PMMI

The Association for Packaging and Processing Technologies

THE FUTURE OF AUTOMATION IN PACKAGING AND PROCESSING

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PLC Status
All
Status
Metric
Value
Servo Temp
220 °F
Air Pressure
285 PSI
Hydolyser
11%
Pressure Pump
2915 PSI
Fan Speed
1300 RPM
Compressor
4450 PSI
Robotic Arm Health and Performance
Overall Performance
89
Unit Efficiency
49
Temperature
195
Humidity
25
Temperature (°F)

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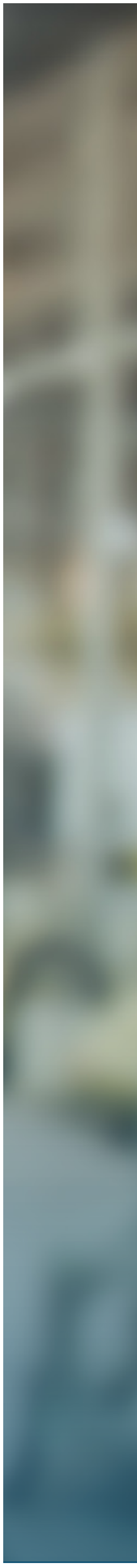

PMMI – What we do

PMMI is a global resource for the packaging and processing industry, uniting the industry across the manufacturing supply chain. Our members promote business growth in a variety of industries by developing innovative manufacturing solutions to meet evolving consumer demands, today and in the future. PMMI membership represents more than 950 North American manufacturers and suppliers of equipment, components and materials as well as providers of related equipment and services to the packaging and processing industry.

About this report

This report was produced by **PMMI** in conjunction with leading market intelligence company **Interact Analysis**, a global research house with offices in the US, China, and the UK. The company specializes in the entire automation value chain from product manufacturing in automated factories, through to storage in automated warehouses, and finally to distribution via fleets of increasingly electrified and automated commercial vehicles. Interact Analysis boasts a wide industrial client base that includes market leading industrial automation companies, such as Siemens and Rockwell Automation. The report was compiled by a team of experts with a wealth of experience and knowledge in the field, conducting extensive primary analysis informed by the following research tools:

An online survey to gather insights from

119

VPs, CEOs & engineers at consumer packaged goods (CPG) companies based in the USA

15

in-depth semi-structured interviews with industry experts working at CPG companies

4

in-depth semi-structured interviews with engineers at OEMs

Executive Summary

Automation. What's all the fuss about?

The automation of processes in the consumer packaged goods (CPG) industry is a clear route to achieving greater efficiency, quality, and productivity. While automation isn't a new thing, widespread disruption to production lines during the pandemic and subsequent disruption to supply chains together with labor shortages have sharpened the focus on this rapidly developing technology. CPGs are realizing they can enhance and optimize their production, storage, and distribution processes through the use of a range of automated solutions including automated guided vehicles, industrial robots, collaborative robots, and mobile robots, some of these technologies being supported by AI and advanced vision technology. In this report we highlight and examine key issues surrounding the adoption of automated technologies by CPGs, as well as likely trends for the future.

Introduction

Labor shortages are driving CPGs to adopt automated solutions, although there are obstacles to overcome. For example, installing automated machinery in unsuitable building layouts can be a challenge, as can the lack of skilled labor to operate and maintain sophisticated machinery. Another issue is the cost, but prices are falling. Automation of the production and processing phase is considered by many CPGs to be the top priority as improvements in efficiency and productivity are immediately visible. However, there is plenty of scope – and good reason – to automate warehousing too.

E-commerce is currently impacting the processes of nearly half of CPGs and it's fueling the automation trend. As it drives companies towards more responsive modes of distribution such as Direct to Customer (D2C), so it pushes the need for automated solutions and has the side-effect of disrupting traditional highly manual warehousing formats, in some cases potentially making warehousing unnecessary. Ever-changing customer demand means flexibility on the production line is key. CPGs are looking to OEMs to come up with new technologies that enable this flexibility.

The shortage of skilled labor on production lines is becoming a greater challenge as automated machinery becomes more sophisticated. CPGs are looking to OEMs to rise to the challenge of producing machines which are capable of complex operations, while themselves being easy to operate and maintain. The use of 3D printers to produce spare parts for automated equipment has rapidly become a reality, and use of this new but fast developing technology is particularly attractive because it has a positive impact on the ROI for machinery as parts can be produced more cheaply. Perhaps more importantly, it circumvents supply chain disruptions and cuts lead times.

Predictive maintenance is also increasingly being adopted on production lines as CPGs seek to avoid costly downtime when expensive equipment breaks down. Though there are outstanding issues regarding cyber-security, OEMs are taking an increasing role, by overseeing predictive maintenance through remote access. Larger payload cobots are often seen as the solution to the demand for flexibility on the production line. Though cobots were previously considered too small and slow for effective operation in many scenarios, new, larger and faster models, particularly mobile ones with enhanced machine vision built in for safety, are gaining in popularity. That's because they are comparatively cheap, modular and adaptable. As such, they are an ideal solution for SMEs operating on low budgets or who want to start small and build big.

The COVID-19 pandemic and the associated breakdown of supply chains, coupled with recent global geo-political events have led CPGs to look into purchasing machinery and parts from sources closer to home. Rather than depending on one supplier, CPGs are sourcing from multiple suppliers in order to avoid potential problems with elongated lead times. The traditional transactional relationship between CPGs and OEMs is becoming one of partnership and collaboration through such contract offers as Machinery as a Service (MaaS), where the OEM plays a proactive role in assuring optimum production levels through the establishment of agreed production goals, the permanent or semi-permanent presence of OEM engineers on site, or, as is becoming more and more the case, support through predictive maintenance conducted by OEMs via remote access.

Owing to the lack of highly skilled labor on their lines, CPGs are increasingly turning to OEMs to supply on-the-job training of staff. This has traditionally been affected by OEMs sending out experts to provide face-to-face training on lines, but as with remote support, there is a trend towards remote training through such innovative technologies as augmented reality.

The Current Outlook

The Current Outlook for the Industry & Automation Technology

The packaging and processing industry is currently struggling with the challenges arising from widespread supply chain issues and a shortage of labor. These supply chain problems are impacting on the availability and cost of raw materials and parts for packaging machinery. Over 90% of CPGs say these problems are either extremely impactful or somewhat impactful and while the majority of companies expect them to be resolved over the short term (within 3 years) at least 25% of companies anticipate them persisting over a longer timescale.

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90%

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AT LEAST
25%

of companies anticipate them persisting over a longer timescale.

The most immediate challenge, however, is the lack of availability of labor, with

60%

of companies reporting that labor shortages are extremely impactful on their operations.

It's largely issues around labor that are driving CPGs towards the increased adoption of automated solutions. A few specific factors are making the consumer packaged goods sector fertile ground for automated solutions. The COVID-19 pandemic highlighted the pitfalls of an over-reliance on human labor on production lines and in warehouses. When the virus struck a workforce, economic activity either slowed or shut down completely, incurring huge costs to companies. Automation has been recognized as a way of future-proofing companies from further similar shocks. But a more immediate driver of automation lies in the fact that, according to the OECD, since the pandemic many workers appear to have reviewed their situation and no longer accept low pay and low-skilled repetitive work. A rep from a CPG commented in one of our interviews that their line operators typically handled 60-70 packages a minute on hand-pack lines. "People are standing up to do this work. It wears them out. The multifunction of opening boxes and then putting products into them is hard on the wrist. There's a lot of twisting and it's hard on people". People are turning away from this work, and it's putting huge pressure on CPGs, especially those whose lines are operational 24/7.

Hence, we are seeing labor shortages at a time when nearly 70% of American CPG companies have packaging and processing plants which are highly manual, or are only semi-automatic, i.e. still requiring human input. One stakeholder claimed their company was probably short by about 30 or 40 people per shift. Labor shortages and the resultant hike in labor costs are driving the automation trend. And some CPGs are moving fast, with one interviewee telling us:

> We are automating and updating all of our plants which is 40+ plants in North America. We are automating more or less anything that a human touches, whether it's taking something out of a box or assembling a box or putting a product into a box. We're hoping to have full automation by the end of 2024.

But there continues to be barriers, mainly due to cost and ROI. One executive from a packaging company told us that companies need to have market certainty before they invest, as capital outlay on automated equipment can be significant. If companies don't know if the market is going to be there, they will typically put the work out to a contract packer until sales volumes make it viable to bring the packing in-house. It's an ROI issue – ROI is often the reason companies don't automate straight away. It's also about being logical, and not stranding capital. For example, if a CPG installs a multimillion dollar fully automated system expecting it to run 24 hours a day, seven days a week, but then it turns out it's only running three days on day shifts, that's a multi-million-dollar investment that the company is paying for with only a fraction of the product they thought they'd be producing.

A more practical barrier to automation lies in the fact that many CPGs are based in older buildings with small and awkward layouts. In fact, nearly half of CPGs in the US say limited floorspace is hindering automation initiatives. On top of this, the difficulty in filling skilled and technical positions – such as skilled operation and maintenance workers – is also holding companies back from investing in new technology. Skills gaps are having a significant impact on operations and 40% of CPG companies anticipate that they will pose challenges over the longer term, persisting, along with labor shortages as a whole, beyond the next 3 years.

Notwithstanding these barriers, spending on automation in the consumer packaged goods industry has increased across the board and many CPGs expect this trend to continue. As one stakeholder put it:

> "Five years ago automation was something that Walmart did, that Pepsi did, that UPS did. Automation was seen as something for large players with a lot of money and massive throughput. Now automation is a big deal for all packaging and processing companies and is a major part of their development plans.

WITH **90%** of American CPGs reporting that labor shortages are impacting their performance, it's easy to see why this is happening.

For some companies it has been a case of automating the line or stopping production. As a result, over two thirds of American CPGs have reported an increase in their spend on automated solutions over the past 3 years.

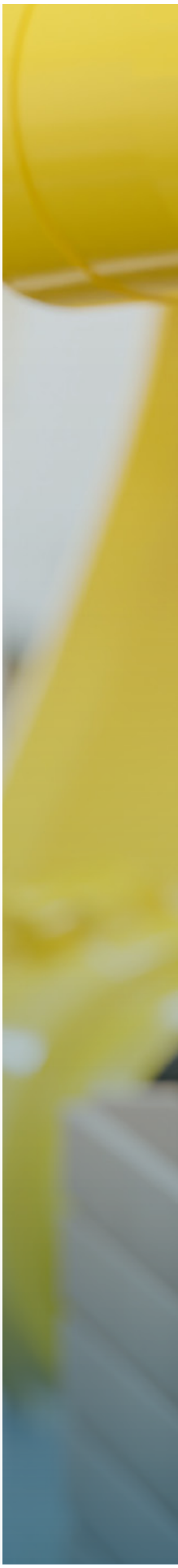
A key factor when automated solutions are under consideration has always been the price. Earlier we mentioned the increase in labor costs, but it's important to realize that automation costs have also decreased. These two factors have worked in tandem to ensure a much healthier ROI for automated solutions. As one CPG interviewee commented:

> You know, five years ago, an autonomous robot might have cost you $100,000. Today, I can [automate] that same job for about $35,000. Also the cost of labor five years ago might have been $8.00 an hour, and now it's $16 to $18 just for the people on the line. So again, that makes the ROI more achievable.

In short, the focus is becoming less on the cost of installation of automated solutions, and more on how installation can be achieved in the most impactful way.

CPGs and OEMs are seeking to deploy existing solutions rather than developing new technologies. One stakeholder said: "Robots and AGVs are relatively easy to deploy. So now it's less about the complexity of the technology or the cost. The focus is more on the application of the technology". Relatively cheap micro-automation solutions mean that adoption of automation is spreading as smaller CPG companies with lower budgets for automation and smaller throughputs find they too can get on board, having previously been priced out of the market. Finally, although there is a trend towards fully integrated automated solutions on factory production lines, there is the realization among some CPGs that they don't have to go all the way – a piecemeal approach can also be very effective (and much cheaper). As one interviewee put it:

> We don't necessarily need to take a factory that's got a lot of manual processes and forklifts running around and roller conveyors and say how am I going to automate this factory?... You could look at just one process within the factory (for instance a) palletizer (and say) how am I going to automate this?"something out of a box or assembling a box or putting a product into a box. We're hoping to have full automation by the end of 2024.

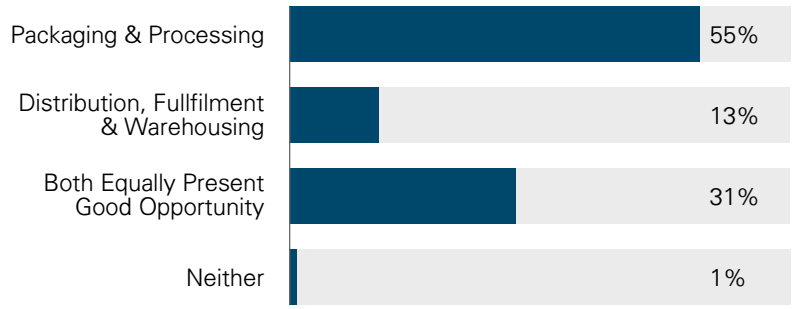


Advancement Opportunities

Where are the opportunities for advancement through automation?

Packaging and Processing

In our June 2021 white paper 'Packaging and Processing – Coming through COVID-19', we reported that there was a strong need to invest in new packaging equipment, with 84% of survey respondents indicating they had increased their investment in 2021. When CPGs were asked which aspect of their end-to-end process presented the best opportunities for advancement through automation, the packaging and processing phase came a clear first, as can be seen in the chart below.



CPGs tend to focus on packaging and processing due to their existing knowledge and the skillset of their workforce.

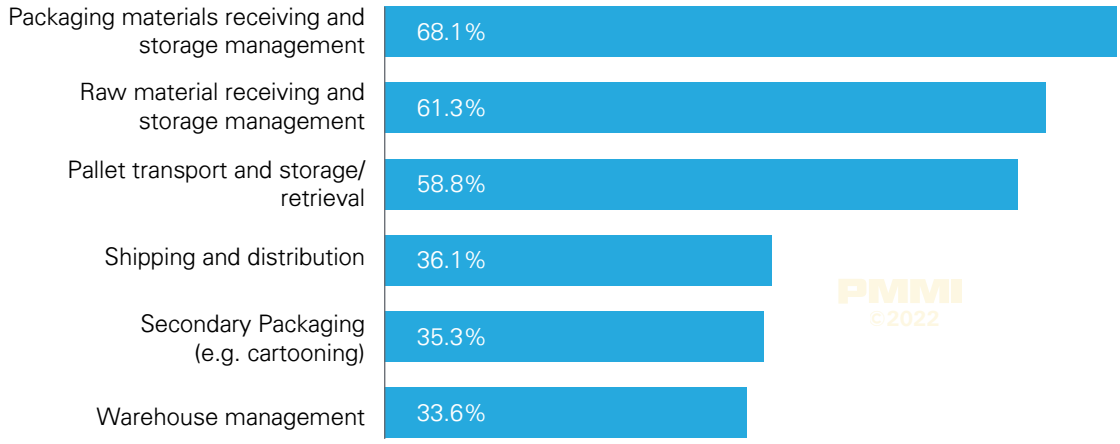
Source: PMMI, The Association for Packaging and Processing Technologies – 2022 The Future of Automation

Automation of production processes is perceived to have many long-term benefits. It increases speed and efficiency on the line and ultimately increases productivity. We found that 31% of respondents said they are currently deploying automated machinery on their production lines as a substitute for manpower and will continue to do so. Another 30% said they had plans to introduce automation in 2021. The white paper emphasizes that although it was the pandemic that was the driver behind this surge in automation, the changes will most likely be permanent.

Warehousing & Storage

The ever-increasing demands of e-commerce mean that CPGs are striving to build faster production lines, creating larger volumes of product. But this advantage can be lost at the end of the line because of the largely manual nature of storage and retrieval processes in warehouses. American CPGs report that the majority of operations relating to storage and retrieval of materials, pallet transport and distribution are still carried out by human operatives.

Which areas/tasks are still highly manual in your plant(s)?



Source: PMMI, The Association for Packaging and Processing Technologies - 2022 The Future of Automation

In terms of development, warehouse and logistics automation technologies are lagging behind the automation of production lines, by a factor of approximately 5 years according to one of our respondents. It's also more expensive to automate or semi-automate a warehouse than it is a production line, but prices are gradually falling, and the technology is advancing. Warehouse automation has huge potential, and there is good reason.

Some industry experts working at CPGs are noticing that in their plants the end-of-line non-automated processes existing in storage facilities can create bottlenecks which can put a brake on production. Furthermore, they observe that the acute shortage of labor in warehouses is exacerbating the problem. Automation is a potential solution here and could be a game changer for CPGs looking for growth. However, there is a disconnect between the perceptions of industry experts and those of engineers and VPs overseeing processes at CPG companies. As we saw in a chart earlier,

55% of CPGs state that the packaging & processing area of their plant presents a better opportunity for advancement through automation than distribution, fulfilment & warehousing.

ONLY **13%** see the automation of warehousing processes as a top priority.

That said, one OEM commented that the majority of inquiries regarding automated solutions they received were in relation to warehousing and the OEMs interviewed tended to consider automation of end-of-line processes as offering a significant business opportunity for CPGs. One respondent explained it like this:

> "Having the ability to require less labor, fewer forklifts, less space, lower footprint and higher density where everything in the warehouse is more automated… increases throughput and capacity without necessarily needing to build more buildings and without needing to hire more people."

But there are hurdles to the automation of existing warehouses. Buildings which were designed for manual handling activities and forklift truck traffic might not be the ideal layout for automated solutions. When automation technologies are used correctly, warehouses can be smaller and more space efficient, but this often requires engineers to rethink the layout of their plants and the cost, time and down-time implications of making large scale changes are often too high for medium/smaller CPG companies. Conversely, some warehouses may be too small. A representative from one OEM commented: "I think it's going to be a struggle for people to retrofit it [automation] into existing plants. Old plants, small and poorly laid out warehouses." But the advantages of automated warehousing are clear. It enhances a company's growth potential. Traditional manual processes in warehousing can create pinch-points which can limit the ability of a company to expand and grow outputs. Automating warehouses would increase available space and could also make way for new production lines or increased automation of existing lines.

E-commerce is an opportunity and a challenge – especially at the end-of-line

Fueled by the pandemic, the burgeoning e-commerce business is having a significant effect on warehousing and distribution.

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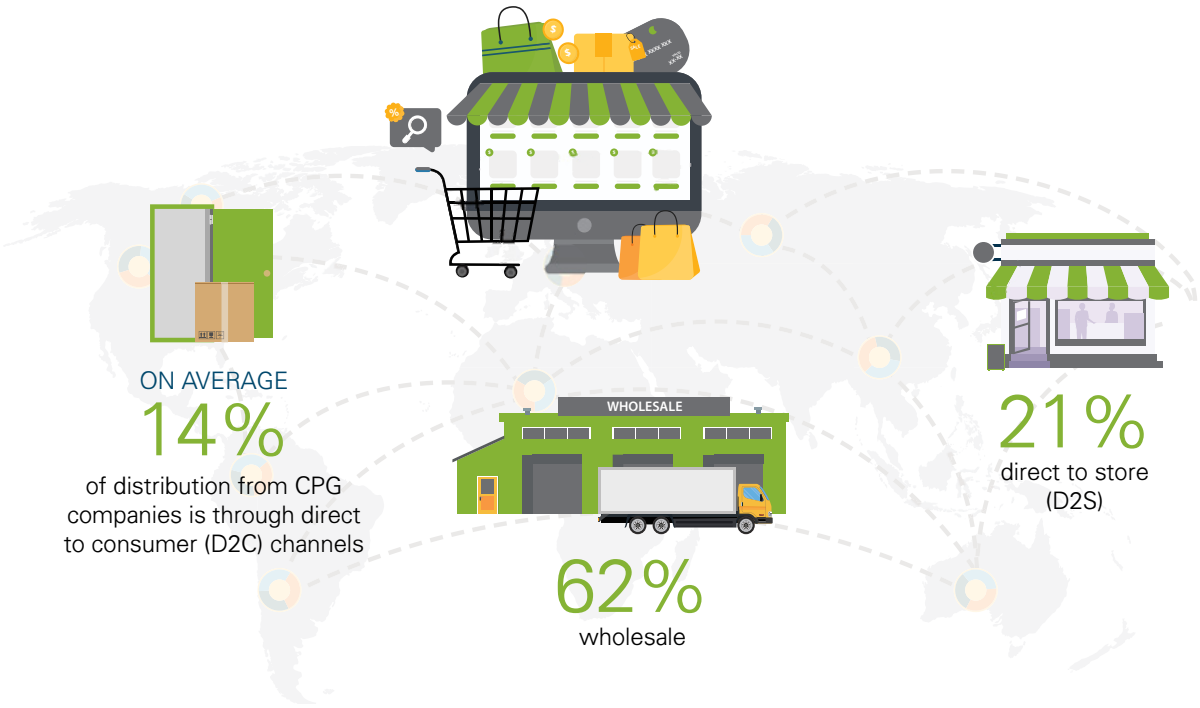

ON AVERAGE

14%

of distribution from CPG companies is through direct to consumer (D2C) channels

21%

direct to store (D2S)

62%

wholesale

Nearly half of CPGs expect direct to consumer shipping to increase over the next 3 years. CPGs traditionally reach their customers through retailers and distributors. But this means they have no direct contact with customers, so they are unable to harvest the accurate consumer data which would enable them to become more responsive to the needs of customers.

For this reason CPGs are turning in increasing numbers to D2C models of retail which offer benefits both to customers and to company balance sheets. If D2C grows as expected, it will have an impact on the automation needs of CPGs and how they think about automating their production lines. Shipping D2C requires minimal mistakes as errors incur more costs than other shipping methods. This makes automation even more vital, and it's already happening: "Some of our clients have fully robotic pick and pack warehouses and that is just for e-commerce," according to one mid-sized OEM

The logistics process and packaging required for products destined for stores won't change significantly, and the demand for shelf-ready packaging will avoid the need for split-case picking for deliveries to brick-and-mortar retailers. But when it comes to e-commerce retailers and D2C shipping, we do expect to see changes in product packaging and shipping requirements. For products being shipped to e-commerce retailers, we'll see smaller pack sizes with minimal branding. This is where speed comes into it. The primary packaging of a product may still proceed at the same speed, but if secondary packaging involves, for instance, packing batches of 6 rather than 12, this means it needs to proceed at a faster rate. This is one opening for automated solutions.

The growth of D2C strategies will require CPG manufacturers to invest in split-case operations. This will require a fundamental shift in the way products are packaged and handled, requiring significant investment in storage and automation. We were told by Walmart that some CPGs are aiming for 10% of their revenue to be generated from D2C channels by 2025 and this will require significant volumes of split-case picking. We're already seeing companies start to build this infrastructure, with PepsiCo, for example, piloting an automated micro-fulfillment center from Dematic for hyperlocal fulfilment.

Based on our research, it seems likely that CPGs will focus heavily on D2C channels and may leverage their existing DSD (Direct Store Delivery) distribution networks. Again, looking at PepsiCo, the company has a large network of last mile facilities (with split-case operations) for its DSD services, and has rolled out two D2C marketplaces where customers can purchase products online. We were told by an interviewee who is a D2C consultant for large CPG manufacturers that many producers are looking to leverage their DSD networks to fulfil online orders as well. Within this model, PepsiCo would a) ship cases to a last-mile DSD location, b) split the cases into eaches, and c) fulfil both DSD and DTC orders from the same location.

While it's unlikely retailers will demand split-case shipments from CPG producers, it's certainly true that the manufacturers are developing split-case picking infrastructure for their own D2C operations, if nothing else. According to one of our researchers who consulted one of the largest global beverage manufacturers on their D2C strategy, the company was aiming for 10% online sales by 2030. However, the pandemic has pushed forward this target to 2027. PepsiCo, for example, launched Snacks.com and PantryShop.com which are online marketplaces serviced by the CPG manufacturer, and its D2C sales more than doubled the year these sites were launched. In February 2021, Reuters reported that PepsiCo's Chief Financial Officer Hugh Johnson said that more than 45% of the company's capital investments over the next few years would be dedicated toward manufacturing capacity, automation, and a "ramping up of investments in our e-commerce channel." The same Reuters article described how other big names in the food and beverage sector – Kraft, Heinz, General Mills and Kellogg's, for example – are also intensifying D2C activity.

We don't anticipate CPG manufacturers shipping reaches to traditional brick & mortar retailers, but we do expect pack sizes to decrease and take different formats as retailers adopt e-commerce friendly packaging. We also expect CPGs to develop in-house split-case picking processes for their own D2C operations. Smaller pack sizes allow retailers to ship smaller quantities on a regular basis in response to online peaks in demand.

As the demand for e-commerce grows, so too does the complexity of the fulfilment operation and the need for it to be supported by automation. The last mile is becoming more challenging, especially as companies like Amazon are getting consumers used to higher levels of convenience such as shorter delivery times and higher levels of order transparency. Due to the increased complexity of fulfilment, we expect more retailers to use third-party consulting services to help design efficient automated fulfilment networks. It's going to be a challenge and nearly half of CPG companies state that e-commerce is impacting on their company right now. The problem it creates for CPGs is slower throughput which could more than halve in order to accommodate the added flexibility required in moving towards an e-commerce led set up.

This may result in third party warehousing and distribution companies fulfilling D2C orders on CPG companies' behalf. That could help maintain speed with the added benefit of reduced inventory and storage. There is even the prospect that future plants could have minimal or even no inventory or warehouse, as holding inventory is just an added cost for the CPG and is effectively wasted space. Holding inventory reduces the flexibility CPGs need in order to be able to be fully reactive to the market in an e-commerce-driven world. Being able to quickly shift production to meet demand and have products shipped directly from the factory to consumers means there is no need for inventory and this saves money and space:

> If you can set up an operation which directly matches supply with demand, why would you keep anything in stock?

As the number of e-commerce and D2C orders continues to grow over the next 5 years, orders are likely to become more personalized, with the possibility of consumers, for example, choosing their own recipe ingredients or products in a variety pack. New plants may need to be built with the e-commerce factor in mind and designed for end-to-end automation. Industry 4.0 could play its part in a re-tooling of the manufacturing and distribution systems to enable e-commerce to be the standard distribution method, rather than just being an add-on to the wholesale route. The table below highlights some of the changes that will occur as the industry shifts more towards an e-commerce-led retail model.

	Retail Model	E-Commerce Model	DTC Model
Destination	Retailer's DC or store (DSD)	E-Commerce retailer's fullfiment center	Direct to consumer or producer's fullfillment center
Packaging	Shelf-ready packaging Branding is the main feauter of the package	More robust packaging (products often repackaged with other items downstream) Need to handle returns No branding required	Light-weight but durable, typically in an envelop or a pouch
Production Lines	High speeds and standardized products	Smaller lines and therefore more frequent changeovers	Late stage customization and personalization to resonate with online consumer
Shipping	Corrugated card cases, often palletized	Smaller individual units, more often shrink wrapped (easier to unpack) If not shrink wrapped, sometimes shipped in bulk totes	Product shipped in bulk and packaged individually with single label on each package

Source: PMMI/ Interact Analysis

Flexibility is becoming more important. OEMs offering flexible machines will go to the top of the list

Flexibility is all about being able to alter output from production lines in order to meet demand. Market demand is becoming increasingly volatile, making forecasting a challenge. Production lines need to be able to respond and change quickly to meet customer needs. This will become even more of an issue as D2C fulfilment increases. But for some the need for flexibility has been a barrier to automation, as one CPG respondent told us:

> …the main reason why we are not further along those roads [implementing automation] is because we package hundreds of different containers with hundreds of different closures with hundreds of different decorations so it's been difficult to set up any sort of automated processes when you've got changeovers, even during mid shift to different products and different sizes and different configurations.

Typically, companies want to automate processes that are repetitive in nature and unchanging, and automating a flexible line where product sizes, materials and formats change regularly is seen as a challenge for CPGs. Smaller companies which don't have the volume of product going through a line and which often need to change the products on a line can find flexibility limiting their automation choices, so they stick to manual processing. But with labor shortages kicking in, together with the need for increased speed and efficiency on production lines, the growing expectation from CPGs is that automation companies will come up with new technologies that enable flexibility, such as adaptable machines that can change to meet a company's needs quickly, even multiple times a day in some cases. Companies want automated solutions, but they don't want to lose the agility to change products and pack sizes and troubleshoot the unexpected.

A rep from one CPG clearly described the challenges of automating a packaging line and talked of the necessity of having at least some human input on more complex, automated lines, in order to have the flexibility to deal with the unexpected:

> Imagine you have a case full of cups. Inside that case is plastic wrapping preventing dirt and dust from getting into the cups. So I have an end tool on the robot arm - the part of the robot that has to go into the case, but it's not smart enough to open up the case, so that has to be done by a person. Now the robot goes in and it has to manipulate around the plastic wrapping so it doesn't get caught on the plastic and then it has to pick up the cups and put them in a specific location. Some of our machines have 10 different lanes where we put cups, so the robot has to know which lane needs cups. And so it's a more complex automation project than you might think at first glance. Also the stacks of cups might not be the same from case to case. There might be the same number of cups, but they might have been bumped about a bit during shipping. And so now the robot says this isn't right. It fails. And then a person has to intervene. So I've taken a lot of the work away from the human, but I haven't eliminated the human. But the upside is that that person is now doing other tasks in addition to interacting with the robot.

Simplified machines will help with skills gaps

One barrier to automation for CPGs is that machines with greater flexibility typically require more advanced technology which requires higher skilled operators and maintenance staff. But these people are in short supply, so while flexible solutions are on the market, finding the right staff to install, operate and maintain them is going to be a challenge. CPGs are therefore calling for the next generation of machines to be easier to operate and maintain. While the machine functions will likely become increasingly complex, the operating systems and maintenance programs will need to be easier in order for them to run with a lower skilled workforce.

One interviewee commented:

> The real challenge is to automate in a simple way, because if operations become more complex, technicians and engineers with higher skill levels will be required to operate and maintain the machinery, so the problem won't be fixed. It will just be a different problem.

"We need to make it as simple as possible, as simple as an iPad or an iPhone. Everybody knows how to use those", one interviewee asserted, so ease of use is clearly seen as a crucial issue. OEMs are aware of the issues and are developing innovative solutions to make machines easier to run. For machine operators, color coding as simple as red/green buttons is being implemented on some PLCs. RFID tags allow operators to easily track raw materials and products along the production line, so they can troubleshoot potential issues. Where maintenance is concerned, CPGs are calling on OEMs for support and we have already seen innovations, such as machines which use automated messaging to suggest parts that need replacing and automatically order the correct part from the OEM, a process which puts less strain on the maintenance team.

Advancements in 3D printing make it a realistic investment opportunity

3D printing is beginning to play an important role in machine maintenance. It can help CPGs keep downtime and maintenance costs low by enabling them to print spare parts for their machines.

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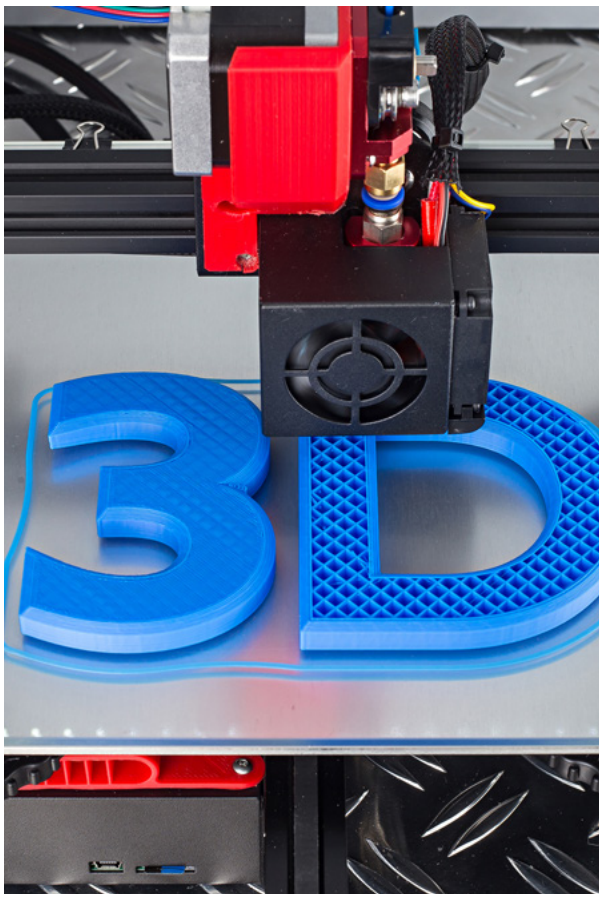
25% of CPGs use 3D printing in this way, and that figure is expected to increase to one third in the next three years.



The technology is often used to print non-moving parts which wear out quickly, such as rails, runners or wheels, but CPGs have also used 3D printers to produce end-effectors for their robots. It's a great solution insofar as it reduces the cost of parts, circumvents potential supply-chain problems and reduces lead-times, and means companies don't have to stock any inventory, saving on admin time and space. 3D printers are also commonly used to create designs and prototypes, saving time and money and having an immediate impact on the ROI for companies which have invested in the technology. It's a new technology and could hold huge potential for the future. As one interviewee put it:

> I don't think we've even touched the tip of the iceberg. I mean, we've got so much room left to learn on what we can actually utilize (3D printing technology) for.

The cost of 3D printing will continue to fall and therefore the adoption of the technology will increase. Affordable 3D printers can already print in metal and the future is likely to bring even more material options to market. With more CPGs and OEMs able to access 3D printers, flexibility in the industry as a whole will be increased. Parts will be available immediately rather than CPGs having to order them from OEMs, and OEMs will be able to customize parts as required for each client at very little extra cost.

Predictive Maintenance

Predictive maintenance is being touted as a solution to supply chain issues for parts

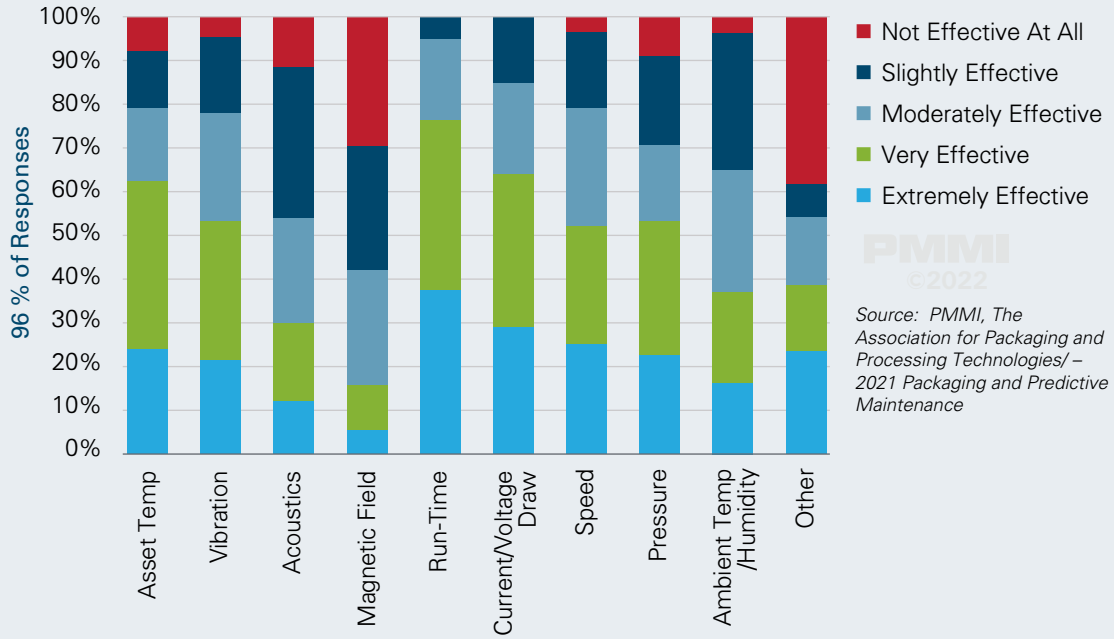
> Usually we don't find out anything is wrong until the thing breaks down and then a line is down and we've got people standing around and our maintenance guy is running around like crazy trying to fix it.

Effective machine maintenance is key to keeping a production line running smoothly. Historically, preventive maintenance, regular and routine maintenance of assets to keep them running and avoid costly downtime, was the order of the day, but this does not stop machines from eventually grinding to a halt as parts wear out. Data analytics have for several years been used to assess the operational condition of assets on a production line and many of them are connected to historians for the purpose of assessing machine performance, but many more are not, and the measurements being collected by existing plant infrastructure are not necessarily the ones needed to be most effective at performing predictive maintenance. This is why the emergence of 'smart sensors' a key category of hardware enabling full predictive maintenance is disrupting the market.

Smart sensors are typically small micro-electro-mechanical systems (MEMS) devices with integrated wireless communications and microprocessors, designed to be placed on existing infrastructure creating new points of asset measurement. They have emerged in the last 3-4 years largely as a result of MEMS technology dropping substantially in cost thanks to its broad uptake in consumer applications. What was cost prohibitive before is no longer so, and assets can be retrofitted and monitored in a way never previously thought possible.

Data collection and analysis has been a major innovation over the last 3 years, and it is having a serious impact on plant performance across the industry. The ability to understand where bottlenecks can appear in production lines and what the causes are for downtime have enabled CPG companies to increase their efficiency. A very wide range of data is available to be collected from most packaging machines, as can be seen in the figure below taken from PMMI's January 2021 report on packaging and predictive maintenance.

Types of Data OEMs and Integrators Feel Would be Most Useful for Predictive Maintenance



Source: PMMI, The Association for Packaging and Processing Technologies/ – 2021 Packaging and Predictive Maintenance

The data being collected can improve the efficiency of a line as well as the effectiveness of maintenance strategies. This is particularly important when we consider that

NEARLY

70% of CPGs consider that their packaging machines are either extremely, moderately, or slightly more likely to experience downtime when compared to other types of machinery.

Moving to a predictive maintenance program enables CPGs to be better prepared in terms of the parts they are going to need and when. With the times needed to source spare parts increasing, and in some cases being double what they were 3 years ago, this is becoming more important than ever. Forecasting when parts will be needed means CPGs don't have to resort to overordering parts or storing large amounts of inventory which only increases the scale of the supply chain issues. Using predictive maintenance technologies can also enable CPGs to keep machines running that are working well even if previously they would have been replaced due to their age. Predictive maintenance can therefore radically extend the lifetime of a machine - a clear cost benefit.

The success of this data revolution is pushing CPGs towards predictive maintenance as they have already seen the benefits that data can bring to other parts of their business.

CURRENTLY

43% of CPGs use predictive maintenance on their lines

83% have registered an interest in the technology

The difficulty employers are having finding skilled labor to fill maintenance roles will cause the use of predictive maintenance packages from OEMs to increase over the next 5 years. With skilled labor at a premium, predicting when machines are likely to fail is as important as it is less likely that maintenance teams will be able to attend immediately.

For their part, OEM maintenance teams see clear advantages to predictive maintenance along the Machines as a Service (MaaS) model. Such a set up can involve an OEM retaining ownership of packaging machines and charging the customer based on the successful operation of the machine. This incentivizes the OEM to minimize downtime and maximize machine lifetime. It involves pricing based on performance goals set between the OEM and the end user, such as the number of cases palletized. The upside for the OEM is it captures the customer in a longer-term, more complex contractual agreement, and, if that agreement is successful, increases the likelihood that the customer will further invest with the OEM.

It's worth noting that the pandemic caused stakeholders to put a strong focus on various forms of remote connectivity. One OEM commented:

> The least efficient way for us to do [Maintenance] is for [CPGs] to call us every time they think they need one of our tech chaps to show up. (Predictive maintenance carried out by us through remote data analytics) is the most effective way for us to monitor the machine, know and predict when it's going to require service, and determine if that service needs to be on site, or if we can do some things remotely and provide that service for them. But in order for us to do that, we need the data. We need to learn as an industry how customers want us to do this in a way which is respectful of their privacy, their data & their security.

Cybersecurity and data concerns are in fact a major obstacle to the use of remote access predictive maintenance packages. CPG companies (especially smaller companies) are hesitant to allow other companies access to their machine data due to cyber security concerns and the complexity of opening up a network to include another party often dissuades CPGs from investing in this technology. When asked about justifying investing a large slice of a budget in cyber-security, one respondent from an OEM commented: "When somebody hacks into your system or steals your information it can cost 10s of millions of dollars and it can shut down operations. We've seen this with oil pipelines and lots of companies that get hacked and it costs them a lot of money and it's very disruptive. But we're actively looking at those sorts of things".

That said, the issue of long term, high-tech remote support solutions, saving the time and expense incurred on in-person site-visits by maintenance people is important to end-users. PMMI's white paper on predictive maintenance mentioned above reported that

56% of respondents were using remote access in 2020 and/or were planning to invest more heavily in the technology in 2021

OEMs are listening to CPGs' concerns and are making efforts to innovate, with one variable speed drives manufacturer pushing encryption as a key feature on the drives they are marketing. Machines/networks that offer increased cybersecurity will be more attractive to machine buyers over the next 5 years with cybersecurity risks being critical to every purchase decision being made by CPGs.

Robots and Cobots

Robots are emerging as a key automated technology

Increased use of robots and robotics is mentioned as one of the next big things that will happen in automation over the coming 5 years. In our 2022 publication 'Robots and Cobots – An Automated Future', we reported a surge in installations of robots in 2021 in North America, with 39,708 units sold at a value of $2 billion. This was a new record: it was a 14% increase over the previous record year, 2017 and it was a 28% year-on-year rise over 2020. 58% of these sales went into non-automotive sectors, and the food and consumer goods sectors saw a 29% year-on-year rise. It was further reported that the North American market is projected to grow by 10% each year up to 2024. CPGs expect the use of robots to become widespread across the industry in all segments. One major area ripe for robotics, for example, is quality control where robots are deployed to check that weights and labels are correct. But the technology has the potential for many other uses.

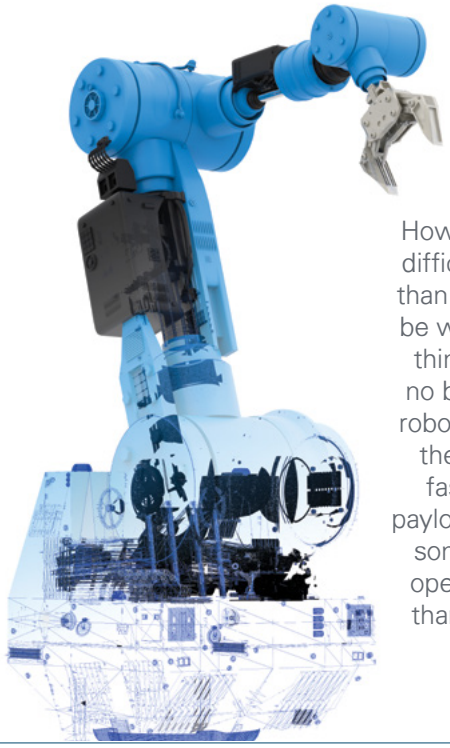
Robots, data and analytics are indeed the technologies which have had the biggest impact on plant performance over the past 3 years. Robots have increased consistency and accuracy in plants and have been vital in keeping lines running when staff availability has been poor. They are seen as the best fit for helping to resolve labor issues. But cobots tend to lack the speed CPGs need.

OVERALL

OVER **90%** of CPGs think that robots and cobots (with the emphasis on robots) have helped to address labor shortages in their plants

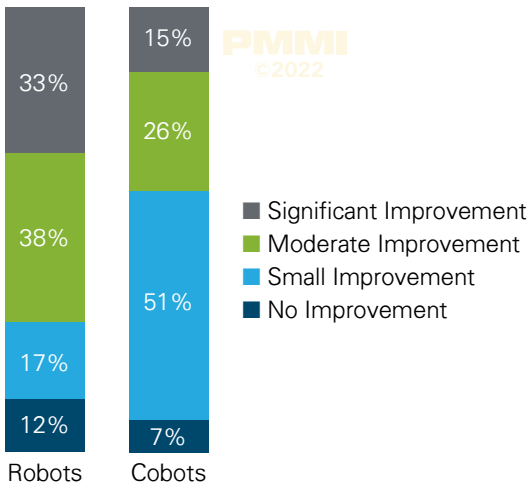
WITH **70%** of them saying that robots could have a moderate or significant impact on the problem

OVER **50%** of CPGs think that cobots could only have a small benefit or no benefit to addressing these shortages



However, robots are more difficult to install in a plant than cobots, and this could be why more respondents think robots would have no benefit. The benefit of robots is that, once in situ, they can operate much faster and with higher payloads than cobots which some CPGs say actually operate at a slower pace than manual processing.

To what degree can robots and collaborative robots (cobots) help address labor shortages in your plants?



Source: PMMI, The Association for Packaging and Processing Technologies – 2022 The Future of Automation

Flexibility is the watchword for many CPGs, though, and here the cobot has a distinct advantage over the robot. Cobots are easier to install on an existing line and they do not take up as much space. This is important because space is at a premium for large numbers of CPGs as they often operate in smaller or older buildings, and it is clear from CPGs that future developments in robotics will require smaller robots that can cope with higher payloads and operate in constrained spaces. But despite issues around size, the focus for many companies is on robots due to the speed and weight limitations on cobots. However, advances in technology mean that cobots are increasingly able to deal with higher payloads, though the cost of these larger cobots has not fallen as much as that of smaller payload models.

Mobility will also be a key factor over the coming years, as demands for flexibility on production lines grow, and mobile collaborative robots will increasingly be seen as the go-to solution for CPGs. PMMI has previously reported that

AROUND **27%** of CPGs currently deploy cobots in their plants

This figure is projected to rise to **57%** over the next 5 years

Mobility is being achieved by mounting the robot arm on an autonomous guided vehicle/ autonomous mobile robots (AGV/AMR) so as to give the manipulator mobility and flexibility. While the combined cobot/AMR emerged a few years ago, this particular solution has not yet found a mass application in industry. The main barrier here is that realizing the collaboration between the functional components (autonomous mobile robot base, a collaborative robot arm, an industrial camera, end effector, etc.) has been technically challenging and brings additional cost. But Interact Analysis forecasts that in 2026 over 10% of the industrial robots market will be taken up by mobile cobots. In the initial stages, the mobile cobot was developed mainly by enterprises with both mobile chassis and cobot production capabilities, such as Omron and Siasun, or by integrators purchasing mobile chassis and collaborative robot arms for customized assembly.

In recent years, the joint development of mobile robot companies and collaborative robot companies has gradually become a trend. At present, the mobile collaborative robot business model is dominated by mobile robot manufacturers, accounting for nearly 70% of the market. Collaborative robot manufacturers also develop their own products that specifically meet the needs of end-users. These customized solutions account for about 10% of the market. Customer-facing integrators also take a slice of the market, tailoring their solutions according to the needs of the project in hand.

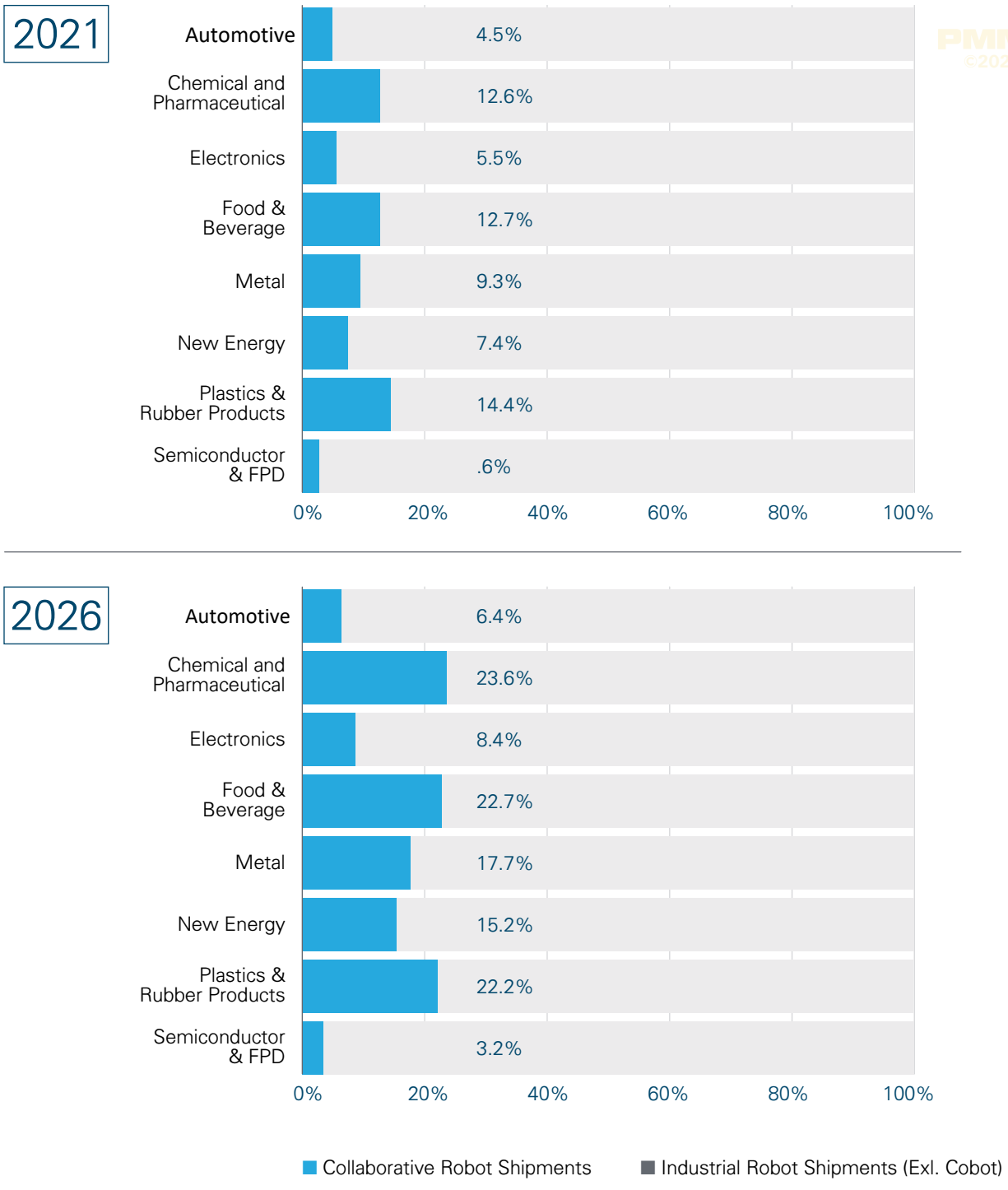
SMEs are increasingly taking an interest in cobots owing to the low capital outlay required when compared with industrial robots. As costs continue to decline, we're seeing increasing deployments of the technology by these smaller companies. Their high degree of mobility and flexibility and their ease of use are particular draws for SMEs who often do not possess the skill sets to operate more sophisticated robotic applications. Whilst we rarely see SMEs investing in whole lines of integrated robotic machinery, what we do see is gradual automation of lines as SMEs experiment with new flexible and modular collaborative robot technologies. Likewise, bigger companies are attracted by the competitive pricing of cobots, and their ease of use, but the main attraction of these small robotic solutions for larger CPGs is that much vaunted flexibility which cobots, particularly mobile cobots, afford.

Future developments in cobot technology are likely to center on speed of operation, their slowness being a factor currently hindering their adoption by CPGs. It's all about safety vs productivity: i.e. how to increase the speed of a cobot, designed to work alongside human operatives, without compromising on safety. If this can be achieved, CPGs installing cobot solutions would see a greatly improved ROI. The expected route to success is through AI applications, among them, intelligent vision technology that allows a cobot to slow down when the machinery gets too close to a human or another obstacle. Vision systems are already in place on a range of machines currently in use at packaging and processing plants. 2D vision systems are used on packaging and palletizing machines and 2.5D vision sensors are used on layered bin picking machines.

As already happens in the automotive industry (often a trail-blazing sector where the development of machine vision technology is concerned) 3D vision could be used as a safety mechanism in CPG settings as a means of increasing speed of operation. While this technology is currently too costly to implement on a wide scale, the cost will

likely decrease as its use becomes more widespread and economies of scale are achieved. This will likely blur the lines between cobots and robots to the point where in the future they are unlikely to be considered to be two distinct robotic technologies as they are at present. The challenge is going to be developing vision systems that can cope with motion with a high level of accuracy, at speed. These systems exist in the automotive sector, but they are expensive. As the use of sophisticated vision technologies continues to broaden, the cost will reduce and they will become easier to integrate into current systems.

Shipment Share by Industry – Collaborative Robots vs. Industrial Robots (Excl. Cobot)



Source: Interact Analysis – Industrial Robots May 2022

Conclusion:

The future of automation may be more about relationships than technology

CPGs are recognizing the need to source equipment from closer to home

> Whenever we can, we buy equipment that's made in the US or has a huge presence in the US so that we know that parts are available here in the United States and we don't have to wait for them to come from Germany or Italy or someplace. That's a key factor in selection. But we just recently bought a new piece of equipment that's foreign made, but it's assembled in the US and the parts are not proprietary, so pretty much everything on this machine we can get from several different vendors. Some of the stuff that was here when I got here, a majority of it, it's all proprietary and we won't buy anything that has proprietary parts at this point in time.
>
> *— Manager, Food Processing Company*

The pandemic appears to have concentrated the minds of CPGs, and the thinking around globalization is changing, with companies starting to look for domestic suppliers offering a more secure service. A CPG food manufacturer made the point that, in the past, the idea that a 30% saving (for example) on capital outlay could be made by purchasing a piece of custom machinery from China was highly attractive. But the disruption to supply lines caused by the pandemic, notably the shutting down of Shanghai, a key global trade hub and the world's largest container port, and the Sino-US trade wars have made CPGs ask if these savings are worth it. Re-shoring, or at least purchasing equipment from sources closer to home is a hot topic currently. Lead times, which can be as much as 12-18 months, have caused CPGs to consider other suppliers for parts and machines who previously wouldn't have been considered. The number of machine builders and suppliers of parts that CPG engineers are aware of has increased over the last few years and they all now have closer working relationships with more machine builders than ever before.

"Anything we're adding, we try to make sure that there's availability in the US, there's a lot of equipment in this plant that comes from overseas," said one CPG Food Manufacturer. Furthermore, whereas CPGs might have previously relied on one supplier, it's now considered essential for manufacturers to ensure they have multiple suppliers for machine parts owing to the unpredictability of lead times. CPGs need to be able to plan ahead and rely on concrete deadlines. It's no good if a part or a machine is due to arrive in 3 months, then when the 3 months is nearly up, notification arrives that it will be another 2 months. CPGs are seeing the need to hold other suppliers in reserve.

Partnership and collaboration between CPGs and OEMs is replacing the purely transactional relationship, to the benefit of all.

> We don't need somebody to come and sell us their latest piece of technology and then walk away and go on to the next customer. We want to buy from somebody who will train us. We might not get it right the first time or the second time but if we can get a partner who is going to stick with us and invest their time in helping us get it right, that's the one I'd go for.
>
> *— Manager, Global Personal Care Company*

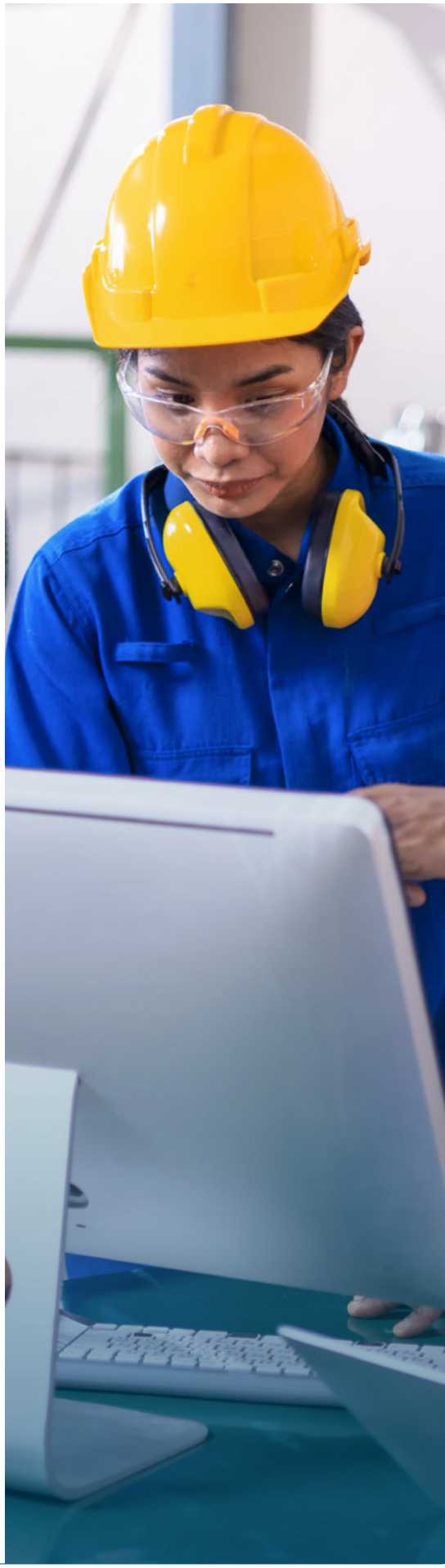
The disruption to markets which we have seen in recent years caused by the pandemic and the ensuing supply chain problems and labor shortages have pushed CPGs to recalibrate their relationship with OEMs and reset their priorities when they are investing in new machinery. Factors such as locality and lead times have already been mentioned, but a deepening of relationships between CPGs and OEMs is happening. Partnerships and longer-term contracts and training offerings are particularly growing in importance. OEMs are increasingly taking these factors into consideration when formulating their offers to CPG companies. A mid-sized OEM commented,

> Labor shortages are putting a greater burden on us as OEMs to not only simplify the equipment to make it more user friendly and more maintenance friendly. But we're also forced now to do much more hands on work to support our customers so that they can run their lines.

Previously, price/ROI would have been the number one (or close to number one) consideration when companies were choosing a supplier or a machine. But the age of the transactional relationship between the CPG and the OEM is giving way to one of collaboration, support and cooperation. As a stakeholder in a CPG put it:

> A typical procurement evaluation would look at the vectors of price and technology, aftermarket costs and the total cost of ownership. But we've now added partnership opportunities as a key consideration.

Both CPGs and OEMs see significant advantages in establishing binding links through longer-term service contracts, Machinery as a Service (MaaS), longer warranties and enhanced training services, for example. CPGs are also calling on OEMs to be conscious of the whole product processing/packaging process rather than of just their specific automated spot of the process. With reduced availability of high level skills, CPGs are increasingly turning to OEMs for leadership in terms of planning and operation of plant.



Over the next 5 years training will play a larger role in the relationships between OEMs and CPGs

The operation of automated equipment on a production line requires skill. The likely long-term shortage of higher skill-levels among the workforce available to CPGs is a challenge and

WELL OVER **90%** of CPGs would like to see enhanced training offerings from OEMs.

One trend among OEMs has been to offer training through continuous preventive maintenance agreements, as well as service agreements, where their engineers visit production lines on a regular basis to make sure that machines are operating at optimum performance levels. When the engineers are in attendance, they provide on-the-job training to the production line staff, enhancing their skill-levels so they become experts on their machines.

Additionally, some OEMs are beginning to offer remote solutions in this area. Innovations and technologies in the field of training that were largely forced on companies during the pandemic such as remote learning, wearable technologies and augmented reality are increasing in use. Although the pandemic is no longer a driver, skills shortages in the industry mean that OEM support teams are continuing to use these solutions to save on their use of human resources and reduce their own travel time and costs. As is so often the case in the field of automation, the key to how these technologies will develop and be used is simplicity. Currently innovations like wearable AR glasses are often too complex for those using them but AR technology via a smart phone or tablet could well become the preferred option.

One representative from an OEM remarked that Industry 4.0 has really helped their company with training and support by enabling augmented reality training, remote diagnostics and remote connection.

> “We’ve taken a leadership role in that because we’re saying that if we can (be immediately responsive) from 10,000 miles away rather than sending somebody there, it’s going to save time and money, and make a better partnership.

But remote training does have limitations and often it takes engineers longer to learn things than they would with face-to-face training. However, OEMs are aware that without remote learning and support services they will not be able to support all the CPGs they need to, due to their reduced number of skilled technicians. So the solution is a support package which offers a mix of remote and face-to-face training. This eliminates some of the perceived drawbacks of a uniquely remote package, such as the impersonal nature of remote training, given the absence of human contact, the barriers to communication which it may generate, and the additional training which instructors and trainers may need to undergo.

A final thought

There are lots of conclusions that can be drawn from the findings we present in this report. Perhaps the key one is that in the fast-evolving consumer landscape, production issues center around speed, efficiency and flexibility; while key production line maintenance and training issues focus on establishing a deep partnership between the CPG and the OEM. It is clear that automated technology has a pivotal role to play in every aspect of this.

Glossary of terms used in this report

CPG – Consumer Packaged Goods Company

D2C – Direct to Consumer

DSD – Direct Store Delivery

D2S – Direct to Store

MaaS – Machinery as a Service

OECD – Organization for Economic Cooperation and Development

OEM – Original Equipment Manufacturer

ROI – Return on Investment

SMEs – Small- & Medium-Sized Enterprises

Appendix A

119
Respondents

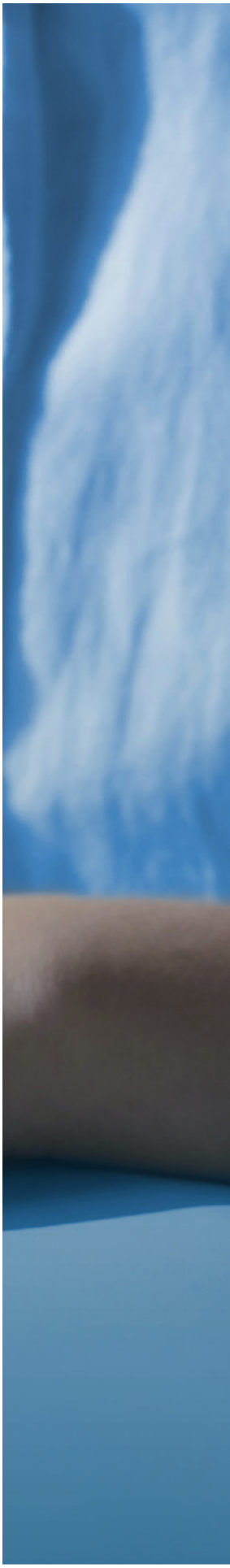
105
CPG Companies

Methodology

An online survey was distributed by PMMI to engineers, managing directors and CEOs at a range of different CPG (Consumer Packaged Goods) companies in the USA.

After data cleaning, 119 respondents completed the survey in full and represented 105 different CPG companies based in the USA. A large proportion of the respondents operate in the food industry (60) with other respondents operating in pharmaceuticals (17), Beverages (12), Personal Care (8), Chemicals (7) and other end user sectors (15). The majority of respondents work in company's who employ more than 500 people (65).

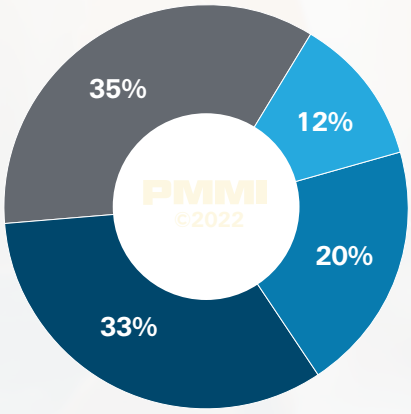
The survey was developed based on 6 initial qualitative interviews with CPGs who helped frame the focus for the questionnaire. Subsequently additional qualitative interviews with CPGs have been conducted and some of the observations and commentary draw on findings from those discussions.



CPG Plant

Findings relating to CPGs current plant operations

For the plants you are responsible for, what percentage of the production line falls into the categories below?



- Highly Advanced Automation Technologies
- Networked Machines
- Semi-Automatic Machines
- Processes or Production Lines that are Highly Manual

OBSERVATIONS

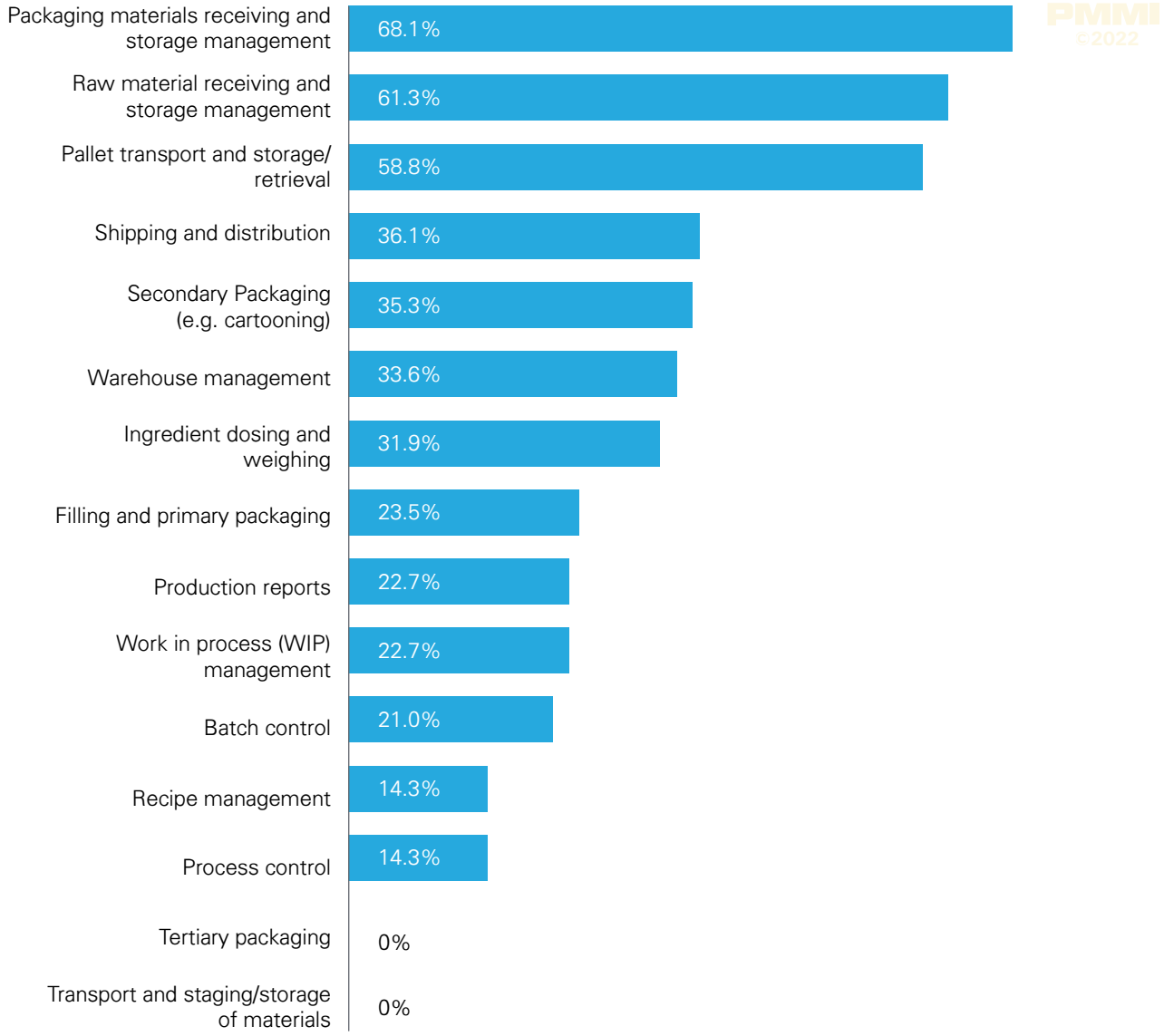
> Highly advanced automation includes technologies like: Cobots, Mobile Robots, AI, Digital Twin, Augmented Reality and IIoT.

> This chart shows, **on average**, what proportion of respondents' production lines fall into each category.

> Over 2 thirds of the production lines are highly manual or semi-automatic and require at least some manual input. **CPGs are highly reliant on labor and manual processes.**

> Only a tenth of production currently uses advanced automation technologies.

Which areas/tasks are still highly manual in your plant(s)?



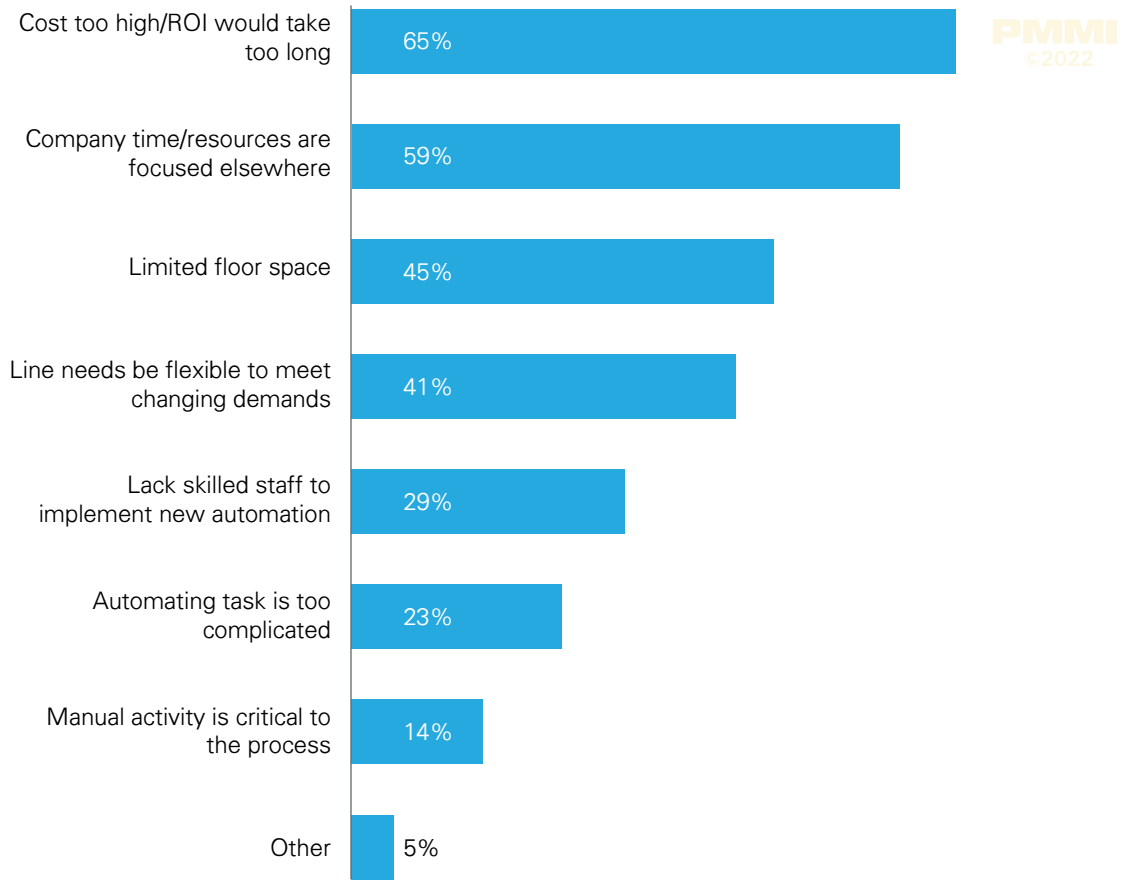
OBSERVATIONS

> Operations relating to **storing and retrieving materials, pallet transport and distribution** are the most likely to still be highly manual across a range of CPG companies.

> With the industry struggling to cope with a shortage of **labor, automation is a necessary** solution that can help CPGs combat this challenge during the 'end of line' processes.

Why haven't those areas/tasks been automated?

Respondents were asked why processes that are still highly manual in their plant have not been automated. Respondents could select multiple answers.



OBSERVATIONS

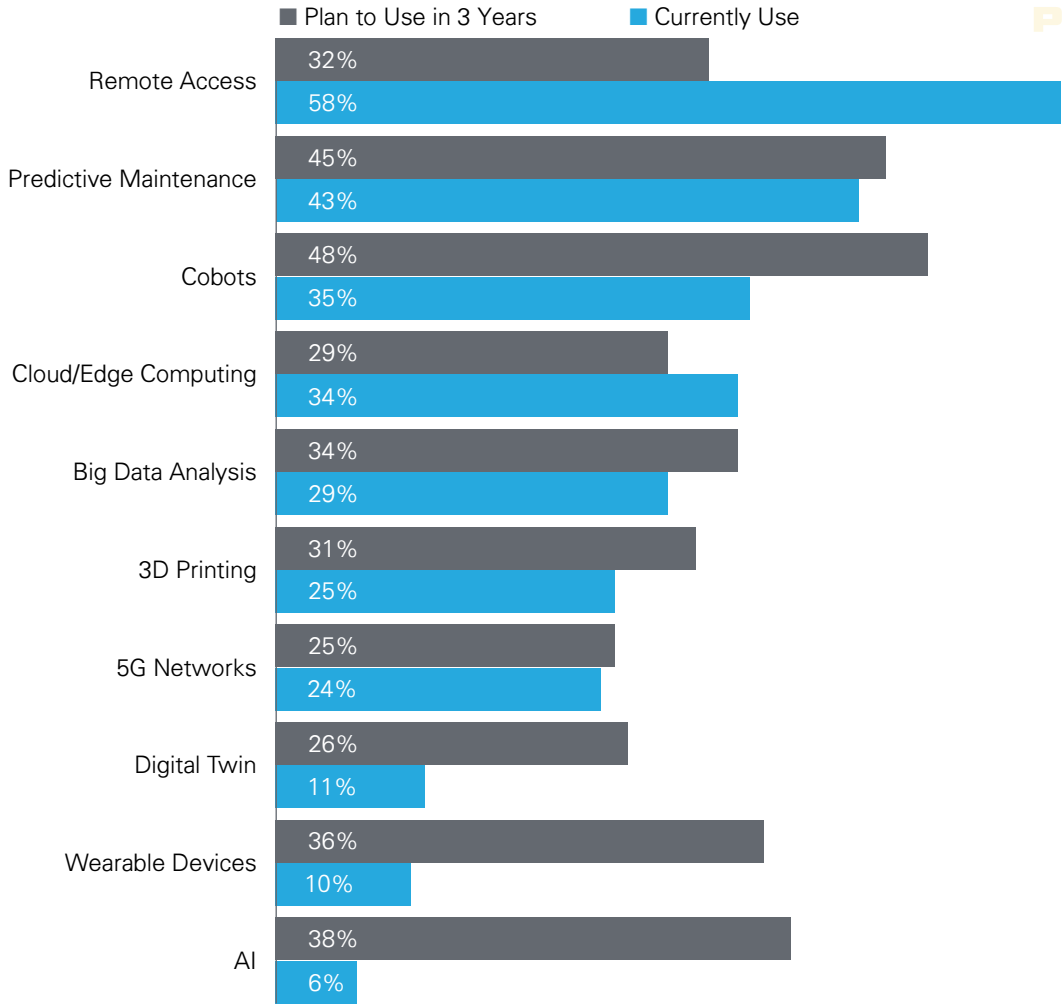
> Most CPGs think their organization **have the skills** to implement automation technologies and that it is **not too complicated** to automate these manual tasks.

> The major barriers to automation are **cost and time/resources**. Labor shortages are driving up costs and taking senior leaderships focus which leaves less time to consider automated solutions and their implementation.

> For nearly half of CPGs in the US, floor space limits their ability to automate.

> Flexibility is also an issue with this growing in importance over recent years with the pandemic creating the need for companies to respond quickly to changes in the market.

Select the automation technologies that currently use, or plan to use in the next three years.



OBSERVATIONS

> **Predictive Maintenance is growing in popularity** and use with 43% of CPGs currently using it and 45% planning to use it in 3 years time. The benefits are seen to be reduced downtime with spare parts difficult to get hold of.

> Interestingly 48% of CPGs say they are **planning to begin using cobots in the next 3 years.** The benefits of a cobot relating to flexibility make it an ideal solution in plants with limited space for automation.

> **Nearly a third of CPGs are looking to invest in 3D printing** over the next 3 years. Uses of 3D printers range from designs and prototypes to printing parts for machines.

Over the last three years, which technology has had the most significant impact on your plant's performance, and why has this technology been so successful?[1]

DATA COLLECTION & ANALYSIS

Collecting data and understanding the root cause of that downtime.

Our productivity tool has impacted our performance by providing real time data to the production team.

Data and analytics - driving use of technology and accountability while reducing unnecessary tasks.

22 Responses

ROBOTS

Focus on robotics. This has increased the ability to repeat processes consistently from run to run.

Robotic packaging equipment because it has automated this station and removed a large amount of the labor used in this area of packaging.

22 Responses

CONNECTING & NETWORKING MACHINES

Networking integration of the machines. Being able to see what is going on with the machines.

Our case printers being hooked up to our network for easy access to upcoming jobs.

12 Responses

Over the last three years, which technology has had the most significant impact on your plant's performance, and why has this technology been so successful?[2]

PREDICTIVE MAINTENANCE

Predictive Maintenance. It's helped reduce downtime and lessen worker frustration

Predictive maintenance, because unexpected failures can be very costly.

9 Responses

WAREHOUSE AUTOMATION

End of line automation - Cobots, robots, autonomous MHE, etc. It is fairly easy to develop ROI and it is easy to see and conceptualize for Sr. Management.

Robotic palletizing - much higher reliability, lower costs

9 Responses

COBOTS

Cobots made a huge difference in how my company package large orders. Removing a good deal of the manual work that can easily be automated.

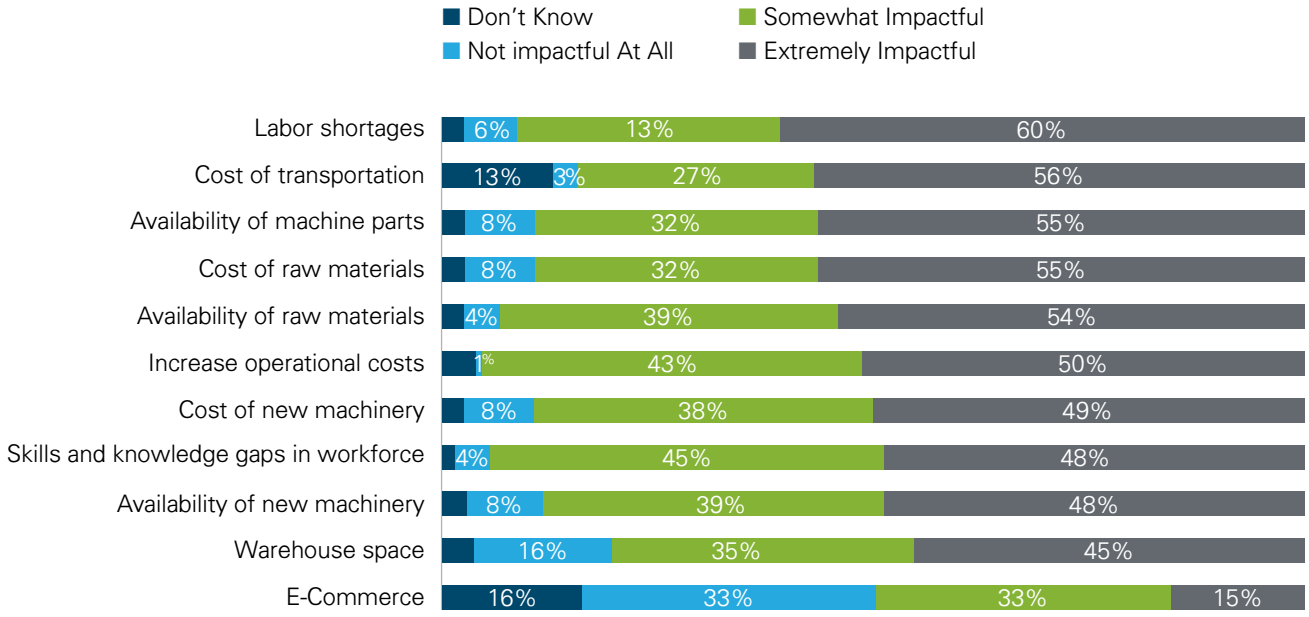
Collaborative robots have been key. We have confined workspaces (old plant not designed for automation) and the collaborative robots have been a serious improvement for us.

8 Responses

Industrial Challenges

Challenges Facing CPGs

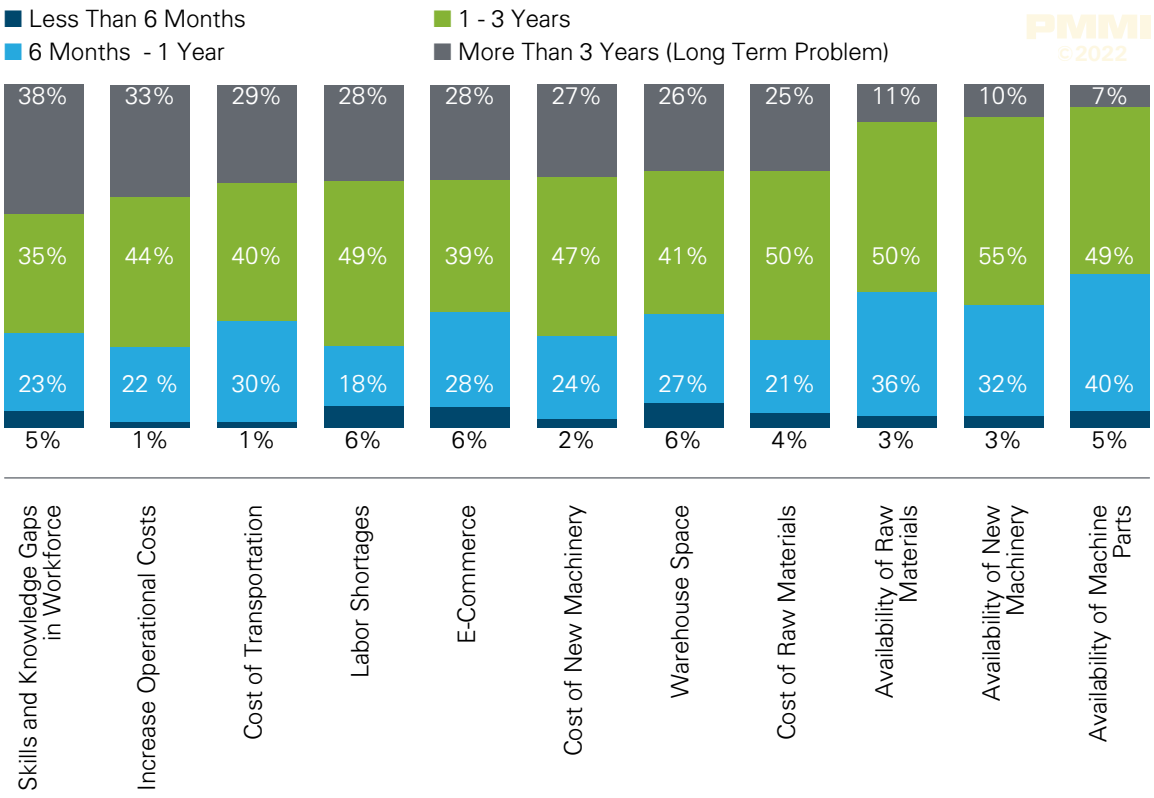
How are these industry challenges impacting your company right now?



OBSERVATIONS

- CPGs are being impacted by nearly all of these challenges.
- **Labor shortages are the number one** issue right now that is having the biggest impact on operations. 90% of CPGS say this is impacting their company.
- Labor shortages, cost of transportation, availability of machine parts, cost/availability of raw materials and increase operational costs are all having an extreme impact on more than half of CPGs.
- **Increased operational costs are impacting everyone** with only 1% of respondents saying this will have no impact.
- Limited **warehouse space is impacting 80%** of CPG companies.

How long do you anticipate these issues continuing?



OBSERVATIONS

> CPGs expect all of these challenges to still be around in 6 months time and the majority expect to be facing them in over a year's time.

> **Skills/knowledge gaps, cost of transport and increased operational costs are the most likely to be seen as long-term problems.**

> The issues CPGs are facing with availability of machine parts is largely seen as a short-term issue which will be resolved over the next 3 years.

Impact and length of challenges facing CPGs

HIGH IMPACT AND LONG-TERM PROBLEM

- Availability of Machine Parts
- Availability of Raw Materials
- Cost of Raw Materials
- Cost of New Machinery

HIGH IMPACT AND SHORT-TERM PROBLEM

- Labor Shortages
- Skills & Knowledge Gaps in Workforce
- Cost of Transportation
- Increased Operational Cost

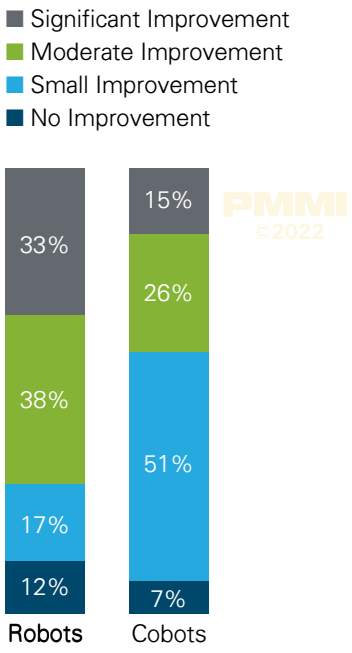
LOWER IMPACT AND SHORT-TERM PROBLEM

- Warehouse Space
- Availability of New Machinery

LOWER IMPACT AND LONG-TERM PROBLEM

- E-Commerce

To what degree can robots and collaborative robots (cobots) help address labor shortages in your plants?



OBSERVATIONS

> Over 70% of CPGs think that **Robots could have a moderate or significant impact** on addressing labor shortages in their plant.

> Over 50% of CPGs think that **Cobots could only have a small benefit or no benefit** to addressing labor shortages.

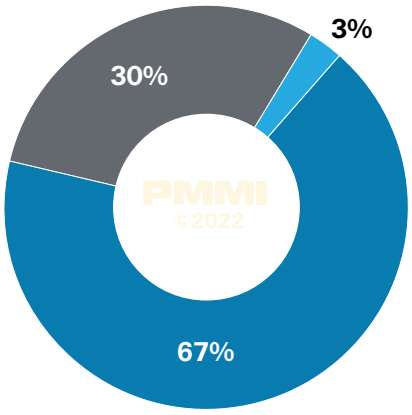
> Robots are often seen as harder or more complex to implement in a plant than cobots which could be why more respondents think robots would have no benefit. However, once implemented, **robots can operate much faster and with higher weights** than cobots which some CPGs say are slower than manual processing.

> Plants are likely to be looking to invest in robotic solutions to "address" labor shortages over cobot options.

Investment Trends in Automation

How CPG spending on automation is changing

How has your company's spending on automation changed in the last three years?

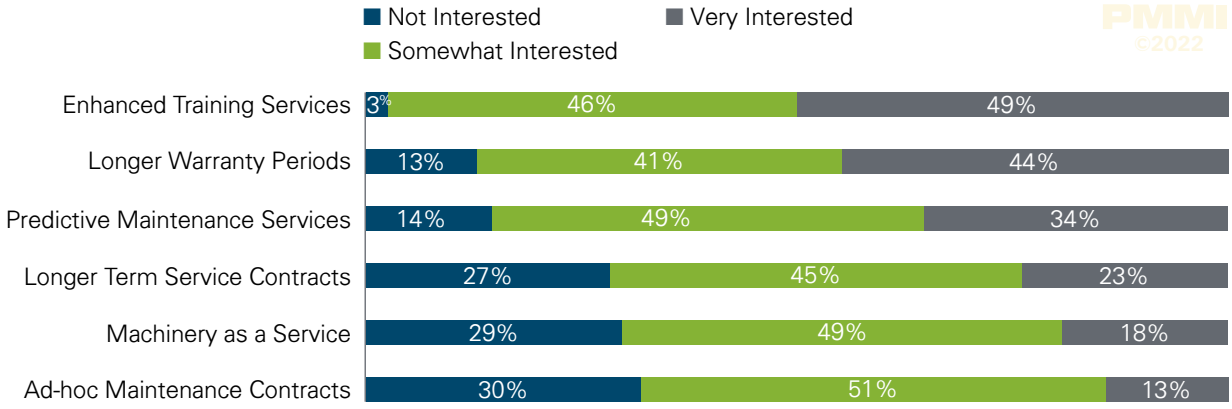


OBSERVATIONS

> Two thirds of CPGs have increased spend on automation over the last 3 years. Almost none have reduced their spend.

> This is likely to have been driven by labor shortages and the increasing cost of labor as well as the pandemic forcing companies to look at remote and flexible working options.

Which of the following services would you like to see more from Machine Builders?



OBSERVATIONS

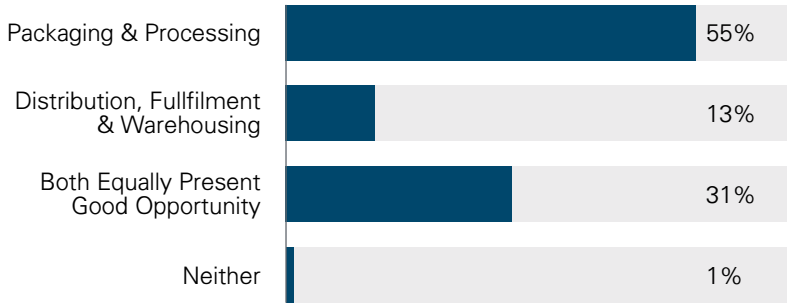
> **97% of CPGs would like to see enhanced training offerings from machine builders.** This is likely due to the expected long-term impacts of skills gaps and labor shortages. Some OEMs are beginning to innovate in this area with Augmented Reality and wearable technologies being used for remote training and support.

> Interestingly **86% of CPGs are interested in predictive maintenance** services and currently only 43% use some sort of predictive maintenance. Predictive maintenance is seen as a potential solution to supply chain issues facing CPGs for machine parts.

Opportunities for Automation

Where the best opportunities are for automation & how automation will impact the warehouse

Which of these present the best opportunity for advancement through automation at your company?



OBSERVATIONS

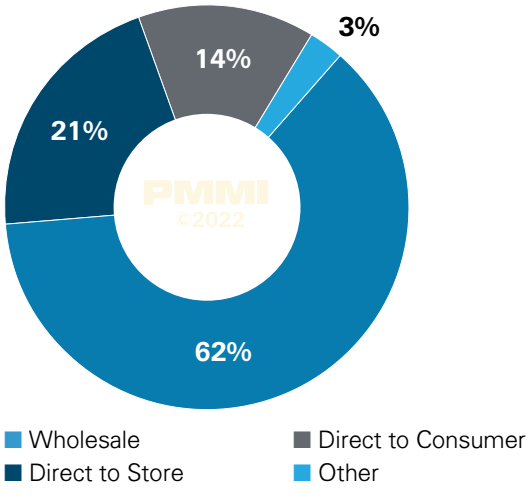
> **55% of CPGs state that the Packaging & Processing area of their plant presents a better opportunity** for advancement through automation than Distribution, Fulfilment & Warehousing.

> **Interestingly processes related to distribution, fulfilment and warehousing are typical the most manual** areas of plants which would suggest they offer more opportunity.

> CPGs tend to focus on Packaging & Processing when investing their budgets dues to existing knowledge and the skillset of their workforce

> Some respondent bias could have impacted this result as the survey was distributed by PMMI who are seen as having a vested interest in packing & processing automation.

What proportion of your output currently ships through these channels?



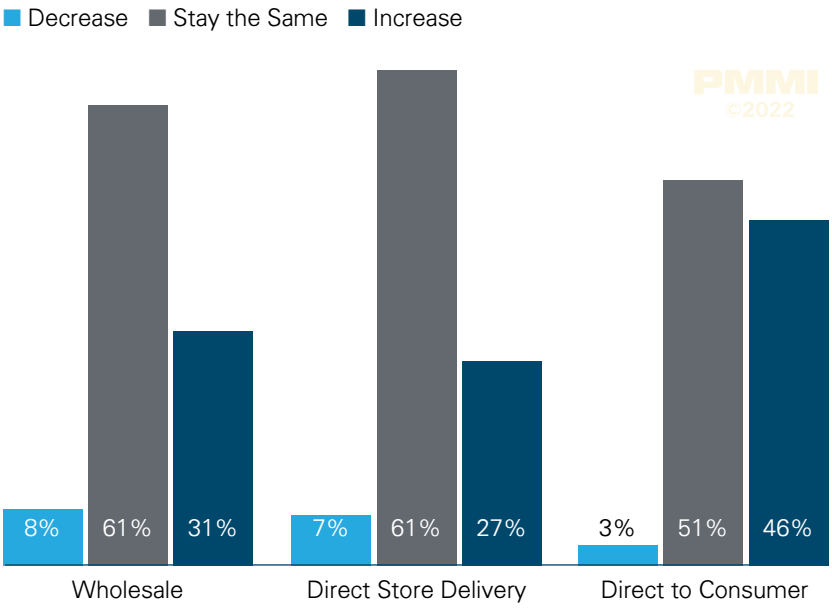
OBSERVATIONS

> Wholesale remains the most common shipping channel and accounting for over 60% of output on average.

> Direct to Store and Direct to Consumer shipping currently account for around or less than a fifth output each.

> **E-commerce is creating a drive towards more Direct to Consumer shipping** which could create challenges for automation.

How do you see these [shipping & distribution] outputs changing over the next three years?



OBSERVATIONS

> Around half of CPGs expect to see changes to some element of their shipping and distribution outputs over the next three years.

> The largest increase is expected to happen in Direct-to-Consumer shipping where a drive towards e-commerce is pushing CPGs to develop online sales platforms and **ship straight to their customers.**

What do you think will be the next big thing in automation?

ARTIFICIAL INTELLIGENCE & SMARTER MACHINES

Artificial Intelligence to learn and know how to maintain operation of a packaging line.

Improved smarter automation, that will have less downtime.

Automation with increased AI abilities.

13 Responses

AUTOMATED WAREHOUSE & DISTRIBUTION

CPG's shipping formats to support Micro Fulfillment Centers.

Finding a way to automate very random D2C shipments. Packages with many different size items.

Increased use of automatic guided vehicles for warehousing.

13 Responses

INCREASED USE OF ROBOTS

Robots and guided vehicles.

Additional robotics.

11 Responses

FLEXIBLE AUTOMATION

Adaptable machines that do more than one unit operation.

Flexible line with multipack capabilities. Continuous vs batch production.

Flexible case packing and palletizing.

10 Responses

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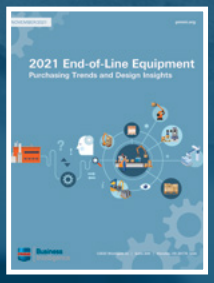

End-of-Line Equipment

Key Challenges for Packaging and Processing Operations

Beverage Trends Driving Change