Automation Timeline:
The Drive Toward 4.0 Connectivity in Packaging and Processing

PMMI { Business Intelligence

CONTENTS

"

There will not be an immediate transition, but the impact from COVID-19 will drive more automation of all kinds.

— *Industry Expert*

"

INTRODUCTION

The majority of CPG manufacturers interviewed for this automation update were also participants in the 2017 report. Their collective voice has revealed the following key points:

- COVID-19 has **affected most every manufacturing company,** across all industries.

- Since 2017, the needle on automation has moved forward in the **adoption of smart technologies,** in all markets and applications.

- The obstacles to automation that are **slowing progress** remain consistent from 2017: ROI (return on investment), labor, and internal resources.

- Manufacturing operations and machines of the **future** will be driven by an automated and integrated enterprise.

- OEMs and industry suppliers have the opportunity to lead the way in identifying applications to deploy **smart manufacturing** technologies.

Markets represented:

Food

Beverage

Personal Care

Pharma/ Nutraceuticals

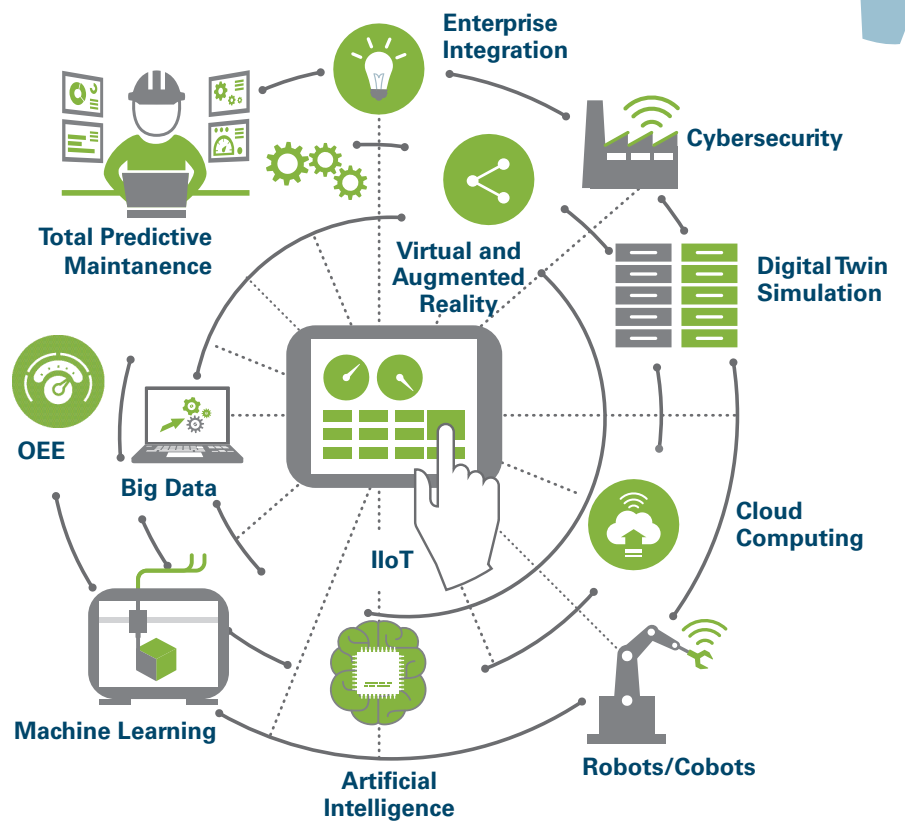Household Products

Participants:

End Users

Contract Packagers

OEMs and suppliers that meet the needs of the changing times will thrive along with the CPGs of the future. CPGs want partners that are transparent in their operations, willing to listen to unique needs, and offer appropriate suggestions and solutions.

Five Takeaways

① The COVID-19 pandemic has drastically altered the course of many industries, but opportunities to expand automation still exist and some are even accelerating.

② The primary challenges faced by manufacturers when considering automation expansions – ROI, labor, and internal resources – have remained top of mind over the past few years.

③ Expanding IIoT and integration at an operation – especially the automated collection of data – is key to enabling many future automation strategies.

④ Manufacturers recognize the "Big Picture" advantages of automation, but often struggle to translate that understanding into identifying applications within their own facilities.

⑤ The bulk of automation is still concentrated at end-of-line; OEMs and suppliers have significant opportunity to educate manufacturers on automation integration across their entire enterprise.

The Web of Industrial Internet of Things (IIoT)

Enterprise Integration

Cybersecurity

Digital Twin Simulation

Cloud Computing

Robots/Cobots

Artificial Intelligence

Machine Learning

IIoT

Big Data

OEE

Total Predictive Maintenance

Virtual and Augmented Reality

"

In 20 years, our plant will be 100% automated and IIoT deployed and active . . . we increasingly rely on our OEMs to help us better understand the potential capabilities of our equipment.

— *Plant Manager, Meat Plant*

"

Advancements in automation, both machine and software, are moving manufacturing toward a smarter factory.

As traditional manufacturing evolves, the implementation of Industry 4.0 will be a vital solution that helps manufacturers remain competitive. The foundational concepts of Industry 4.0 are data, connectivity, continuous monitoring, and process optimization. A comprehensive deployment of an Industry 4.0 strategy requires a high level of operational integration, which is in turn a key enabler of many advanced automation solutions.

Technology that will enable new levels of operational excellence and production intelligence is being implemented now.

The charts throughout this report indicate that manufacturers have been actively expanding both machine and software automation since 2017, yet there remains significant room for continued growth into the next decade. All statistics derived from conversations are based on the collective average of participants. Some companies are operating at higher or lower levels of automation than is charted.

Large Operations Outpace Small

In general, larger companies are automating and integrating their operations faster, but SMEs (small to medium enterprises) are also investing in technology at a steady pace to optimize manufacturing.

Machine Automation

Implementing machine automation is an ongoing process that will ebb and flow depending on the specific product applications at manufacturers.

Software Automation

Currently, some machines are connected, but many are not: the IIoT (Industrial Internet of Things) will connect M2M (Machine-to-Machine) and machines to people. Big data repositories will utilize the cloud for sophisticated analytics, but less than half of CPGs are accessing it now.

The global pandemic has altered automation plans due to:

- Declining consumer spending from travel restrictions and personal income uncertainties.
- Budgets being reevaluated, interrupting capital spending or pushing back timelines.
- Supply chain disruptions and production challenges that have interfered with new projects.

All companies interviewed are taking precautionary steps to protect their workers and provide safe products through initiatives such as installing plexiglass for social distancing, wearing masks and gloves, and temperature monitoring.

Hit by COVID-19

Any discussion these days must inevitably begin by addressing the ever-changing impact of the SARS-CoV-2 (COVID-19) virus on manufacturing. The proliferation of COVID-19 has reversed many of the otherwise positive trends that were carried over from the fourth quarter of 2019. Until early March of 2020, manufacturing had been showcasing steady new growth with numbers trending positively for new orders and equipment purchases. This was a welcome change from the first three quarters of 2019, in which manufacturing dipped and new equipment orders slowed. However, these initially positive numbers for 2020 have been mostly reversed as the COVID-19 outbreak has settled into the U.S., drastically altering the landscape for manufacturers.

> "We delayed our automation plans on the last filling line in order to expedite the manufacturing of test equipment for COVID-19." *Product Engineer, Leader in Pharma*

Before the emergence of COVID-19, the outlook for manufacturing was trending in a positive direction. In January of 2020, the ISM purchasing managers index rose from 47.8 in December to 50.9 in January, pushing that index into growth territory (50+) for the first time since July 2019. In addition to this, new orders increased by over four points over the same time period, from 47.6 in December to 52 in January. This growth was further punctuated by reported gains by manufacturers in new orders (+4.4%), overall production (+9.5%), and rate of employment (+1.4%). Taken together, this data portrayed a manufacturing sector on the rebound, working to recover after marked losses in 2019.

In January of 2020, the ISM purchasing managers index rose from

47.8
December 2019

▶

50.9
January 2020

By April 2020, the gains previously exhibited by the manufacturing sector were wiped out. The ISM purchasing managers index dropped sharply, falling a full 7.6 points, from 49.1 in March to 41.5 in April. This drop is even more drastic when compared to earlier reports, with PMI dropping off by 10.5 points since January. In addition to this precipitous decline, individual metrics for manufacturing fell across the board as well. Negative numbers were registered in April for new orders (-24.9% since January), overall production (-26.8% since January), and employment (-19.1% since January).

The ISM purchasing managers index dropped sharply, falling a full 7.6 points

49.1
March 2020

▶

41.5
April 2020

There are bright spots

While the first quarter has been filled with dire news for manufacturers, there are indications that industries are beginning to feel their way toward a rebound. Up until May, investment activity had been depressed across manufacturing sectors, with some industries such as pharmaceuticals and personal care fairing better, but still seeing declines. This trend has largely reversed in the June *U.S. Packaging Machinery Purchasing Index* from PMMI. Investments are exploding across almost all sectors as manufacturers scramble to chart a course through the pandemic. Interestingly, the hardest hit segment – durables – actually declined from April to May, a trend not exhibited by any other industry.

In addition to a rush of investment, manufacturers have also started to gain back some of the deep losses suffered in the first quarter in new orders, overall production, and employment rates. While still well into the double digits in overall decline since the start of the year, May has seen small gains for manufacturers in these areas as they work to staunch the outflow. From April to May, manufacturers saw increases in new orders (+4.7%), overall production (+5.7%), and rate of employment (+4.6%). While manufacturers still have a lot of ground to regain just to return to their baselines in January, the trends are moving in a positive direction again.

Impact of COVID-19 on Automation Plans

Different sized companies also appear to be dealing with the fallout from COVID-19 in different ways. Overall, data indicates that larger, leading CPG companies are more likely to have put automation plans on hold (67%) than are their SME counterparts (23%). Interestingly, only larger CPGs stated that COVID-19 had expedited their automation timeline, with 13% saying that the pandemic has accelerated their plans for the near future. For instance, the Sr. Director of Plant Engineering at a snack food leader has plans to deploy robots soon, stating:

> *"Our plan to use robotics has accelerated to reduce human workers . . . we're looking at robotics for end-of-line: material handling, pick-and-place, stacking, and loading and unloading conveyors."*

Automation Plans:

- 🟩 Remained Steady
- 🟥 Delayed Automation Plans
- 🟦 Accelerated Automation Goals

Industry Leading CPGs: 20%, 67%, 13%

SMEs: 77%, 23%, 0%

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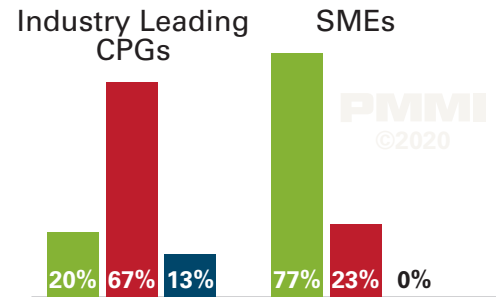
Confidence plummets

Adding to the difficulty manufacturers are experiencing is a decline in consumer sentiment and confidence, resulting in a decrease in consumer spending. Consumers have been reporting depressed spending numbers and reduced income expectations since March; while spending jumped 8.2% in May as reported by *McKinsey*, it still has not returned to pre-pandemic levels. The most recent data shows that overall consumer confidence has actually declined since March: in mid-March 44% of consumers expected an economic rebound to occur within two to three months, while only 33% of respondents believed this to be true in June.

Spending decline

In addition to sentiment, consumers are also making consequential adjustments to their spending, with 70% of consumers reporting that they expect their household income to be impacted for more than two months. Despite gains in April tried to the government stimulus check, *Reuters* reported that personal income again dropped in May by 4.2%.

The real-world consequences of these depressed manufacturing numbers and reduced consumer spending have manifested as declining investment from manufacturers, who are more closely guarding their capital in the face of future uncertainty. Manufacturers are now less willing to invest in new projects such as widespread automation upgrades and in some cases have put off larger capital-heavy purchases of new equipment.

An industry in flux

The undercurrent to be gleaned from this snapshot of manufacturing is of an industry in flux. While COVID-19 has upended the global markets in unprecedented ways, manufacturers are still striving to navigate their businesses forward as best they can. While manufacturing as a whole may be struggling, data indicates that many sectors are still actively purchasing equipment, and some are seeing a return to growth.

❝

The timeline on some of our automation projects has been pushed back.

— *Engineering, Sr. Manager, Leader, Shelf Stable Products*

❞

Challenges Driving Change:
ROI, Labor, Internal Resources

When it comes to automation, manufacturers overwhelming recognize that their operations and broader enterprise can be improved through the expansion of their current automation strategies and components. Expanding automation is easier said than done, however. For many manufacturers, actually implementing a new or expanded automation strategy means weighing and overcoming a litany of challenges and hurdles that hinder the wider adoption of fully automated and connected operations.

The three main challenges identified by manufacturers when expanding the use of automation are justifying the return on investment (or cost in general), a lack of internal knowledge and expertise to identify new areas to automate, and a lack of labor needed to properly operate and maintain increasing levels of automation. Interestingly, these three challenges are virtually unchanged since the previous 2017 PMMI Automation report, indicating that OEMs and suppliers still have ample opportunity to craft strategies that will directly address these three areas that manufacturers continue to grapple with.

ROI justification remains top of mind

The first major hurdle in implementing automation identified by manufacturers is justifying the return on investment (ROI) of any automation project. This concern is broadly related to the total cost of a given automation project, with data indicating that manufacturers are specifically concerned with applying an ROI calculation that will justify automation projects to management. In the current COVID-19 climate, a clear and reliable ROI calculation is more important than ever to make the case for automation expansion as many budgets tighten up. Assembling such a metric can be a tricky undertaking, however, and not all manufacturers have standard ROI strategies in place.

To accurately calculate the ROI of a given project or purchase, manufacturers must factor in numerous variables regarding the cost of the project and the total impact on their operations to determine which automation strategies hold the most potential value. This can be an incredibly complicated exercise, as it requires manufacturers to gather, analyze, and interpret a continous stream of manufacturing and operational data to accurately assess the time it will take to recoup the cost of an automation project. Establishing a precise universal methodology for calculating ROI is often an unattainable goal, as each project is unique and requires its own factors and input data, but implementing a standardized set of parameters is certainly achievable. Rather than attempt to exhaustively address a long list of potential factors in an ROI calculation, we will focus on one key component that is garnering more attention: overall equipment effectiveness (OEE).

While the factors that go into an ROI calculation will vary drastically from business to business and from project to project, one of the key components that should be examined is a metric referred to as overall equipment effectiveness, or OEE. In general, OEE is a measurement of the total potential manufacturing output of a given machine or enterprise against the actual, realized total output of a machine or enterprise. In essence, OEE is a measurement of the percentage of overall manufacturing capability that is actually realized during production. For instance, an OEE of 100% would mean that a given machine or enterprise is producing the most it is capable of without defect, at the fastest speed possible, with no downtime between production runs.

> "
> Only about 5% of our machines calculate OEE, but we plan to increase that to over 25% in the years ahead.
> — *Engineering, SME Beverage Co.* "

> "
> We're looking for 25% ROI within two years from our automation investments.
> — *Product Engineer, Pharma/Supplements Leader* "

> "We are considering accelerating our decision to install cobots for case packing to avoid any loss of labor in the future.
>
> — *Director, Process Technology, Personal Care and CBD*"

> "Capital spending has come to a screeching halt and we will delay our automation plans due to COVID-19.
>
> — *Director of Manufacturing, Leader in Meat/Poultry*"

> "We will go back to manual operations on one line to increase efficiencies for repairs and maintenance, there is just too much downtime and product damage with robots.
>
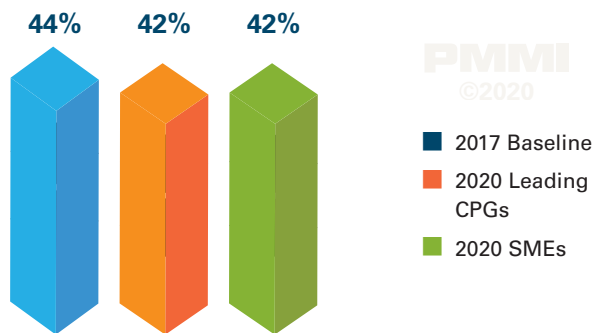> — *Engineering, Leader in Frozen Dairy*"

Utilization of OEE

The usage rate of OEE calculations remained consistent in the last few years and future predictions show steady adoption.
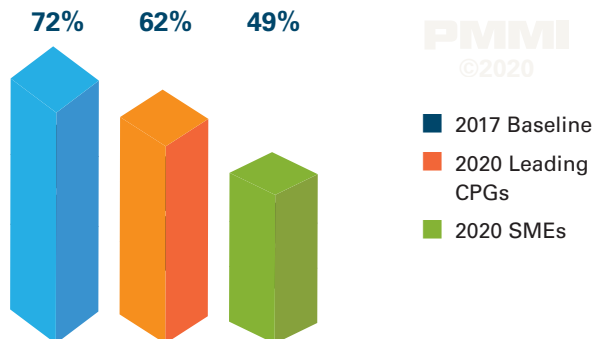
> 1 in 4 leading CPGs and SMEs are already calculating and utilizing OEE across most of their lines.
>
> Over 2 in 5 companies interviewed are not calculating OEE on the majority of their machines, but predict they will increase OEE calculations in the next several years. However, predictions of use fall short from the 2017 baseline over the coming decade.
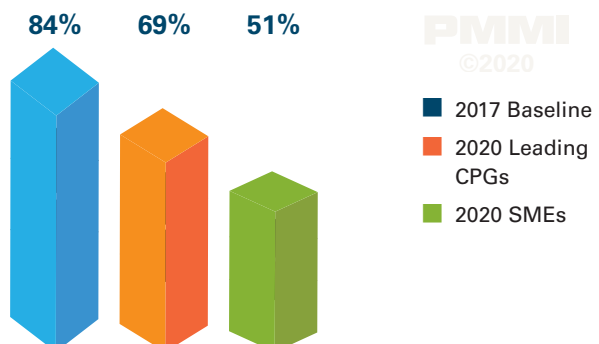
Current Estimates of OEE Usage

44% 42% 42%

- 2017 Baseline
- 2020 Leading CPGs
- 2020 SMEs

5 Year Predictions of OEE Usage

72% 62% 49%

- 2017 Baseline
- 2020 Leading CPGs
- 2020 SMEs

10 Year Predictions of OEE Usage

84% 69% 51%

- 2017 Baseline
- 2020 Leading CPGs
- 2020 SMEs

OEE and TEEP

OEE is also the crucial input needed to calculate total effective equipment performance, or TEEP, which is a metric comparing OEE against total time of production. This calculation can be used to measure the percentage of active manufacturing time against the realized OEE output of an enterprise to give an accurate picture of how often a manufacturer is producing at their full capability, or how far they are from that ideal. For instance, a TEEP score of 100% would indicate that for the entirety of the time measured, an enterprise was operating at 100% OEE; in other words, during the entire time measured, the facility was producing the most goods it could at the fastest achievable speed with no interruptions or downtime.

The two measurements, OEE and TEEP, play a crucial role in calculating the ROI of any given investment. They equip project leaders with data that clearly indicates to management what the potential output of a project is, laying out the length of time and level of efficiency required before an enterprise will break-even on their ROI for automation projects. However, despite the power of this data, the majority of manufacturers do not currently calculate OEE (and therefore cannot calculate TEEP) to include in their ROI measurements. Data shows that despite ROI being a top concern amongst manufacturers considering automation projects, only about 42% are calculating OEE in any meaningful way, as shown on the previous page. Manufacturers are aware of how important ROI is to advancing their automation goals, with the majority (approximately 60%) planning to calculate OEE regularly within 10 years. Since manufacturers identified justifying ROI as a key challenge to expanding automation but not even half are calculating OEE, there is a clear gap that OEMs and suppliers should be looking to bridge.

OEE=(Good Count x Cycle Time)/ Planned Production Time

TEEP=OEE x (Planned Production Time/ All Time)

Opportunity to fill the gap

OEMs and suppliers have an emerging opportunity to step in and offer assistance to help manufacturers craft ROI and OEE calculation strategies. Manufacturers require this data to justify their future automation goals, but without clear strategies to calculate both ROI and OEE, most do not know where to begin accurately compiling these metrics. OEMs and suppliers should consider a suite of services that will assist manufacturers in better assessing their current and future operations, with an eye toward justifying future automation expansion. By partnering closely with manufacturers and helping them deeply understand their operations, OEMs and suppliers can make a stronger case for their own products and services.

> While increasing automation generally tends to reduce the number of employees needed at a given facility, it paradoxically increases the level of skill required from some employees.

Labor resolutions are not short term

Another key hurdle to expanding automation indicated in both the 2017 and 2020 data is a general lack of labor. Then and today, manufacturers reported not being able to find and/or retain the needed labor to pursue, achieve, and maintain their automation goals. These labor challenges extend to both large and small operations and include both skilled and unskilled labor.

When it comes specifically to automation advancement, manufacturers are particularly challenged with the lack of skilled labor that is available. Stated another way, the average level of skill amongst potential employees does not rise to the level required by automated processes.

According to *Deloitte,* the manufacturing sector in the U.S. will need to fill as many as 4.6 million jobs over the course of the coming decade. Due to the lack of necessary skills amongst the current available workforce, it is predicted that only 2.1 million of those openings will be adequately filled by properly skilled employees. This means that in ten years, manufacturers could be facing a labor shortfall of 2.5 million positions. This labor shortage threatens to exacerbate the already fraught challenge of finding and retaining skilled employees that is currently plaguing manufacturers.

More impact from COVID-19

This growing labor shortage has been brought into sharper focus with the outbreak of COVID-19. While many industries within the manufacturing sector have been deemed "essential" and are still producing, employees have been hesitant to continue working and employers have had even more difficulty making new hires. While the cumulative unemployment rate in the U.S. fell from 14.7% in April to 13.3% in May, and despite 30% of manufacturers stating they are currently seeking new hires during the COVID-19 pandemic, the overall employment rate in manufacturing has contracted sharply, declining 19.1% from January to April, according to government data and *ThomasNet*.

For manufacturers, these labor struggles translate into added difficulty when seeking to expand the scope of automation in their operations. While increasing automation generally tends to reduce the number of employees needed at a given facility, it paradoxically increases the level of skill required from some employees. As a result, expanding the use of automated features and processes at an enterprise may actually create new labor needs and requirements, even while simultaneously eliminating others.

Opportunity to differentiate with simplification

While OEMs and suppliers cannot conjure up a ready-made stock of ideally skilled employees for their customers, there are a number of design strategies that can be considered to assist manufacturers with their labor struggles. CPGs suggest making automated machines and processes more accessible to the average skillset: OEMs and suppliers should endeavor to simplify their equipment features as much as possible. Changes should be explored, such as streamlined machine interfaces featuring graphic-driven explanations and prompts that can help employees make correct selections without the need for a deep understanding of programming or digital skills. These simplifications can be expanded into the maintenance of the machine as well, where employees can be directed to perform maintenance or cleaning tasks with guided, demonstrated steps that mitigate much of the need for specialized knowledge.

Automation tools that can take control

In addition to machine simplifications, OEMs and suppliers can also help their customers overcome labor shortages by employing the opposite strategy: making the functionality of their equipment significantly more complex through advanced automation. Specifically, OEMs and suppliers can harness the power of artificial intelligence (AI) and machine learning to mitigate manufacturers' labor challenges. These two automation tools can be utilized to analyze production data, allowing an operation to be streamlined from individual movements/processes, all the way up to the entire integrated production strategy. By utilizing automation to identify and execute improvements, manufacturers are able to take optimization responsibilities out of the hands of individual employees, freeing up labor that can be deployed elsewhere. Incredibly powerful and cutting-edge technology, both AI and machine learning will be discussed in more depth in the coming pages.

Lack of internal resources

While labor shortages are a key challenge for manufacturers pursuing automation expansion, there is another pernicious hurdle to overcome on the road to more integrated, data-driven operations: a lack of project execution resources. Manufacturers state that they often struggle with identifying, planning, and executing new automation projects at their facilities. These difficulties with initiating automation projects stem from a lack of internal knowledge, skill, and expertise required to proactively seek out new areas in need of automation.

The labor shortage challenges faced by manufacturers also play a role in this lack of internal resources for automation projects. Without adequate skilled labor, manufacturers lack the resources and knowledge necessary to identify and execute new automation projects. On top of that, a lack of skilled labor means fewer internal resources can be easily devoted to carrying out a new automation strategy without having to pull from existing operations. This creates an either/or decision scenario for manufacturers, where they must determine which personnel to allocate to a given project, without interrupting existing operations.

"

We are most challenged with gaining technical knowledge and understanding how to apply data metrics efficiently.

— Process Engineer, SME

"

Expanding the knowledge base

Even when labor shortages are not an issue, a lack of internal knowledge and expertise about automation technology can hamper its expansion at a manufacturer. The pace of technology advancements in the automation realm has only increased in the last decade or so, with new applications emerging just as rapidly. The speed and quantity of new information relating to automation technology can be overwhelming, and it is often difficult for individual engineers, or even entire departments, to keep abreast of all the new advancements. Without a dedicated team of experts whose sole responsibility is to keep themselves and their peers up to date on the latest new developments and applications in automation technology, it can be difficult for manufacturers to maintain the ever-growing level of knowledge needed to execute new projects. While such a program is a possibility at larger enterprises, many SMEs lack the resources to even consider establishing a dedicated "knowledge" team, or something similar.

Opportunity to accelerate knowledge

When internal resources are lacking, OEMs and suppliers have an opportunity to build stronger relationships with their customers and forge new bonds with manufacturers who are struggling with identifying automation projects. One strategy that OEMs and suppliers can adopt is providing ongoing, regular education to their customers with the goal of keeping them abreast of new automation technology developments and new applications for automation components. Manufacturers have shown an interest in educational workshops (which may quickly transition to a virtual setting as a result of COVID-19), where OEMs and suppliers can engage with engineers and illuminate new technology advancements. These educational discussions can also be immensely beneficial to OEMs and suppliers, who are able to showcase their own advancements and suggest investments that manufacturers may not even know are an option.

Opportunity to outsource line integration and monitoring

In some instances, OEMs and suppliers may want to consider taking some of the responsibility for automation projects out of the hands of the manufacturer. With manufacturers strapped for resources, and with that strain being brought into sharper focus in the COVID-19 pandemic, OEMs and suppliers have an opportunity to play a larger role in condition-based monitoring of their equipment. In these instances, OEMs and suppliers can demonstrate their value to manufacturers by expanding their offerings into data monitoring along with integration services. Installing, troubleshooting, and monitoring new automation technology, especially when added to existing operations, is both time consuming and challenging for many manufacturers; OEMs and suppliers can step in to alleviate these pain points.

"

Our lines are mostly automated but none are considered 4.0-ready, it will be implemented on future manufacturing lines.

— *Sr. Director, Packaging, Leader in Personal Care* **"**

While some larger enterprises should consider offering full integration services – connecting disparate lines, upgrading legacy technology, and integrating standalone machines – smaller OEMs and suppliers with fewer resources at their disposal can still play a role. Ease-of-use additions to machines, such as adaptable software and flexible physical configurations, can greatly assist manufacturers in integrating new automation technologies into their existing operations. These relationships can also be immensely beneficial to the OEMs and suppliers, who will have opportunities to identify and suggest new automation strategies that manufacturers might not have otherwise identified without a close working relationship.

Opportunity to become the expert

More than anything else, OEMs and suppliers should strive to position themselves as full service automation partners at their clients' disposal by understanding their ins and outs on the plant floor. By taking a leading role on automation and proactively keeping their customers informed and educated, OEMs and suppliers can increase their value to their customers and build stronger working relationships. Some OEMs and suppliers may even consider taking services a step further and offering integration expertise along the entire line, strengthening trust by identifying and installing new automation technology in partnership with manufacturers.

Manufacturers Know They Need More Automation, but Where and How?

Despite the ongoing challenges that manufacturers face when looking to advance automation technology at their companies, the vast majority recognize the urgent need to broaden the use of automation. At the very least, manufacturers are quite aware of the "Big Picture" benefits that automation can provide. There is still ample opportunity for OEMs and suppliers to offer automation solutions to all size companies, across all markets, and along the entire line.

Percent of Automation (on average)

■ Automated ■ Semi-Automated ■ Manual

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Industry Leading CPGs: 64% | 21% | 15%
SMEs: 56% | 20% | 24%
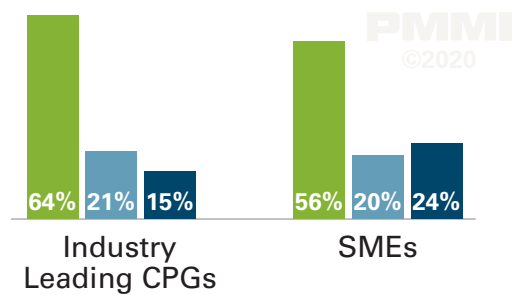
On average, leading CPGs' manufacturing lines are 64% automated, with SMEs not far behind with 56% automation on their lines. At leading CPGs, 21% of tasks are semi-automated and 15% remain manual, while at SME's 20% of processes are semi-automated and 24% of tasks remain manual.

On an overall average, about 20.5% of manufacturing lines at the CPGs interviewed remain semi-automated, and about 19.5% of applications across operations rely on manual labor. When averaged together, this means that about 40% of operations at any given manufacturer are some combination of semi-automated or manual.
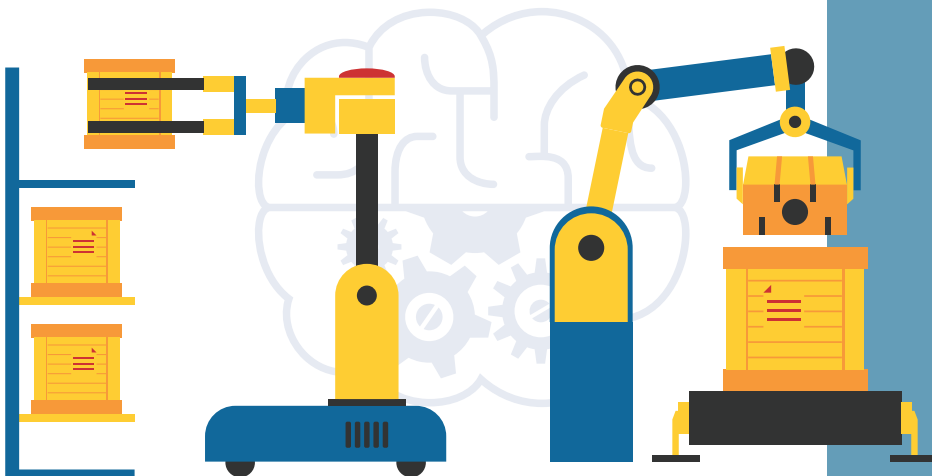
PROCESSING TASKS ARE SEEING AUTOMATION

Processing and warehousing both need automation updates to expedite product handling.

— Engineering, Sr. Manager, Leader in Dry Shelf Goods

Product manipulation moving into slicers needs to be automated and is our next project.

— Process Development Engineer, Frozen Foods

PICK-AND-PLACE APPLICATIONS ARE TARGETED FOR PRIMARY PACKAGING

The most challenging operation to automate is the primary packaging line.

— Director of Process Engineering, Leader in Meat Industry

In the next five years, we could increase automation for primary packaging, and also for automated filling, capping, and labeling.

— Engineering Manager, CP/CM Household Products

AUTOMATION AND ROBOTICS DOMINATE SECONDARY PACKAGING

We plan to move toward more digital printing to speed up changeover from carton to carton.

— Sr. Director, Packaging, Personal Care

The next project will be to automate cartoners, case packers, and palletizers.

— Process Engineer, Leader in Pharma/ Supplements

All of our lines need to be integrated but we're still automating secondary packaging – we are working on a pick-and-place application for case packing.

— Plant Manager, Dairy SME

We are looking at using robotics for material infeed.

*— Advanced Manufacturing Manager, Household Products SME*

Automation along the line

In general, automation has played a bigger role at the end of the line, where automation has long been applied to processes such as secondary packaging and palletizing. There are numerous areas outside of end-of-line in which automation can play an important role, but where utilization of automation technology is still fairly low. When examining potential automation strategies, manufacturers typically embody this thinking of automation as primarily an end-of-line solution, which in many cases narrows their understanding of the scope and depth of automation capabilities. This is reflected in data gathered from manufacturers regarding future automation plans, in which 60% of leading CPGs and 46% of SMEs identified secondary packaging as their next planned automation project.

Further up the line, primary packaging continues to see a growing level of automation with 47% of leading CPGs and 38% of SMEs targeting this area for automation. Processing is often overlooked however, with only 27% of leading CPGs and 31% of SMEs identifying processing as the area of their next automation expansion.

Where CPG Companies are Specifically Planning their Next Automation Project

■ Leading CPGs ■ SMEs

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	Processing	Primary Packaging	Secondary Packaging
Leading CPGs	27%	47%	60%
SMEs	31%	38%	46%
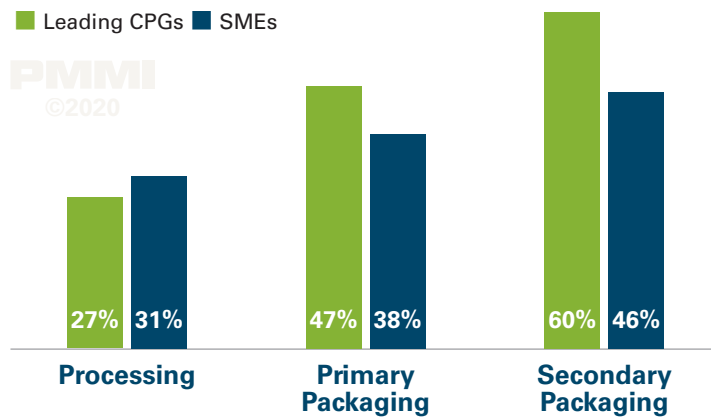
Based on overall average of companies interviewed

Opportunity for automation at companies of all sizes, across all markets, along the entire line

For OEMs and suppliers, this means that manufacturers still have potential to add new automation technology, and that manufacturers also have a gap in recognizing areas for future automation applications. With this in mind, OEMs and suppliers should consider assisting manufacturers in identifying new automation projects that lie outside the traditional scope of end-of-line packaging and palletizing.
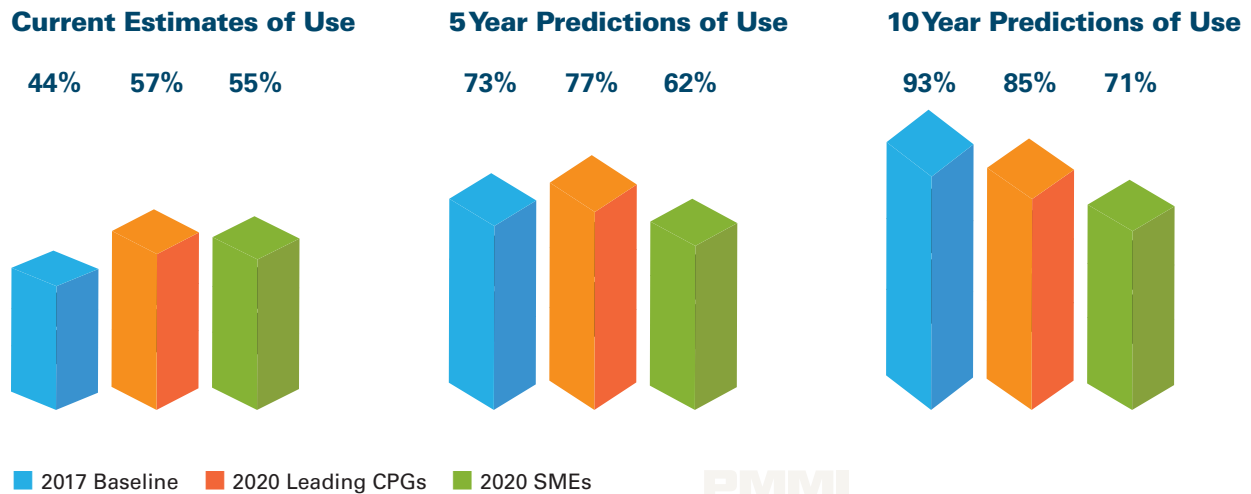
Future Automation Tools Driving to 4.0

IIoT and integration: enabled by data acquisition

One of the most crucial areas where automation is lacking at most manufacturers is on the IIoT and integration side. While automation is typically envisioned as hardware – a robot, or a sensor on a machine – one of the most important aspects of automation is the more nebulous concept of IIoT software and integration capability. Automation strategies now extend out beyond individual machines to encompass entire operations, and the key to linking an entire operation together is a comprehensive IIoT strategy. In order to implement a viable 4.0 strategy, individual machines within an operation need to be integration-ready, meaning they are prepared for and designed to easily link up with a larger IIoT network. In many ways, IIoT integration and data acquisition are the keystones to expanding automation, enabling the deployment of many other advanced automation strategies.

In the next five years, on average, 75% of machines at leading CPGs will be capable of collecting critical machine performance data.

Data Acquisition Keeps Pace With Predictions

Current Estimates of Use			5 Year Predictions of Use			10 Year Predictions of Use		
44%	57%	55%	73%	77%	62%	93%	85%	71%

■ 2017 Baseline ■ 2020 Leading CPGs ■ 2020 SMEs

Based on overall average of companies interviewed

With IIoT deployment - and integration in general - at lower levels, manufacturers have also struggled with more widespread adoption of automated data collection and analysis. A truly comprehensive integrated strategy requires a high level of IIoT capability, in which machines and sensors are managed under one umbrella, allowing for the collection and analysis of data at an operation-wide level. The graph above shows that in 2017, only 44% of lines were reported as collecting continuous data for later use. While this number has grown to an average of 56% of current lines in 2020, there are still nearly half of all manufacturing lines that will need to be adjusted, upgraded, or replaced to achieve full IIoT connectivity in the future.

> "
> Only half of our lines are collecting data now; all new equipment must have the capability to collect data, it's part of our capital plan as we upgrade or replace legacy equipment.
>
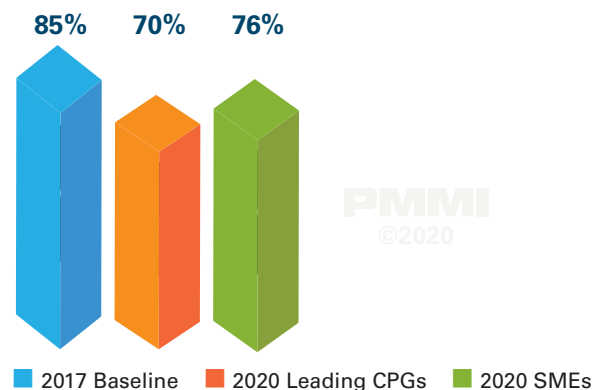> — *Engineering Manager, Large Canned Goods Facility*
> "

SMEs are keeping pace with 2017 predictions

There is significant opportunity to expand IIoT and integration-ready machines at manufacturers, who have identified only a small portion of their plant floor operations as fully IIoT enabled. In 2017, manufacturers estimated that only 15% of their lines were IIoT ready. While this number rose to 30% for leading CPGs and 24% for SMEs in 2020, there is still a significant gap to be met when it comes to IIoT capability. While SMEs have slightly lower rates of IIoT and integration than leading CPGs, on average any given manufacturing operation will have 73% of its lines that are not fully connected and integrated.

Current Estimates of IIoT Ready Lines

15% **30%** **24%**

■ 2017 Baseline ■ 2020 Leading CPGs ■ 2020 SMEs
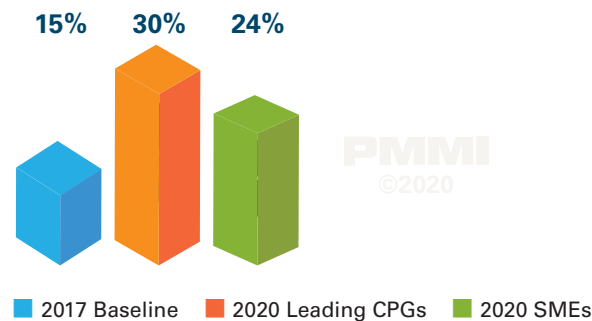
Lines Remaining to be Integrated

85% **70%** **76%**

■ 2017 Baseline ■ 2020 Leading CPGs ■ 2020 SMEs

Based on overall average of companies interviewed

"

Nearly half of our lines are automated, integrated, and collecting machine performance data now, but older lines are not collecting any data.

— *Process Development Engineer, Frozen Food Manufacturer*

"

LEADING CPGS CONTINUE ON THEIR INTEGRATION TIMELINE

We have 10 lines that are about 70% automated but not yet integrated; we still have some areas in both primary packaging and secondary packaging that need to be automated and we're considering robotics for case packing and palletizing.

— *Chief Engineer, Snack Food Leader*

All of our lines are fully automated, but not all are fully integrated yet; we are progressing with 2 to 3 lines per year.

— *Principle Engineer, Beverage Leader*

We are moving toward more automation but have not yet fully integrated our lines.

— *Continuous Improvement Manager, Leader in Frozen Foods*

We are adding more automation and robotics in general across our lines and incorporating magnetic motion control; however, none of our lines have the capability to be 4.0 ready - it will be implemented into our manufacturing lines in the future.

— *Sr. Director, Packaging, Personal Care Leader*

LEGACY LINES STILL CREATE A ROAD BLOCK

Seventy percent of our lines are fully IIoT functional. We still have some old filling lines with low volume that might be considered for future upgrade.

— *Product Engineer, Leader in Pharma/ Supplements*

4.0 / IIoT IS NOT EVERY COMPANY'S STRATEGY

Our plants are decentralized globally across very diverse markets and all lines are nearly fully automated, but our strategy does not move us toward a smart 4.0 model.

— *Packaging and Processing Engineer, CPG Leader*

Opportunity to identify technology gaps

OEMs and suppliers have the opportunity to assist manufacturers in expanding their IIoT connectivity outside of just production. A key component of automation advancement is the deployment of IIoT connectivity across an entire enterprise, including receiving, warehousing, and shipping. While these areas are seeing a gradual adoption of advanced technology, they are key links in the production chain that must be integrated to realize higher levels of automation. OEMs and suppliers can greatly assist manufacturers by identifying their IIoT blind spots, especially those beyond traditional production processes.

IIoT Line Functionality – The Vision of Future Manufacturing
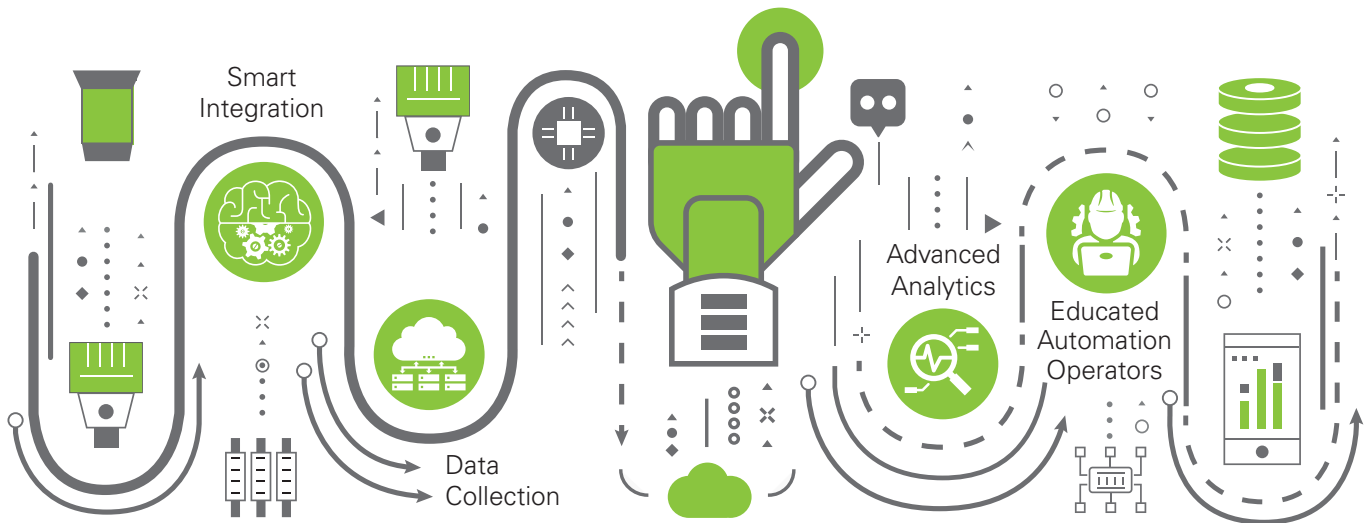
Early adopters of the Industrial Internet of Things have identified competitive advantages and new business models to increase revenue, cut costs, and improve customer service and support. Terms like predictive maintenance, artificial intelligence, smart manufacturing, and augmented and virtual reality are no longer buzzwords. They're ideas, technologies, and concepts being adopted and applied to industries every day.

Robotics are the Future

While robotics have long been utilized in manufacturing and are now a staple of automation strategies, their use has been primarily relegated to a handful of traditional areas such as secondary packaging and palletizing. Robotics technology has now advanced to a point where robots, including cobots, are more than capable of branching out beyond end-of-line applications.
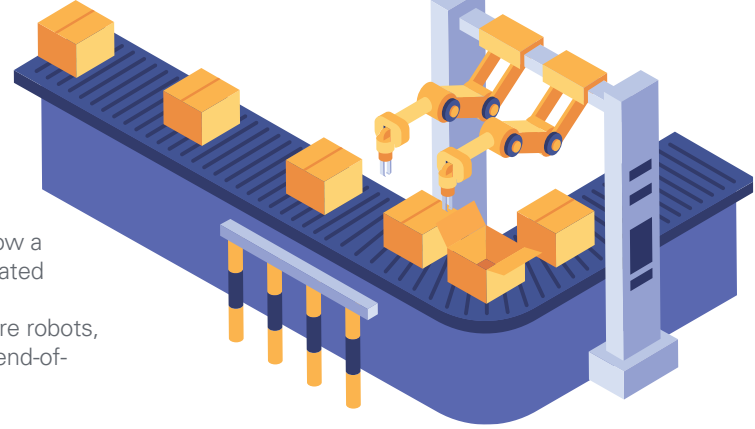
End-of-line continues to see the bulk of robot deployments

The limited deployment of robots along the entire line becomes clear when examining manufacturer data on robot usage. Overwhelmingly, robot usage appears at the end of the line: amongst leading CPGs, 67% are utilizing robotics for secondary packaging and 87% are using robotics for palletizing, as shown in the table below. Robotics usage overall is lower at SMEs, but the majority of usage is still at the end of the line, with 31% deploying robotics for use in secondary packaging and 54% for palletizing.

Robotics Being Used Now as an Automation Solution and Plans for Future Deployment Include Co-Bots

	Depalletizing	Product Handling	Product Processing	Filling/ Dosing/ Pick & Place	Secondary Packaging	Palletizing
Leading CPGs—All leading CPGs are using robotics now somewhere on their line:						
% of companies using robotics now	**13%**	**20%**	**7%**	**20%**	**67%**	**87%**
% of companies with future plans to increase robotics	**7%**	**7%**	**13%**	**13%**	**33%**	**20%**
SME's—3 in 5 SMEs are using robotics now somewhere on their line:						
% of companies using robotics now	**0%**	**31%**	**8%**	**8%**	**31%**	**54%**
% of companies with future plans to increase robotics	**0%**	**23%**	**15%**	**8%**	**38%**	**23%**

Application sites:
Injection molding
Pick and place
loading and
unloading
Material handling
(infeed)
Stacking
Tray packer
Case packer
Stretch wrapping
Palletizing

Application sites:
Welding
Collate, pack, stack
Pick & place
Color sorting
Material infeed
Inspection
Case packer
Palletizing

> The engineering manager at a nutritionals company is targeting secondary packaging in the year ahead, "We are using robotics now for cartoning, to collate, pack, and stack, and have plans to install robots for case packing and palletizing."

> Robotics usage remains the focus at the end of the line, as the continuous improvement manager at a leading frozen foods company explains: "We are adding more robotic case packing for putting bags into boxes."

Robots slowly moving up the line

Robot usage in areas up the line is significantly lower. Depalletizing, product handling, product processing, and even filling/dosing/pick-and-place are all areas where manufacturers reported significantly slower adoption of robotics. At leading CPGs, 13% were utilizing robotics for depalletizing, 20% for product handling, 7% for product processing, and 20% for filling/dosing/pick-and-place. These numbers were fairly similar at SMEs, where none were using robotics for depalletizing, 31% for production handling, 8% for product processing, and 8% for filling/dosing/pick-and-place.

At leading CPGs	**13%** are utilizing robotics for depalletizing	**20%** for product handling	**7%** for product processing	**20%** for filling/dosing/pick-and-place
At leading SMEs	**0%** are utilizing robotics for depalletizing	**31%** for product handling	**8%** for product processing	**8%** for filling/dosing/pick-and-place

Continuing to expand end-of-line

Evidence of manufacturers' slower robotics deployment outside the end-of-line is also apparent when examining planned future automation projects. For secondary packaging and palletizing operations, as shown in the table on the previous page, CPGs stated they will be expanding their robotics usage 33% in secondary packaging and 20% in palletizing. Similarly, SMEs predicted growing the use of robotics in either secondary packaging, 38% or palletizing, 23%.

At leading CPGs, planned robotics expansion was markedly lower in depalletizing (7%), product handling (7%), production processing (13%), and filling/dosing/pick-and-place (13%). These numbers were again reflected in SMEs where future robotics expansion was predicted to be lower in depalletizing (0%), product handling (23%), product processing (15%), and filling/dosing/pick-and-place (8%).

"

We will be deploying robotics for pick-and-place functions in the future, and a few one-off applications to replace manual labor.

— *Process Engineer, Leader Pharma/Supplements*

"

March of the cobots

One of the fastest areas of growth for robot usage in manufacturing is cobots. Designed to work alongside employees, cobots enhance processes by alleviating the requirements placed on humans, making production more efficient. The use of cobots was growing significantly before the outbreak of COVID-19: even with the downturn in manufacturing that persisted for most of 2019, the overall cobot market continued to grow in both revenue and units installed in 2019. Much of this growth is attributed to the versatility and approachability of cobots, which can be utilized in a variety of applications and can often be easily redeployed elsewhere with only minimal reprogramming. These advantages have also made cobots a potential solution during the COVID-19 pandemic, with many analysts suggesting that cobots could play an important role in helping companies transition into new operational realities as labor availability fluctuates and production schedules shift.

Robots and cobots find applications along the entire line

One of the industries that has been significantly disrupted by the COVID-19 pandemic is meat packing. Since the outbreak began, the CDC reports that 16,233 cases have been identified amongst employees at meat processing facilities across 23 states. This heavy case load has pushed many large meat processing companies to reevaluate their options when it comes to automation.

Several of the largest meat processing companies have been actively developing robotic processing systems for at least the last five years, with one key industry player having invested $500 million since 2017 alone, according to the *Wall Street Journal.* As COVID-19 has magnified an already challenging labor shortage issue, many of these companies have announced accelerated plans for deployment of robotic processing systems to address urgent labor needs.
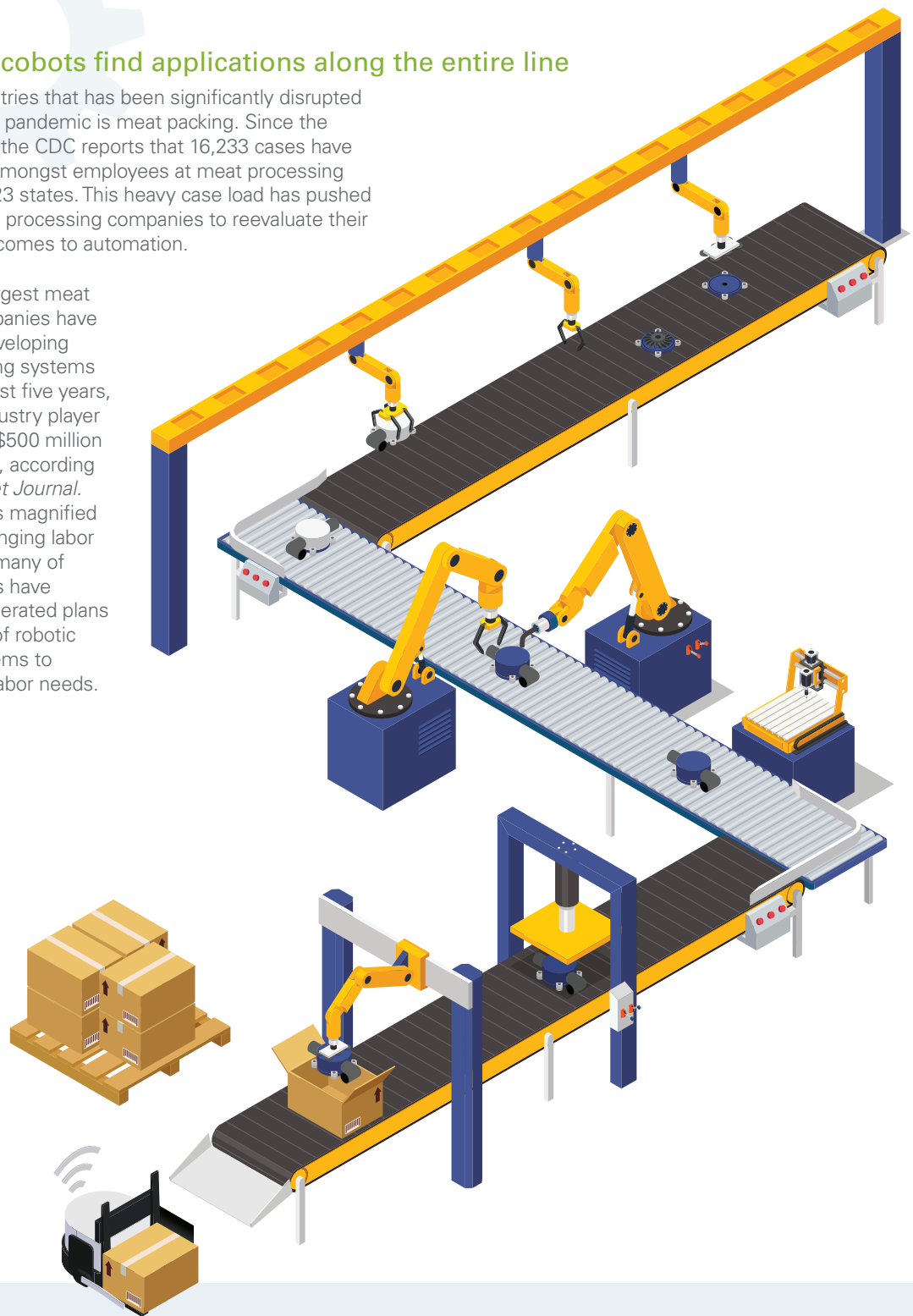
Opportunities to guide robot and cobot applications

There is a gap in familiarity with new robotic applications at manufacturers in understanding where and how robotics can be successfully deployed. The data indicates that many manufacturers are stuck in a sort of "end-of-line box" in which they are hard-pressed to envision robotics applications outside of traditional roles in secondary packaging and palletizing. OEMs and suppliers have an opportunity to provide education and guidance to manufacturers on how robots and cobots can improve their operations well beyond the traditional scope of end-of-line operations.

Artificial Intelligence (AI) and Machine Learning: Visions of the Future

The technology that has perhaps the most capacity for expansion on the automation front is the usage of AI and machine learning. Currently, only 1% of all manufacturers, both large and small, are utilizing some form of AI or machine learning in their operations. When queried on why these usage numbers are so low, the majority of manufacturers explained that they are still exploring this technology to gain a better understanding of how it can be utilized in their operations.

> We continue to learn how AI could be used and explore what benefits we can expect.
>
> — *Sr. Director of Packaging, Leading Personal Care Company*

Interestingly, there is a significant divide between large and small companies when envisioning future usage of AI and machine learning, as shown below. While an average of 45.5% of leading CPGs interviewed predict incorporating these powerful tools to advance their productivity and bottom line within ten years, only 7% of SMEs predict expansion of these technologies in the same time frame. This would appear to indicate that SMEs in particular are unsure of how such cutting-edge technology could be applied in a cost-justifiable way to their operations.
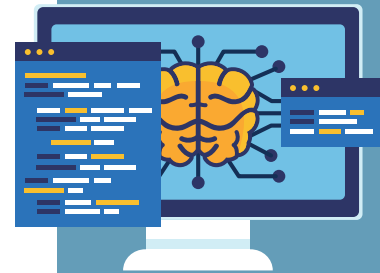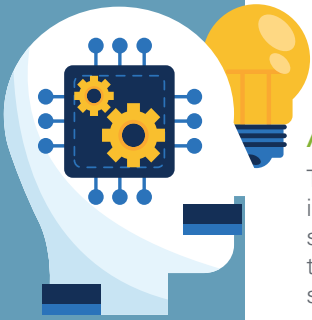
AI remains at the fringes of use, but predictions continue for steady adoption in the coming decade, primarily at leading CPGs

■ 2020 Leading CPGs   ■ 2020 SMEs

Using in 2020   **5 Year Predictions**   **10 Year Predictions**

1%
1%

4%
21%

11%
71%
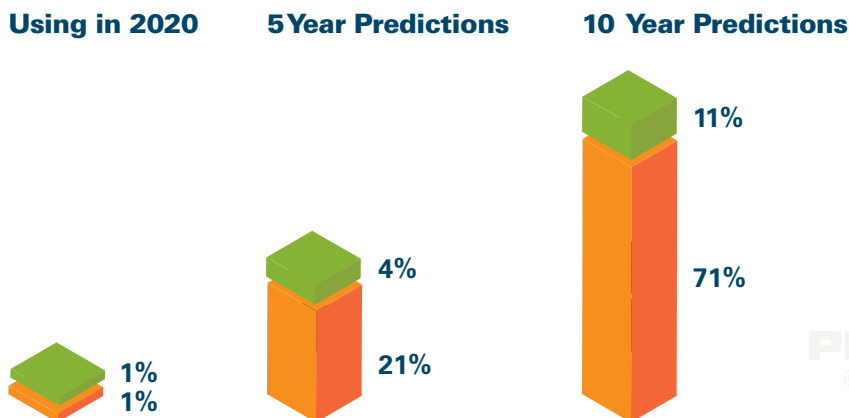
Based on overall average of companies interviewed

AI and machine learning, visions of the future

The lower levels of usage for both AI and machine learning amongst those interviewed indicates that industry suppliers have a continued role to play in educating manufacturers on the benefits of these systems. The technologies might appear as expensive investments left for the advanced future, but they are increasingly affordable and available solutions that can bring measurable efficiencies to smart manufacturing.

For instance, one of the most popular uses of AI and machine learning is to improve the processes at a manufacturing operation, with the goal of making the entire operation more efficient. To achieve this goal, manufacturers can utilize both AI and machine learning in tandem. Sensors are deployed to key areas of the operation to gather continuous, real-time data on efficiency, which can then be analyzed by an AI program to identify potential tweaks and adjustments to improve the overall process. This technology has proven to be more efficient than human analysis for applications ranging from the movement patterns of robots on a line to the rotational speed of turbines to optimize energy usage.

> *A plant manager at a private label SME reiterates AI technology is still being explored, stating:* "We are only now talking about how to use AI and predict it will impact nearly half of our lines in the next 10 years."

> *An example of a beneficial AI application was explained by the sr. director of plant engineering at a leading snack food company, who says,* "AI has been useful for regulating our baking ovens on several lines."

While AI is typically aimed at improving operation-wide efficiency, machine learning is directed more toward the actions of individual machines. Like a larger AI analysis system, machine learning allows individual machines to track and analyze their movements and processes, with the goal of improving efficiency on a smaller scale. By monitoring and analyzing the wealth of production data, machines can "learn" from their past experiences, identifying inefficiencies in areas such as rotation and movement and then adjusting their processes to correct for those inefficiencies.

Machine learning is predicted to gain momentum in the next decade, predominately at leading CPGs

■ 2020 Leading CPGs ■ 2020 SMEs

Using in 2020 **5 Year Predictions** **10 Year Predictions**

1%
1%

2%
14%

3%
20%

PMMI
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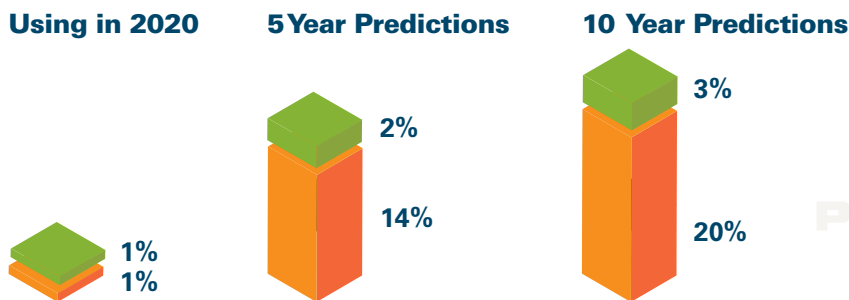
Based on overall average of companies interviewed

CPGs forecast that machine learning will gain momentum in the next decade, with some of the strongest near-future applications likely to come in vision and inspection systems.

> *As a sr. maintenance supervisor at a SME food plant explains:* "We are looking at vision with learning capabilities and will probably implement it in the future."

Highlighting an existing application of this advanced technology, a process engineer at a dry shelf goods manufacturer reports they are already using AI in their x-ray detectors.

Opportunity to achieve greater productivity

The advantages to be gained through the use of AI and machine learning are significant. One study released by *Accenture and Frontier Economics* found that by 2035, AI-empowered technology could increase labor productivity by up to 40%, creating an additional $3.8 trillion in direct value added (DVA) to the manufacturing sector. In this sense, it is advantageous for manufacturers to begin recognizing AI and machine learning as the technologies of today that can immediately help improve efficiency. The gains in labor productivity and operational efficiency may be even more attractive in the near-term as manufacturers struggle to overcome the challenges imposed by the COVID-19 pandemic. OEMs and suppliers can play a key role in the adoption of these technologies by educating their customers on the benefits of AI and machine learning and by including options for AI and machine learning in their equipment designs.

The expectations of AI and machine learning to aid less skilled workers in the future

Companies want to rely less on skilled labor and more on machine intelligence – it's a vision that CPG companies see coming in the future.

AI and machine learning can alleviate the responsibilities of human employees by:

- Optimizing individual processes and even the overall function of entire operations
- Managing production and maintenance schedules
- Expanding and improving the functionality of existing technology such as vision inspection

Operators will need to be properly trained to best harness the full power and functionality of AI, but it has the potential to greatly improve the productivity of individual employees.

"

Utopia would be having machines smart enough so that less skilled operators can run the line.

— *Packaging and Processing Expert, CPG Leader*

The goal is to leverage technology to reduce manpower.

— *Sr. Director Plant Engineering, Snack Food Leader*

AI and machine learning could take the operator out of the picture for much of the decision making currently.

— *Engineering, Beverage SME*

Machine learning and AI will give us more user friendly machinery to operate equipment with automated programs.

— *Sr. Maintenance Supervisor, SME, Meat*

"

Predictive analytics will prove its value

Another area of automation forecasted to grow by manufacturers is the utilization of predictive analytics. Predictive analytics allows manufacturers to monitor machine conditions and identify future problems such as failures or malfunctions, which can then be addressed before an emergency shutdown and downtime are necessary.

Like the deployment of AI analysis, predictive analytics relies heavily on a network of integrated sensors that continuously monitor and record production data. Unlike AI however, these sensors are more attuned to the performance of individual machines on the line, keeping track of their wear and tear to identify when maintenance will be required. This allows manufacturers to proactively plan their machine maintenance schedules to both service multiple machines at the same time and to avoid additional costly downtime from unexpected failures. In fact, tapping into and managing predictive systems is another growing use of AI: the technologies behind automation advancement are often intertwined.

> "
> For some areas on our line, predictive analytics are implemented at critical control points.
>
> — *Sr. Director, Packaging, Leader in Personal Care*
> "

While predictive analytics is a powerful tool for manufacturers that can often be utilized with additions to existing operations (especially if a larger IIoT system is already in place or at least partially in place), adoption of this automation technology has been gradual. While usage of predictive analytics has more than doubled (as shown below) since 2017 – from 10% usage then to 26% usage today – this technology is still not being embraced by the majority of manufacturers in the next five years. In 2017, companies forecasted far greater usage of predictive analytics, and in 2020 adjusted their long-term vision.

Predictive analytics for maintenance will prove its value

Current Estimates of Use			5 Year Predictions of Use			10 Year Predictions of Use		
10%	26%	23%	32%	47%	42%	91%	57%	54%

■ 2017 Baseline ■ 2020 Leading CPGs ■ 2020 SMEs

Based on overall average of companies interviewed

> "
> Our goal is toward more predictive maintenance but we don't have a solution for older equipment.
>
> — *Sr. Maintenance Supervisor, SME, Frozen Foods*
> "

Digital twinning broadens the vision

One possible application for predictive analytics is the concept of digital twinning. While not entirely new technology, digital twinning is finding new uses in the realm of predictive analytics. Currently, digital twinning is utilized primarily by OEMs to model machine functions and processes for customers before actually commissioning construction. This application of digital twinning allows manufacturers to precisely calibrate machine parameters to fit seamlessly into their existing operations.

> **"**
> We have used twins for our new machine builds only; it was done for new lines at some facilities and I see it increasing in the future.
> — *Sr. Director, Packaging, Leader in Personal Care Products*
> **"**

Utilizing digital twinning technology

The usage of digital twinning from 2017 to today has remained essentially unchanged. Then, as now, about 33% of leading CPGs are working with machine builders who are utilizing digital twinning, with aggressive predictions of expanding this technology to future designs in order to streamline installations. The usage numbers for SMEs have also remained low, with less than 10% of companies reporting the use of digital twin technology.

Digital modeling continues to take hold for individual machines, but the technology is expanding to a larger scale, in which an entire line - or even an entire operation consisting of multiple lines - is recreated in a digital space. This allows for the simulation of production processes across the entire line – run in an entirely virtual format – to accurately model line performance, greatly expanding the power and scope of standard predictive analytics. Rather than focusing on the specifics of one machine, comprehensive digital twinning of all manufacturing processes enables manufacturers to more accurately predict events such as multiple machine failures or to model crucial processes, such as changeovers, to predict required downtime and improve the efficiency of processes along an entire line.
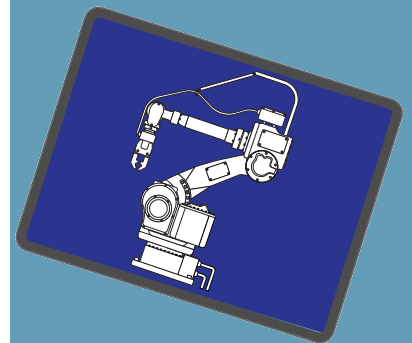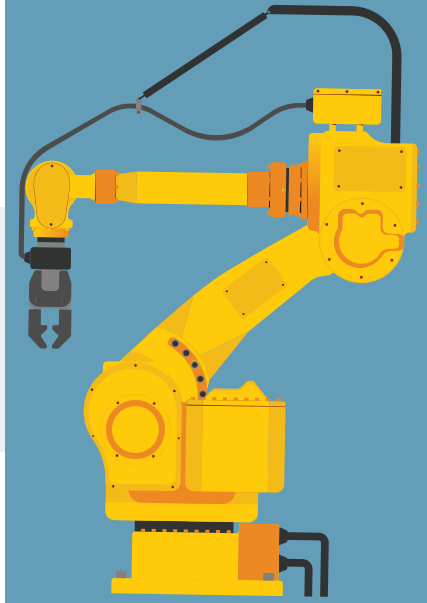
Virtual and augmented reality

Virtual and augmented reality are two technologies that are just beginning to find applications in the manufacturing space. Augmented reality (AR) in particular can be immensely beneficial for manufacturers, who have found uses for AR in areas such as maintenance and training guidance for employees working on the plant floor. Augmented reality systems create virtual overlays on real physical spaces, instructing employees on how to complete tasks with imbedded video/audio and digitally rendered alterations to the existing environment.

Virtual reality (VR) is essentially a more expansive use of AR technology, creating an entirely digital world rather than only a digital overlay on the existing environment. VR applications have been more limited than AR in manufacturing, but VR is finding uses in areas such as virtually modeling production processes and spaces. In fact, digital twinning is one important VR tool that is beginning to see wider adoption.

> **"**
> We may think about having 'Twins' for our controls and operating systems or modeling process flow in the future.
> — *Sr. Director, Plant Engineering, Leader in Snack Foods*
> **"**

Opportunity to advance technology

While most manufacturers are aware that digital twinning exists, it appears that the vast majority conceptualize it as the application of modeling individual machines before they are built. OEMs and suppliers can assist manufacturers in understanding a broader use of virtual modeling that can be achieved through digital twinning and how this predictive analysis tool could aid in improving overall operational efficiency.

Edge and cloud computing accelerated due to COVID-19

One of the loudest buzzwords in manufacturing today is "the cloud." The cloud seems to be everywhere, and everyone seems to want to be in it. But when examining data from manufacturers, it is apparent that its use is not as widespread or universal as it might first appear. Currently, 47% of leading CPGs and 46% of SMEs are utilizing cloud computing.

For manufacturers, cloud computing enables them to access production data and controls, remotely and in real time. By continuously uploading data to the cloud, manufacturers can obtain a truly comprehensive view of their operations, monitoring where products are, controlling what production lines are doing, and analyzing a wealth of gathered data, without the need to be physically present at the site of production. These advantages may have been made even more attractive by the COVID-19 pandemic, as manufacturers are confronted with the challenges of wanting to keep their employees safe by working remotely, but still requiring a team to be physically present. The cloud allows manufacturers to curtail some physical presence for their employees, thus alleviating safety concerns at the production site.

One of the obstacles to the wider adoption of cloud computing identified by manufacturers is security, specifically regarding secure access. Many manufacturers are uncomfortable with the idea of full remote connectivity into their operations and fear infiltration and potential sabotage from outside sources. To mitigate these fears, the concept of edge computing was introduced, whereby data is still uploaded to a centralized repository, but one that is not allowed to be accessed remotely. In other words, whereas the cloud stores data on a remote server that can be accessed remotely, edge computing stores data on a local server that can only be accessed locally.

"

Cloud computing is being discussed, but it's being met with resistance from IT.

— Engineering, Beverage SME

"

Edge computing enables many of the same advantages of cloud computing, just without the option of remote access to data. Edge computing is still a powerful tool for manufacturers to gain a more comprehensive understanding of their entire operation from a high-level vantage point. Despite these advantages and the safety improvements over cloud computing, edge computing is still a relatively niche application. Currently, only 20% of leading CPGs and very few SMEs are utilizing edge computing strategies.

Opportunity to expand plant boundaries

The key to cloud and edge computing is that they rely on a wealth of data to operate, meaning they are best deployed to operations that already have fairly comprehensive IIoT integration and that are gathering large amounts of data through their integrated network of sensors. OEMs and suppliers can assist manufacturers in identifying when the time is right to deploy cloud and edge computing, making these technologies a crucial component in the complex process of upgrading an operation to incorporate widespread automation.

Remote access is more important than ever

One of the key aspects of cloud computing, remote access, is also a tool that has seen growing use at manufacturers. While there are significant concerns with security when it comes to enabling remote access, many manufacturers, and specifically their IT departments, are coming around to the idea of using an expanded remote access strategy.

Manufacturers may be even more willing to expand their remote access use with the outbreak of the COVID-19 pandemic. As working from home becomes increasingly common to mitigate the spread of the virus, manufacturers are turning to remote access strategies as a means to reduce the number of employees that are required to be physically present at a manufacturing location. While manufacturing still demands more physical presence than other industries, remote access to both individual machines and the larger enterprise management system can allow at least some of the workforce to avoid the plant floor. This access can also enable remote troubleshooting and maintenance from OEMs.

Evidence of manufacturers' growing comfort with allowing remote access to their facilities can be seen in the usage numbers for VPN systems. In the 2017 report, only 32% of companies were allowing remote access through a VPN line, gateway router, or other proprietary direct connection means; by 2020, that number had risen to 58%.

In the June 2020 PMMI Purchasing Managers Index, all four industries listed below reported current remote access usage well above the median baseline. In addition, they also all report expected future expansion of remote access capability, although where they are on the remote access timeline varies a bit by industry.

Beverage: Current remote access usage for the beverage industry is 9.1 points above the average of all industries examined, while future usage is predicted to be 8.8 points above the average.

Food: Current remote access usage for the food industry is 1.1 points below the average of all industries examined, while future usage is predicted to be 1.5 below the average.

Personal Care: Current remote access usage for the personal care industry is 5.3 points below the average of all industries examined, while future usage is predicted to be 0.2 points above the average.

Pharma/Medical Device: Current remote access usage for the pharma/medical device industry is 5 points above the average of all industries examined, while future usage is predicted to be 1.5 points above the average.

> We do not allow online access to the control system; access with OEMs is on a case-by- case basis with multiple levels of approval.
> — *Engineering, Sr. Manager, Leader in Dry Shelf Goods*

> In order for OEM's to troubleshoot remotely, the machine needs to be disconnected from the network and go through an in-depth approval process.
> — *Packaging and Processing Expert, Leading CPG*

> We have several layers of cybersecurity and only allow key suppliers remote access.
> — *Sr. Director Plant Engineering, Leader in Snack Food*
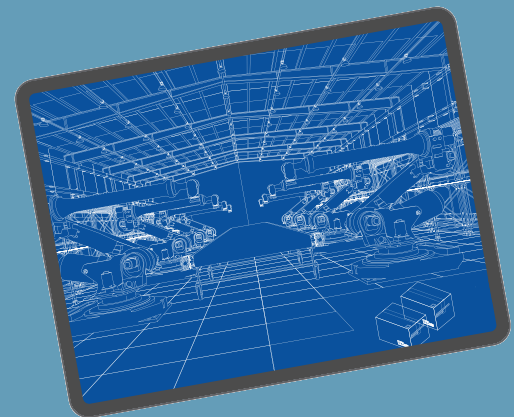
CPGs weigh in on what elements are a "must have" before any discussion of remote connectivity beyond the plant walls becomes the norm:

① VPN connection that is walled off from the factory network

② In-depth approval from IT

③ Trusted partnership with supplier

Blockchain for secure transactions

Perhaps the most enigmatic automation technology being explored by the manufacturing industry today is the concept of blockchain. Blockchain is discussed frequently in manufacturing publications as a game changer, but it appears that few manufacturers have a concrete idea of how to apply this new technology. This is apparent from manufacturers' low reported usage levels of blockchain, with only a select few of leading CPGs and SMEs indicating a blockchain application at their operations.

66

We are looking at blockchain now for more secure track and trace.

— *Sr. Director, Packaging, Personal Care Leader*

99

But what even is blockchain?

With the low usage rates of blockchain, it appears that this is a question on the minds of many manufacturers as well. In the simplest sense, blockchain reporting creates an instant, accurate, precise, and unalterable record of the history of products produced by a manufacturer. The record can be easily accessed and referenced at any time, but it cannot be altered or tampered with in any way. While this may be less of a concern for a manufacturer of personal care items, manufacturers in industries such as food and pharmaceuticals have a much larger concern with building an accurate record of their production. For these manufacturers, blockchain is an incredibly powerful technology capable of making meaningful contributions to a comprehensive track-and-trace strategy. For instance, blockchain allows a food manufacturer to access precise production and distribution data for any given run, enabling manufacturers to rapidly identify and recall any contaminated products.

Opportunity to educate the industry

While it is not the right technology for all manufacturers, blockchain has found ideal applications in industries where an accurate and unalterable record of production is vital. OEMs and suppliers can better educate themselves on the applications of blockchain, so that they can in turn educate their customers that have a need for the capabilities blockchain enables. OEMs and suppliers may need to play a more active role than usual in highlighting blockchain technology to their customers, since it is so new and its application is not universal.

Moving along the **Automation Timeline**

The advancement of automation is a goal that manufacturers know will benefit their operations, but there are still significant hurdles to actually achieving it. From justifying the ROI of automation projects, to overcoming the availability of skilled labor and the capabilities of internal automation resources, manufacturers will require significant assistance from OEMs and suppliers to optimize automation. To achieve this, OEMs and suppliers can focus on a number of areas outside of the traditional applications of end-of-line functionality that are typically associated with automation. Manufacturers will need partners to help them understand how to comprehensively implement an IIoT-ready Industry 4.0 solution that serves as the backbone of many advanced automation strategies. More than anything else, OEMs and suppliers have an opportunity to partner closely with manufacturers, providing them with ongoing education and guidance. OEMs and suppliers can be authoritative and definitive sources of automation knowledge and expertise, helping to facilitate the ongoing expansion of automation at manufacturers through continuous cooperation and mutual collaboration.

A Convergence of Technologies and Talent

- Companies are focused on automation and challenged with understanding what solutions are tangible and attainable in the short run, as existing technologies evolve and the industry specifies standards.

- Automation is a gradual transformation and the science of data holds enormous value for process optimization, but it will take time to properly use big data on a large scale.

- Advanced skills will be needed to implement the automation strategies for vision, motion, integration, and communications.

68% } **Over 2 in 3 End Users Rely on the OEM and Technology Suppliers More Frequently as the Level of Automation Increases:**

Troubleshooting for optimal machine performance	"We approve our OEMs to connect directly for remote troubleshooting and any retooling needed for new product formats." *Process Engineer, Leader in Personal Care*
Maintenance training	"We depend on our OEMs for maintenance training as automation solutions and robotics continue to be installed." *Director, Process Technology, Beverage Leader*
Machine design and modifications	"We need OEMs to be onboard with our own engineers making machine modifications or changes." *Engineering, SME in Beverage*
Installation and start-up	"We have an inside integrator now, but we rely on the OEM for installation, start-up, and ongoing troubleshooting." *Continuous Improvement Manager, Leader in Frozen Foods*
Internal staff enhancement	"We rely more on the OEM for design, install, and training, since we lack real internal capabilities." *Manager Engineering, Leader in Canned Food Products*
Expertise	"We want advice on how to improve our automation capabilities, and also need training and maintenance support." *Process Engineer, SME, Shelf Stable Products*

▶ OEM Actionable Guideline

Fostering the value of partnerships today

Most CPG leaders consider digital technologies to be a priority, but need help to define a clear strategic vision linked to action.

Understand the challenges

- Offer more handholding during critical decisions
- View the physical manufacturing process to offer advice on modifications
- Provide a higher level of more robust training
- Share best practices
- Remain cognizant of internal resistance

Design low maintenance and higher reliability machines

- Flexible machine design, less reliant on labor
- Minimize tweaks at install
- Offer innovative changeover options
- Data analytics identifying root cause
- Streamline cleaning and sanitizing

> **"**
>
> We want more support during critical decisions; more flexible equipment for unique product and packaging configurations.
>
> *— Process Engineer, Dry Shelf Goods, SME*
>
> **"**

The automated manufacturer of the future

What does an automated, integrated manufacturing plant look like in the future?
There will be different levels of automation operability at each plant in the future, and CPGs are moving ever closer to greater efficiencies.

Machine automation and line integration are growing, in every industry and at every stage of manufacturing.

Sensors are getting smaller, actuation is getting faster, vision inspection is more reliable, robotics are moving out of packaging and improving efficiencies up the line – all to maintain maximum uptime.

The progression to smart machines will have a major impact on how OEMs design machines, how data management systems are implemented, and how lines are integrated.

Automation is moving forward and there seem to be no insurmountable hurdles to greatly hinder its growth.

▶ In the future, machines on the plant floor will talk to each other, take corrective action to maintain maximum uptime, schedule repairs, and order inventory - automatically and autonomously.

Sources and References

Levanon, Gad. "COVID-19's Impact On Manufacturers: Expect More Layoffs, But Also More Working From Home." Forbes.com. Forbes, 11 June 2020. Web, June 2020. <https://www.forbes.com/>

Rao, Chaitanya; Dawra, Rinkal. "COVID-19 Impact on Food Automation and Robotics Market." Roboticstomorrow.com. Roboticstomorrow, 5 May 2020. Web, June 2020. <https://www.roboticstomorrow.com/>

Urquhart, Kristina. "How will COVID-19 impact the manufacturing automation market?" Automationmag.com. Annex Business Media, 18 March 2020. Web, June 2020. <https://www.automationmag.com/>

Shedletsky, Anna-Katrina. "Due To COVID-19, Manufacturing Will Experience Five Years Of Innovation In The Next 18 Months." Forbes.com. Forbes, 12 May 2020. Web, June 2020. <https://www.forbes.com/>

Demaitre, Eugene. "Survey finds coronavirus changing consumer comfort with AI, robots, and self-driving cars." Therobotreport.com. WTWH Media, 7 May 2020. Web, June 2020. <https://www.therobotreport.com/>

"Manufacturers Accelerate Automation in Wake of COVID-19." Industrytoday.com. Industry Today, 10 June 2020. Web, June 2020. <https://industrytoday.com/>

"COVID-19 Impact on Continuous Manufacturing Market." Marketwatch.com. MarketWatch Inc, 11 June 2020. Web, June 2020. <https://www.marketwatch.com/>

Ma, Cathy. "Manufacturer Response to COVID-19 Disruptions: Increased Interest in Automation, Reshoring." Thomasnet.com. Thomas Publishing Company, 11 May 2020. Web, June 2020. <https://www.thomasnet.com/>

Urquhart, Kirstina. "A perfect storm: COVID-19 disrupted supply chains. Here's how automation will help." Automationmag.com. Annex Business Media, 7 may 2020. Web, June 2020. <https://www.automationmag.com/>

Greenfield, David. "Where the Pandemic Is Impacting Automation." Automationworld.com. PMMI Media Group, 9 June 2020. <https://www.automationworld.com/>

"Survey: US consumer sentiment during the coronavirus crisis." Mckinsey.com. McKinsey & Company, 26 June 2020. Web, June 2020. <https://www.mckinsey.com/>

Williams, Terri. "Companies Struggle Finding Workers in Five Fields." Goddcall.com. GoodCall, 2020. Web, June 2020. <https://www.goodcall.com/>

Cross, Todd. "Retaining Light Industrial Workers: It's Not Just About the Money." Industryweek.com. Endeavor Business Media, 12 May 2017. <https://www.industryweek.com/>

Rogers, Kate. "Manufacturers to spend $26.2 billion on 'upskilling' in 2020 to attract and keep workers." CNBC.com. NBC Universal, 17 Jan 2020. Web, June 2020. <https://www.cnbc.com/>

Walker, Jon. "Machine Learning in Manufacturing – Present and Future Use-Cases." Emerj.com. Emerj - Artificial Intelligence Research and Insight, 23 Oct 2019. Web, June 2020. <https://emerj.com/>

"10+ AI Use Cases / Applications In Manufacturing Industry 2020." Usmsysterms.com. USM, 22 May 2020. <https://www.usmsystems.com/>

"How has COVID-19 Impacted the Collaborative Robot (Cobot) Industry." Roboticstomorrow.com. Roboticstomorrow, 15 June 2020. Web, June 2020. <https://www.roboticstomorrow.com/>

Blache, Klaus M. "OEE Provides ROI to Management." Efficientplantmag.com. Efficient Plant, 19 March 2018. Web, June 2020. <https://www.efficientplantmag.com/>

Waddill, Carl. "The Importance of OEE in ROI Analysis for Manufacturers." Evocon.com. Evocon, 28 April 2020. Web, June 2020. <https://evocon.com/>

"U.S. Manufacturing Faces a 2-million Worker Shortage." Reliableplant.com. Noria Corporation, 2020. Web, June 2020. <https://www.reliableplant.com/>

Sundblad, Willem. "The Manufacturing Labor Shortage Is Still Coming, Stay Prepared." Forbes.com. Forbes, 23 April 2020. Web, June 2020. <https://www.forbes.com/>

Schroeder, Nolan. "Global Manufacturing Labor Shortages." Globaledge. msu.edu. Michigan State University, 2 June 2020. Web, June 2020. <https://globaledge.msu.edu/>

Gilder, Lindsay. "Despite COVID-19 Impacts, SMB Manufacturers in 21+ States Currently Hiring." Thomasnet.com. Thomas Publishing Company, 6 May 2020. Web, June 2020. <https://www.thomasnet.com/>

Polachowska, Kaja. "10 use cases of AI in manufacturing." Neoteric.eu. Neoteric, 27 June 2019. Web, June 2020. <https://neoteric.eu/>

Mutikani, Lucia. "U.S. consumer spending rebounds; falling income, surging COVID-19 cases loom." Reuters.com. Reuters, 26 June 2020. Web, June 2020. <https://www.reuters.com/>

"Cobot market to reach $5.6 billion in 2027 despite slowing 2019 growth for overall industrial robot market, says Interact Analysis." Controldesign.com. Control Design, 9 Jan 2020. <https://www.controldesign.com/>

Anyadike, Nnamdi. "Cobots Move Beyond Simple Process Applications." Electropages.com. Electropages Media, 14 May 2020. Web, June 2020. <https://www.electropages.com/>

"Cobots Expanding Their Reach in Robot Market." Mhlnews.com. Endeavor Business Media, 11 Dec 2019. Web, June 2020. <https://www.mhlnews.com/>

McBurnett, Marie. "Cobots and Coronavirus." Machinedesign.com. Endeavor Business Media, 6 May 2020. Web, June 2020. <https://www.mhlnews.com/>
Biron, Bethany. "Tyson Foods is ramping up development of robots that can cut meat in response to coronavirus outbreaks in meatpacking plants." Insider.com. Insider, 11 July 2020. Web, July 2020. <https://www.insider.com/>

Wallace, Alicia. "Tyson and other meat processors are reportedly speeding up plans for robot butchers." CNN.com. Turner Broadcasting Systems, 10 July 2020. Web, July 2020. <https://www.cnn.com/>

Bunge, Jacob; Newman, Jesse. "Tyson Turns to Robot Butchers, Spurred by Coronavirus Outbreaks." WSJ.com. Wall Street Journal, 9 July 2020. Web, July 2020. <https://www.wsj.com/>

"US Packaging Machinery Purchasing Index: March 2020." PMMI. PMMI Media Group, March 2020.

"US Packaging Machinery Purchasing Index: May 2020." PMMI. PMMI Media Group, May 2020.

"US Packaging Machinery Purchasing Index: June 2020." PMMI. PMMI Media Group, June 2020.

Finch, Caleb. "Manufacturing with VR Becoming a (Virtual) Reality." Qad.com. QAD, 25 Sept 2018. Web, June 2020. <https://blog.qad.com/>

Brand, Steven. "How Virtual Reality is Changing the Manufacturing Game." Cmtc.com. California Manufacturing Technology Consulting, 2019. Web, June 2020. <https://www.cmtc.com/>

"For US manufacturing, virtual reality is for real." Pwc.com. PwC (PricewaterhouseCoopers), 2020. Web, June 2020. <https://www.pwc.com/>

Nichols, Megan Ray. " How Augmented Reality Will Disrupt The Manufacturing Industry." Thomasnet.com. Thomas Publishing Company, 9 Jan 2019. Web, June 2020. <https://blog.thomasnet.com/>

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