine learning, big data, blockchain, and the Internet of Things (IoT). Through working with leading manufacturers, we know that instead of implementing every new technology available, the industry's foremost companies are extremely discerning with their technology investments, focusing on a few key attributes including connectivity and scalability. This focus is enabling them to leverage the immense amount of data being generated on the shop floor, helping their workforce be as productive as possible, and delivering access to information to make better business decisions."

– JERRY FOSTER
Chief Technology Officer for Plex Systems

Augmented/virtual reality usage needs to take safety into account.

Manufacturers are in a bit of a holding pattern waiting for use cases of augmented/virtual reality. Twenty-three percent say it is the single most over-hyped technology in the industry. Smart wearables (12 percent), artificial intelligence (11 percent), big data (6 percent), and blockchain (five percent) round out the top five.

The shop floor is already a place where safety is a top priority, and until technology can help aid or not further hinder safety, these technologies are often difficult to justify. However, each year we edge more closely to hardware that can meet this kind of strict criteria. Companies like Polamer Precision, have used augmented reality to map out their plant layout with a 3D model to position workstations and tooling, ensuring that forklifts and other equipment have room to operate safely and efficiently. More creative examples like this one could make AR/VR much more attractive to manufacturers.

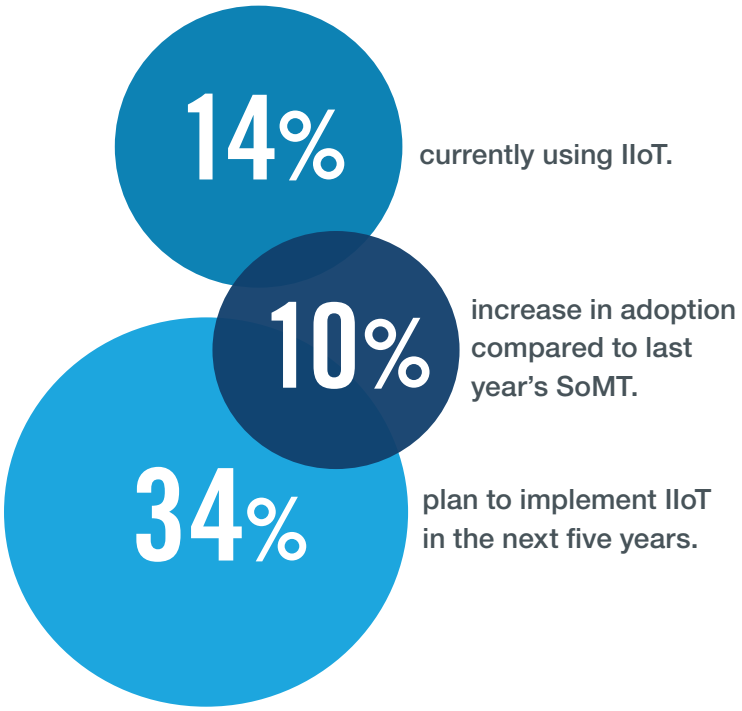


THE INDUSTRIAL INTERNET OF THINGS BECOMES REAL

Connected devices and equipment are not new concepts to manufacturers—but IIoT requires a connected foundation across the entire enterprise. Those companies still using on-premise software have more of a challenge with connectivity. With the cloud, that becomes less of an issue and, as the practical use cases of IIoT within a production environment have become apparent, we see that companies are embracing the opportunity to extract data once locked away.

For manufacturers to realize the full potential of Industry 4.0 and tap into the wealth of data generated across the business and extend that outside the four walls to customers and suppliers, they must begin the process of "digitizing" which lays the foundation for IIoT. The right system will enable connectivity, data management, and analysis to accomplish this in a cost-effective way without disrupting production today.

IIoT adoption increasing:



Increase in use of IIoT compared to previous years.

Compared to previous SoMT surveys, we see a leap in the adoption of IIoT: 12 percent said it was the most-hyped technology (2017) and this year it was only five percent. Adoption rates are only going to grow. Thirty-four percent say they plan on using IIoT in the next five years compared to 14 percent who are using it today. Those companies that identify areas where IIoT projects can have an impact on operations will be farther ahead in mining their data than those who choose to wait.

"By 2024, 50% of MES solutions will include industrial IoT (IIoT) platforms synchronized with manufacturing operations management (MOM) applications providing near-real-time transaction management, control, data collection and analytics."[11]

[11] *Source: Gartner, "Magic Quadrant for Manufacturing Execution Systems," Rick Franzosa, 5 November 2018*

"Industrial IoT is set to transform the way manufacturers do business, creating new opportunities for business leaders to connect, collect, synthesize and leverage vast amounts of data on the shop floor. As more manufacturers harness and begin to share use cases, we expect IIoT adoption will rapidly accelerate—and their value will be as widely demonstrated and accepted as the presence of smart devices to your home. When it comes to IoT implementations, manufacturers may be most surprised to learn that their successes are critically dependent on user habits. A manufacturers' workforce plays a much more important role in disruption than the nature of the technology itself. Products that drive adoption by catering to users' existing habits, and by encouraging users to develop (and sustain) new habits, will be the most disruptive to the manufacturing industry."

– ANURAG GARG
Vice President and Head of Analytics and IIoT for Plex Systems

IIoT use cases that show operational improvements are becoming more apparent.

Any new technology investments that manufacturers make must have operational meaning, purpose, and application. Those who have begun their IIoT journey have done so to achieve realistic, incremental enhancements to support their business strategies. Since 35 percent of manufacturers plan to implement IIoT projects within the next five years, we believe the more examples of practical IIoT use cases that improve operations and quality we start to see, the more other manufacturers will be willing to do the same.

An example is Marwood Fabrication, a multi-facility stamping and modular assembly supplier for the automotive industry, which uses machine data for detailed reports on production to increase uptime and ensure high-quality output. Another manufacturer using IIoT is GenZe, maker of electronic "smart" bicycles and scooters. Each of their products comes with a connected app (using Bluetooth and AT&T Internet of Things technology) to provide riders with an enhanced experience. GenZe then uses the data collected to make their products perform better.

"The IIoT Platform space is one of the fastest growing technology markets today. In just a few short years we already see adoption rates at 15 percent with another 23 percent of companies in the pilot phase."

- **MATTHEW LITTLEFIELD**
President & Principal Analyst for LNS Research

IIoT adoption will get easier for manufacturers with little or no IT resources with the right system.

One of the challenges with IIoT adoption has been unlocking the data that sits in databases, sensors, or machines. For many manufacturers, updating these machines and/or building connections is just too costly and time-consuming. In addition, the data management side of the equation with an influx of huge amounts of data is not yet realistic, especially with a lack of the required data science skillset in their employee base.

The right system, however, leverages the cloud as a foundation, simplifying machine connectivity with protocols and data types used by equipment and sensors on the shop floor. Those manufacturers who build their IIoT foundation on a system that provides this level of connectivity will be able to expand into data analysis providing decision support in areas such as predictive maintenance and machine performance.

TRANSFORMATION THROUGH: IIoT

MANUFACTURER: Fisher & Company

INDUSTRY: Metalforming

Fisher & Company uses iBeacons positioned at work centers to communicate status to smart glasses with heads-up displays worn by supervisors. This allows supervisors to easily scan the floor during their rounds and instantly understand status without interrupting operators. Fisher's material handlers also use hands-free ring scanners to scan barcodes on containers with simple voice commands. This information is then communicated to the cloud and smart glasses instantly, creating real-time inventory and work-in-progress material accuracy.

KEY TAKEAWAYS: NEXT-GENERATION, CONNECTED MANUFACTURING TECHNOLOGY SEPARATES THE LEADERS FROM THE REST

It's clear that manufacturers see technology as an effective way to manage and overcome industry challenges. When next-generation technology is focused on enabling the core functions of a manufacturing business, manufacturers believe it separates the leaders from the followers (76 percent agree). The technologies that make the biggest impact for manufacturing leaders today are those that contribute to and leverage connectivity, whether the business is all-cloud or has a mix of cloud and on-premise software. This cloud foundation results in increased end-to-end visibility across plants and from the shop floor to the top floor.

As this level of connectivity matures, more manufacturers will connect their entire supply chains to gain insight into demand to accurately plan—and this will have a positive ripple effect on inventory, costs, and customer satisfaction outside the four walls of the organization. Leading manufacturers are working to connect all parts of the business—processes, systems, people, machines, suppliers and customers. More manufacturers are also seeing IIoT as a pragmatic solution to solving their connectivity challenges, instead of an aspirational tool with limited ROI. Additional endpoints will be in order to feed more information to business leaders, helping them make better business decisions in real time.

Many manufacturing companies—both large and small—are already making the transition to digital processes and automation. They have seen the benefits from more visibility, control, and collaboration. The hard truth is that manufacturers who invest in technology that doesn't allow for connectivity and integration will only fall further behind, and eventually become obsolete.

It's absolutely critical for manufacturers to take the steps necessary to modernize as quickly as possible. For those who have been concerned about the process, it will not be easy—but it's necessary and worth it.

Next-generation manufacturing technology will separate leaders from followers:

NEXT STEPS FOR MANUFACTURERS WHO WANT TO LEVERAGE NEXT-GENERATION TECHNOLOGY

The best way manufacturers can embrace next-generation technology is to identify operational challenges that match the technology. The beauty of these technologies is they don't require a "rip and replace" approach that many legacy solutions have in the past. Manufacturers can tackle digitization on a problem-by-problem and process-by-process basis while laying the groundwork for a complete transformation. This approach, and a carefully mapped out plan to leverage next-generation technology across the entire enterprise, gives companies an advantage over those that do nothing—since the agile nature of new technology positions them to weather the ups and downs within the industry much better.

ABOUT PLEX

Plex is the Manufacturing Cloud, delivering industry-leading ERP and manufacturing automation to companies across process and discrete industries. Plex pioneered cloud solutions for the shop floor, connecting suppliers, machines, people, systems, and customers with capabilities that are easy to configure, deliver continuous innovation, and reduce IT costs. With insight that starts on the production line, Plex helps companies see and understand every aspect of their business ecosystems, enabling them to lead in ever-changing markets. Learn more at **www.plex.com**.