Trends in Remote Services & Monitoring

PMMI { **Business Intelligence**

CONTENTS

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. Interact Analysis 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. 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 method.

METHODOLOGY

For the purpose of this report, an online survey was distributed to gather insights from 144 VPs, CEOs, and Engineers at end-user companies, including contract packaging/ manufacturing and CPGs, and 36 OEMs based in the USA. A series of in-depth, semi-structured interviews were also conducted with industry experts working at both end-user companies and packaging machinery OEMs. Experts from Interact Analysis employed their wealth of experience and knowledge relating to remote services and monitoring to analyze the results and provide further context.

Introduction

The term **remote services** refers to a set of services and tools that can be used by end-users to support their operations remotely, either internally or through a connection with equipment suppliers. This requires consumer packaged goods companies (CPGs) to allow remote access into their plants so that end-user staff and equipment suppliers can interact with machinery or offer support. A variety of methods are utilized, such as real-time video streaming and augmented reality, to deliver support when it is needed, rather than having to wait for costly in-person appointments.

This paper explores a range of remote services, including:

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Virtual Factory Acceptance Tests (FATs)	Through the use of video conferencing software and streaming, equipment suppliers can use a hybrid model where videos are streamed remotely to end-user customers to check packaging equipment and machinery meet their specifications, in conjunction with a team of 2-3 representatives that are on site. This process is recorded and can be submitted with documentation.
Remote support	Used when there is a problem that cannot be resolved by an end-user's internal team, and they require additional assistance from equipment suppliers. It can range from a telephone or video call to augmented reality, providing detailed support from OEM technicians remotely.
Remote commissioning	The use of video conferencing software and streaming at end-user plants to perform commissioning via remote instructions and support from the equipment supplier. As part of remote commissioning, Site Acceptance Tests (SATs) are sometimes completed using a hybrid model with only 2-3 representatives from the OEM present on-site and the rest participating remotely.
Remote training	Equipment suppliers can provide training to end-user technicians and operators remotely through the use of various tools, without the need to visit the plant.
Remote monitoring	Assists in analyzing the performance, status, and behavior of the machine from a distance. IoT (Internet of Things) technology and cloud computing are employed to track the performance of devices, both internally and by sending data to equipment suppliers.
Predictive maintenance	An advanced form of machine monitoring which involves monitoring a machine or component to determine when it is likely to fail in order to take action to prevent unplanned downtime.
Preventative maintenance	Regular and routine maintenance of a machine or component to keep it running and prevent unplanned downtime from unexpected failures.
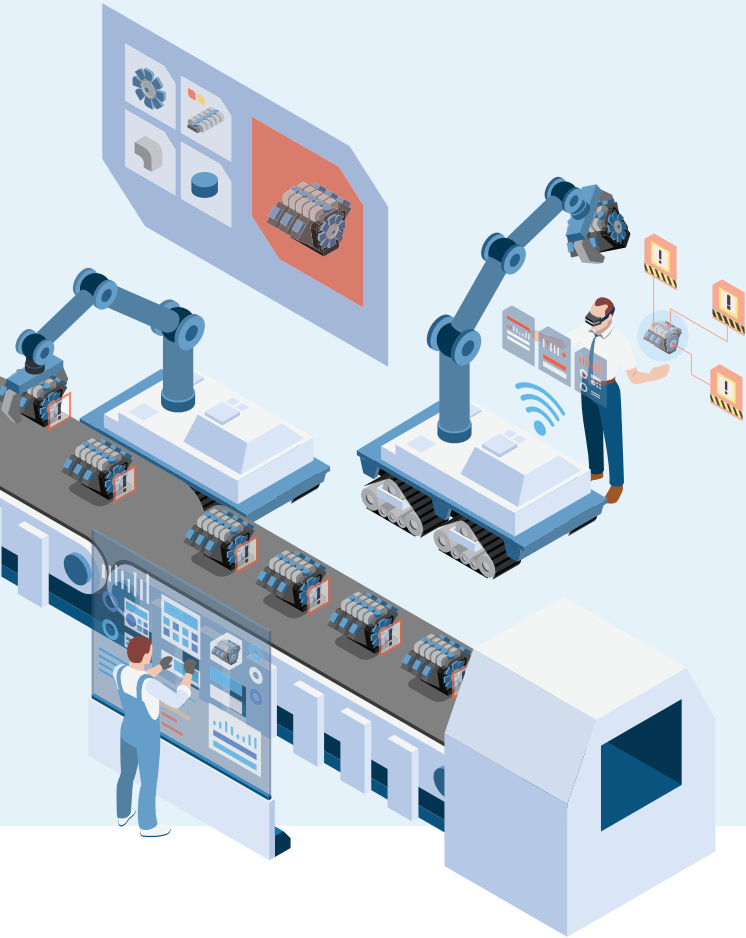
This report assesses current use of remote services by end-users following the Covid-19 pandemic, examines what attributes are most important in driving end-user investment in remote services and monitoring, and explores the barriers to this investment. It also looks at end-users' attitudes to remote in-person support and training and investigates the potential for remote services to mitigate the impact of skills gaps in the workforce, alongside the role remote services and monitoring technology is likely to play in the future of end-user operations.

▸ How are end-users choosing to use remote services?

Use of remote services by end-users has risen sharply in recent years, driven in part by the effects of the Covid-19 pandemic and skills shortages within the industry. As the representative of one large beverage CPG said of the company's increased use of the technology, **"Covid forced us to get used to it."** We were interested to see if this trend has continued since the pandemic or if end-users are choosing to return to traditional, in-person services. Our survey found that 54.1% of end-users have increased their investment in remote services and monitoring in the wake of the Covid-19 pandemic (since the beginning of 2021) through to today.

End-users in our interviews mentioned that many technicians and operators who had been in the packaging industry for decades retired during the Covid-19 pandemic, resulting in many end-users employing a more inexperienced workforce, which caused businesses to rely on OEM support much more. One respondent to our survey from a large food CPG explained,

> It's been very difficult to find qualified operators and technicians, and we have a lot of open positions and [we have] lost a lot of skill since Covid.

Many end-users saw the benefits remote services can provide to their operations during the Covid-19 pandemic and have continued to request remote assistance from their suppliers. More than three-quarters (75.8%) of OEMs surveyed stated they have increased their investment in R&D related to remote services and monitoring, indicating they are developing their existing remote capabilities and looking for new ways to provide customers with a better service.

Which remote capabilities are end-users seeking?

In 2023, the remote service utilized by the highest number of end-users is remote support, with more than half (55.1%) using it at their plants (Figure 1). This provides them with immediate technical support from their equipment suppliers, rather than having to potentially wait days for an end-users technician's visit. Remote support is the service with the clearest value to end-users and, with skills gaps worsening, it is expected that they will continue to rely on it. As a result, those OEMs best equipped to provide a high level of remote support will be the preferred choice of end-users, with one end-user saying they are getting insufficient support from their OEM and so are looking to use an external IT support company to help them with controls issues.

Figure 1. The proportion of end-users currently utilizing each remote service, which remote services they plan to implement into their plants by 2026, and the proportion of OEMs which are currently offering each remote service to their customers.
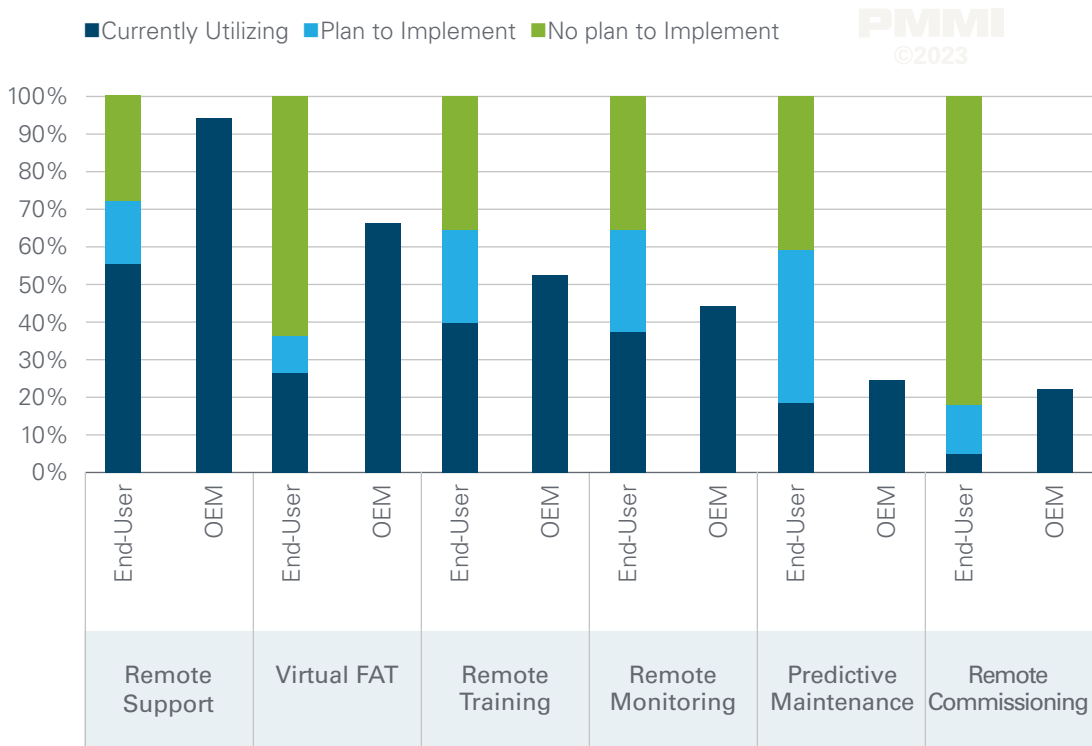
▶ Remote support came out on top as the most popular remote service at present.

However, not all remote services are as valued as remote support, with only 26.5% and 5.2% of end-users currently utilizing virtual FATs and remote commissioning, respectively (Figure 1). Many end-users believe that people need to be present to properly assess equipment in order for these processes to be effective.While virtual FATs were carried out using a hybrid model out of necessity during the Covid-19 pandemic, where in-person representatives were fewer and used in conjunction with remotely streamed videos to carry out the assessment, our survey found that end-users would now rather invest time and money sending their staff to OEMs to carry out an in-depth assessment where they can **"climb all over the machine,"** rather than watch a real-time stream, which may not **"give the same level of scrutiny."**

A respondent from a large cleaning and home care CPG stated,

> To really get a good picture of the equipment, you have to be there… the physical aspect of an FAT is crucial.

As a result, only

13.9% + **13.5%**

Virtual FATs   **Remote Commissioning**

of end-users said they planned to use these remote services in the next 3 years.

Despite this, there are cases where virtual FATs and remote commissioning are seen as valuable, including repeat purchases where end-users already have experience with the machine or when the FAT is for a less complicated element such as a conveyor. In the future, remote commissioning is likely to be seen as an additional offering within an OEM's remote service portfolio, as opposed to an essential element.

Meanwhile, remote monitoring is currently being used by 37.5% of end-users (Figure 1). Sensors are used to track vital machine parameters such as temperature, pressure, and vibration, with data accessed off-site by end-users, or even sent directly to equipment suppliers for monitoring and alerts. For 18.4% of end-users surveyed, remote monitoring data is also used to perform predictive maintenance and there is growing enthusiasm among end-users, with 50.4% looking to implement it in their plants by 2026. OEMs have responded to this rising demand, with almost two-thirds (63.0%) planning to begin offering predictive maintenance to their customers within 3 years. The managing director of one OEM revealed,

> On the predictive maintenance side, certainly we're continuing to advance there in terms of what we can sense and what we can give feedback to truly maintain the machines. So that continues to be our focus.
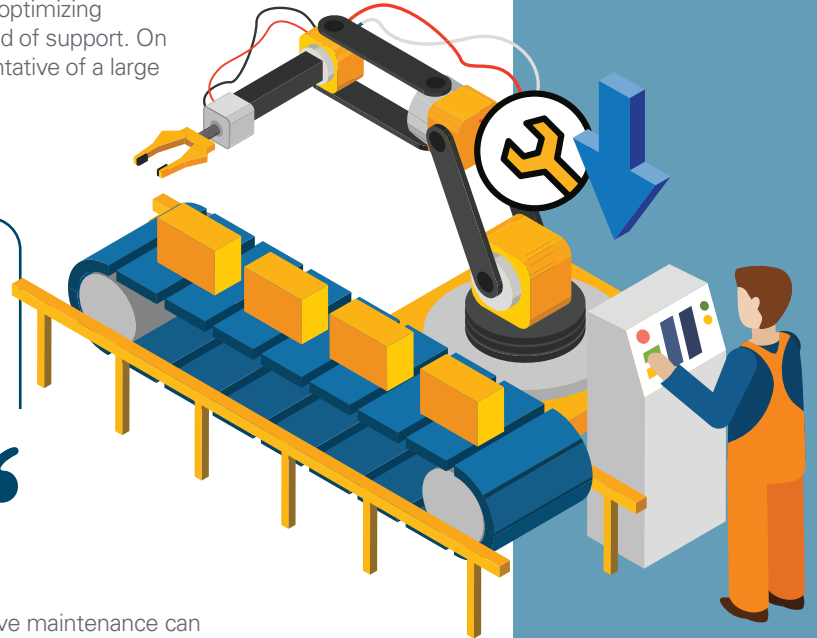
What is driving end-users to invest in remote services?

The most important reasons behind end-users choosing to invest in remote services include reducing machinery downtime, optimizing machine/operation performance, and the increased speed of support. On the attraction of remote service technology, the representative of a large food CPG explained that

> Any downtime is very [expensive] and very critical so being as quick as possible is key.

Combining tools such as remote monitoring and predictive maintenance can dramatically reduce the frequency of stoppages, while remote support provides the means to solve issues quickly when problems arise. However, decreased cost of ownership, usually a very important metric for end-users, was seen as the least important attribute when looking to invest in remote services and monitoring. This means that when CPGs are looking to invest in remote services and monitoring, the other metrics specified in Figure 2 are prioritized in the final investment decision.

> The ability to use predictive maintenance was seen as either somewhat or very important by 83.1% of end-users (Figure 2). This indicates that the appetite for this service exists for end-users and presents a great opportunity for the 75.0% of OEMs surveyed who do not currently offer it.

Reduced machine downtime is a major factor in end-users specifically investing in predictive and preventative maintenance (Figure 2), with 92.4% of end-users citing it as either a very or somewhat important factor.

Figure 2. The importance of various attributes to end-users' investment in remote services and monitoring.

Legend:
- ■ Not at all Important/Somewhat Unimportant
- ■ Neither Important nor Unimportant
- ■ Somewhat Important/Very Important

Chart categories (top to bottom):
- Reduced Machinery Downtime
- Ability to Optimize Machine/Operation
- Increased Speed of Support
- Ease of Use and Maintenance
- Increased Worker Safety
- Ability to Utilize Predictive Maintenance
- Increased Longevity of Machinery
- Limit the Impact of Skills Gaps
- Limit the Impact of Workforce Shortages
- Decreased Reliance on On-Site Technicians
- Less Cost and Time Spent on Travel
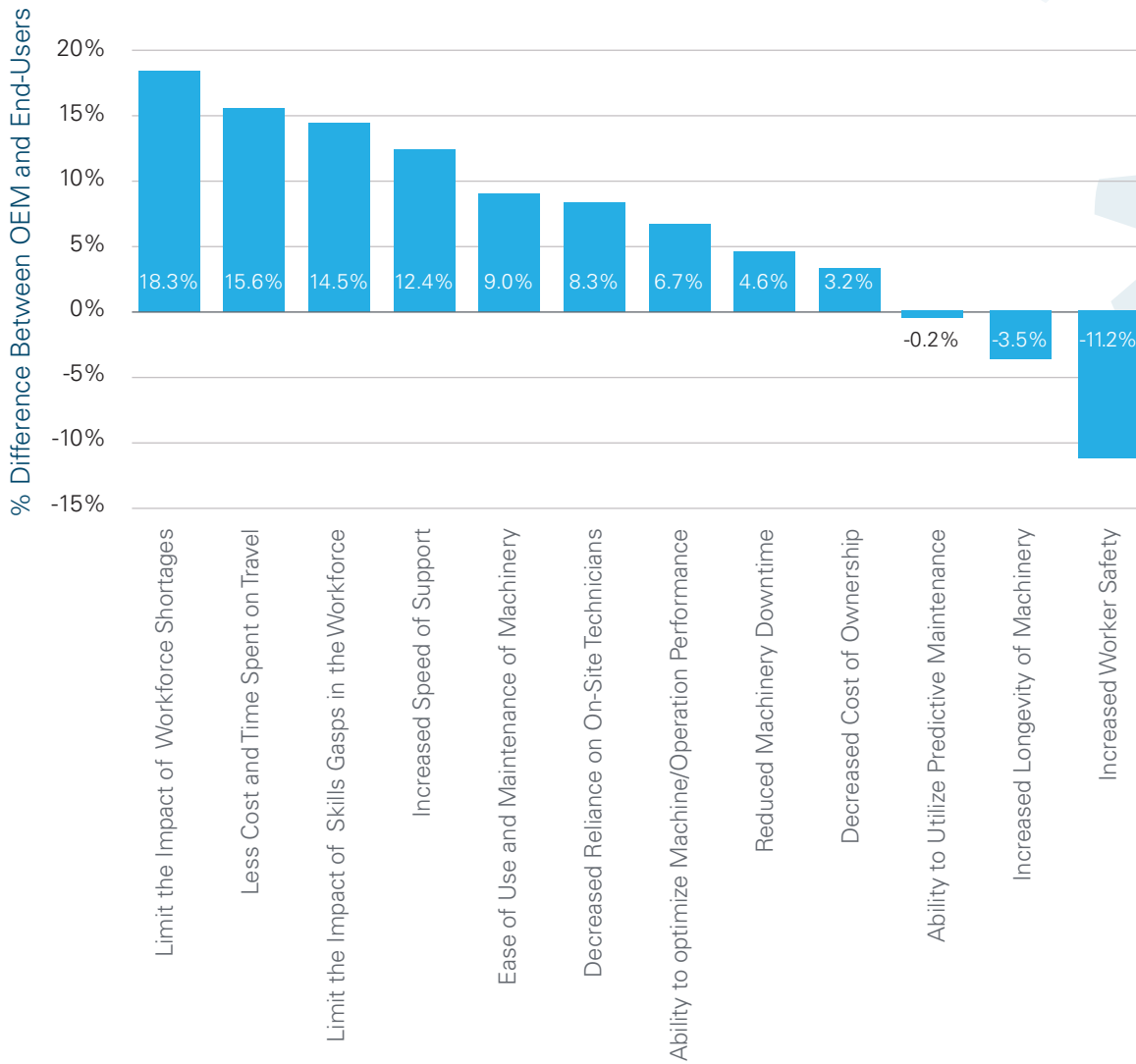- Decreased Cost of Ownership

▶ **Reducing machinery downtime is the most important factor in end-users investing in remote services and monitoring.**

OEMs were also surveyed about the most important factors for end-users investing in remote services and monitoring. The responses indicate an understanding among OEMs of customers' priorities, including the correct identification of the top 3 most important reasons given by end-users.

However, within the data there were some interesting differences. The attribute with the biggest difference when comparing OEMs' and end-users' responses was to "limit the impact of worker shortages." 96.8% of OEMs stated this was either somewhat or very important, compared with only 78.5% of end-users (Figure 3). The next largest difference between OEM and end-user answers was in **"less cost and time of travel,"** with the extent of importance OEMs believed of their customers 15.6 percentage points higher than what their customers indicated. Interestingly, both labor shortages and costly travel to customer sites are arguably issues which affect OEMs as much as end-users. This may reflect the key benefits to OEMs' own operations that are generated by providing remote services to their customers.

Figure 3. The difference between OEM's predictions of their end-users' responses and end-users' actual responses as to which attributes are important to end-users' investment into remote services and monitoring. A positive percentage value indicates that OEM's overestimated how important an attribute is to end user's investment, and a negative value represents an underestimation.

% Difference Between OEM and End-Users

Attribute	Value
Limit the Impact of Workforce Shortages	18.3%
Less Cost and Time Spent on Travel	15.6%
Limit the Impact of Skills Gasps in the Workforce	14.5%
Increased Speed of Support	12.4%
Ease of Use and Maintenance of Machinery	9.0%
Decreased Reliance on On-Site Technicians	8.3%
Ability to optimize Machine/Operation Performance	6.7%
Reduced Machinery Downtime	4.6%
Decreased Cost of Ownership	3.2%
Ability to Utilize Predictive Maintenance	-0.2%
Increased Longevity of Machinery	-3.5%
Increased Worker Safety	-11.2%

▶ The biggest difference between OEM's predictions and actual end-user responses was to limit the impact of workforce shortages.

Barriers to adopting remote services and monitoring

Despite most end-users understanding the benefits remote services can provide, there are still significant barriers to their adoption. We found that, for end-users, the most common barriers are the cost of service, the limited IT skills of their own staff to maintain and update systems, and the risk to cybersecurity (Figure 4).

Retrofitting older machinery is a hurdle to overcome

Although the additional cost of remote services is small compared with the cost of purchasing new packaging machinery, it was the most common barrier to investment (cited by 60.2% of end-users [Figure 4]). This may be because of the initial upfront cost of retrofitting existing machinery so that it is capable of connecting to their local network to enable access into their operations. Although it is possible to retrofit old machinery and update operational technology (OT) systems, this can take a long time due to technical complications, running the risk of an extended period of machine downtime. There is also the issue of incompatibility with some machines, particularly if they are older. As one medium-sized end-user put it, **"We have a couple on our system that are over 40 years old. You're not going to be able to retrofit that with […] anything digital because it just wasn't built with that capability."** This problem also extends to remote monitoring and predictive maintenance, which require machines to have complex sensors.

Some end-users would rather wait for machines to run through their lifecycle and replace them with updated models which already have remote services and monitoring capabilities installed rather than commit the cost of retrofitting. An end-user responding to the survey stated, **"You're talking about 25-year-old assets that have pieces of hardware that are obsolete. Almost every CPG company is in that position and they are replacing assets because of lifecycle, which is a lot of what we're doing also."** As machinery reaches the end of its lifecycle, we expect end-users to explore replacements that come fitted with remote services and monitoring capabilities.
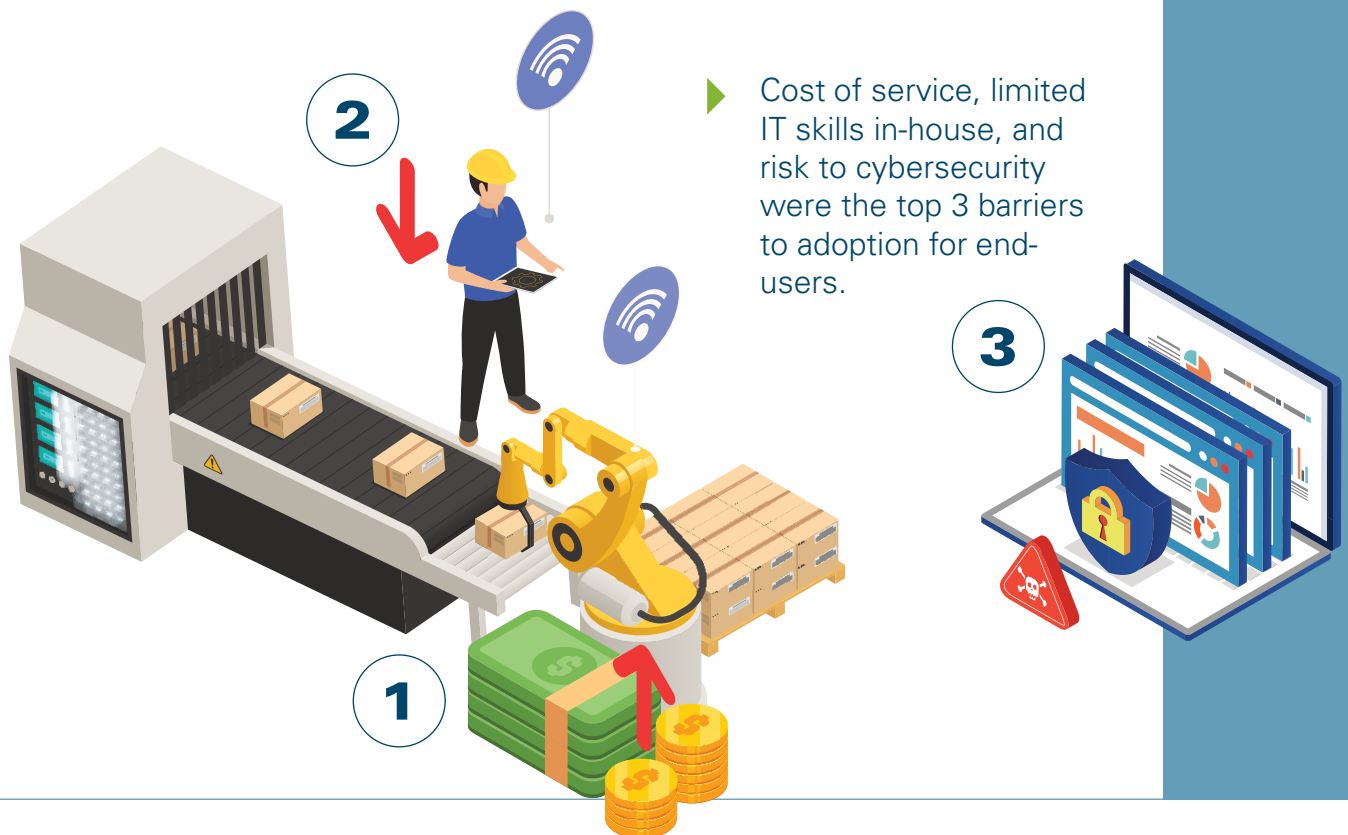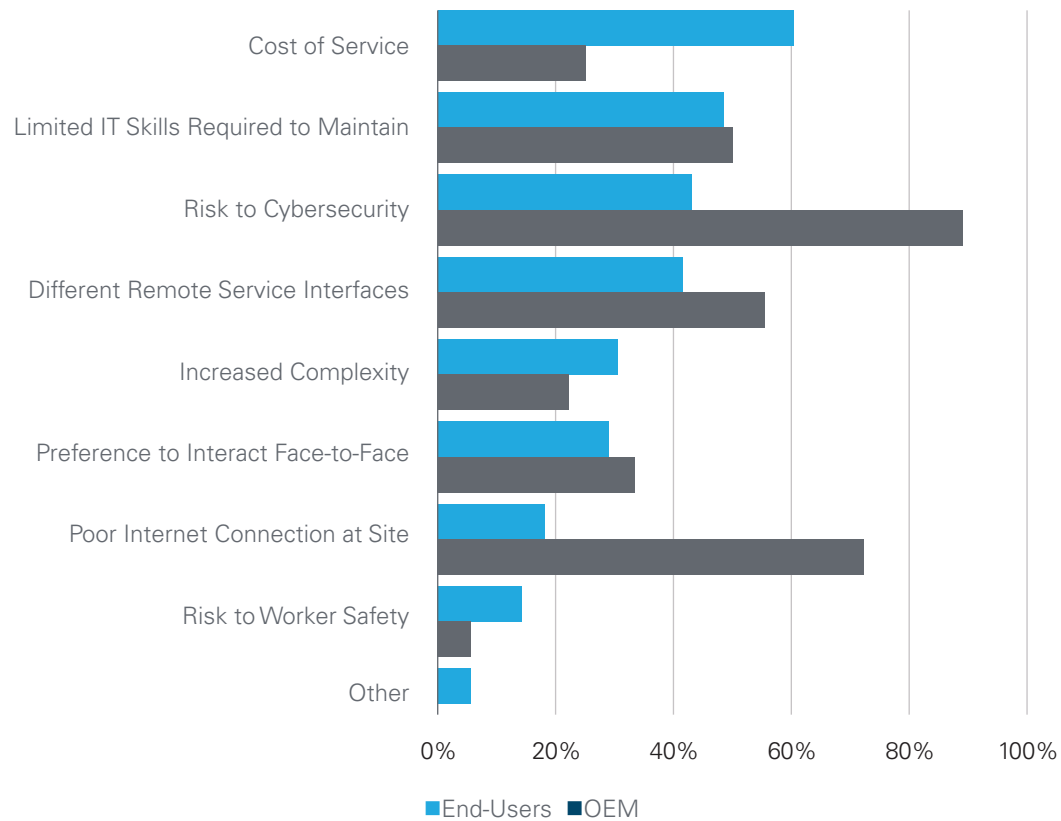
It seems some end-users are often unaware that OEMs can help them to retrofit their existing machinery to facilitate a remote connection, with 70.0% of OEMs stating that they offer remote support services for both new and existing machinery, compared with 42.6% of end-users utilizing remote support for new machinery only. One end-user respondent explained,

> Our vendors aren't informing us about retrofitting the lines to do a remote setup. Again, I'm sure there's a cost involved with that, but I think that's something that we may not be informed about […] so maybe our vendors need to better inform us on it, because we're always looking at ways to improve our operations.

Figure 4. The main barriers end-users and OEMs associate with adopting remote services and monitoring.

	End-Users	OEM
Cost of Service		
Limited IT Skills Required to Maintain		
Risk to Cybersecurity		
Different Remote Service Interfaces		
Increased Complexity		
Preference to Interact Face-to-Face		
Poor Internet Connection at Site		
Risk to Worker Safety		
Other		

■ End-Users ■ OEM

Cost of service, limited IT skills in-house, and risk to cybersecurity were the top 3 barriers to adoption for end-users.
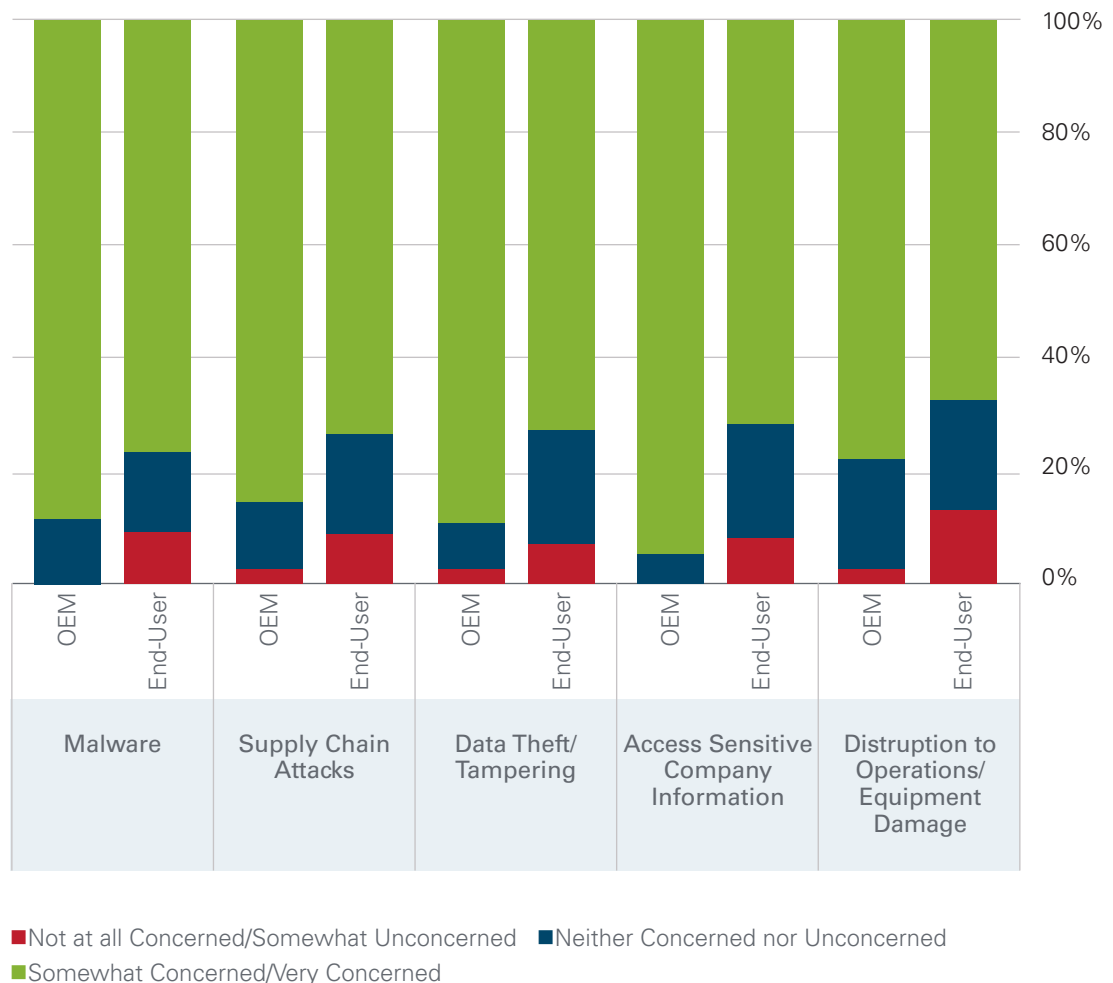
Cybersecurity concerns are a barrier to investment

Almost 90.0% of OEMs state cybersecurity is a major barrier to end-users investing in remote services (Figure 4), which require end-users to enable remote access to their plants, and some networks have suffered cyberattacks in recent years, increasing concerns. The main fears among end-users regarding cybersecurity were found to be malware (76.9%), supply chain attacks (73.2%), and data theft/tampering (72.4%) (Figure 5). However, it seems end-users are becoming less concerned with cybersecurity as they have strengthened their IT networks and improved their methods of allowing remote access. Compared with 100% of end-user respondents surveyed for PMMI's 2020 whitepaper *Trends in the Adoption of Remote Access: Moving Forward During Covid 19*, less than half (43.0%) of end-users in 2023 stated that risk to cybersecurity was a main barrier to investment.

Figure 5. The extent of concern end-users have regarding cyber security issues associated with remote access compared to OEM's estimation of their end-users' concern.

Legend:
- ■ Not at all Concerned/Somewhat Unconcerned
- ■ Neither Concerned nor Unconcerned
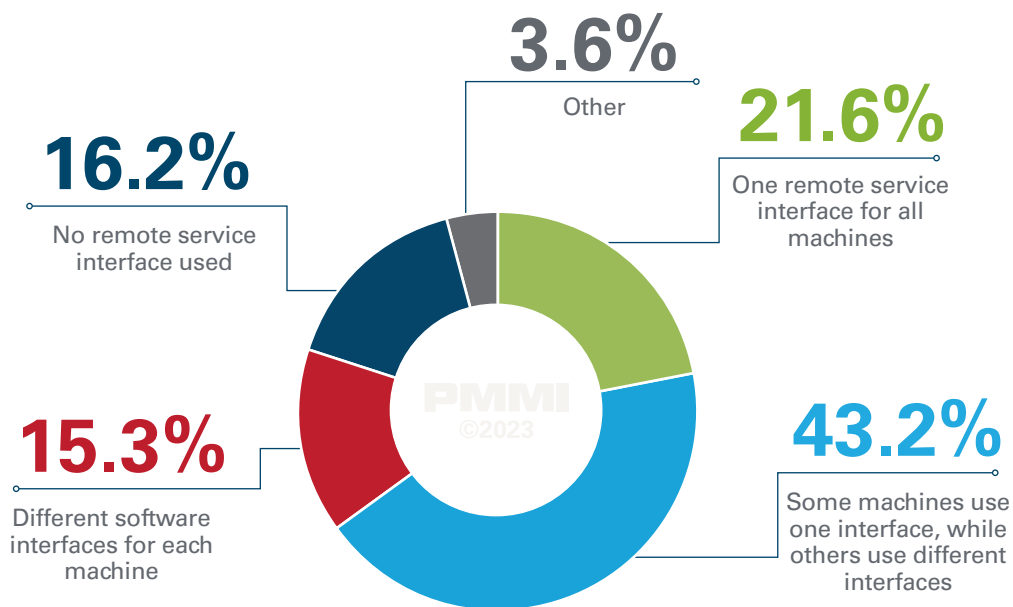- ■ Somewhat Concerned/Very Concerned

Multiple interfaces across plants and machines 'a barrier to remote services'

Another challenge to investing in remote services and monitoring cited by 41.4% of end-users surveyed is having different interfaces across separate machines (Figure 4). The majority of end-users currently have to utilize multiple interfaces for remote services, with 43.2% stating they have multiple interfaces across the plant and a further 15.3% stating they are actually using a different software for each machine (Figure 6). Just one in five end-user respondents (21.6%) use one remote service interface, with likely reasons for this including building their own interface in-house or utilizing remote services of a single OEM provider.

Figure 6. The proportions of current scenarios to how remote interfacing works across machines in end-user's operations.

16.2%
No remote service interface used

15.3%
Different software interfaces for each machine

3.6%
Other

21.6%
One remote service interface for all machines

43.2%
Some machines use one interface, while others use different interfaces

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End-users are improving cybersecurity

End-users are moving towards secure methods of remote access and are becoming better educated about the associated risks. Direct VPNs are the most common method of enabling remote access for both end-users (71.0%) and OEMs (76.5%) (Figure 7). The method with the largest increase in adoption from 2020 (Source: *Trends in the Adoption of Remote Access: Moving Forward During Covid 19*) to now is externally managed secure networking, which increased from 13.8% to 26.1%.

Figure 7. The proportion of end-users and OEMs currently utilizing (2023) each remote access delivery method, alongside the delivery methods they predict will be in-use by 2026 and which delivery methods were in-use during 2020. Data for 2020 is taken from PMMI's *Trends in the Adoption of Remote Access: Moving Forward During Covid 19*.

■2020 ■2023 ■2026
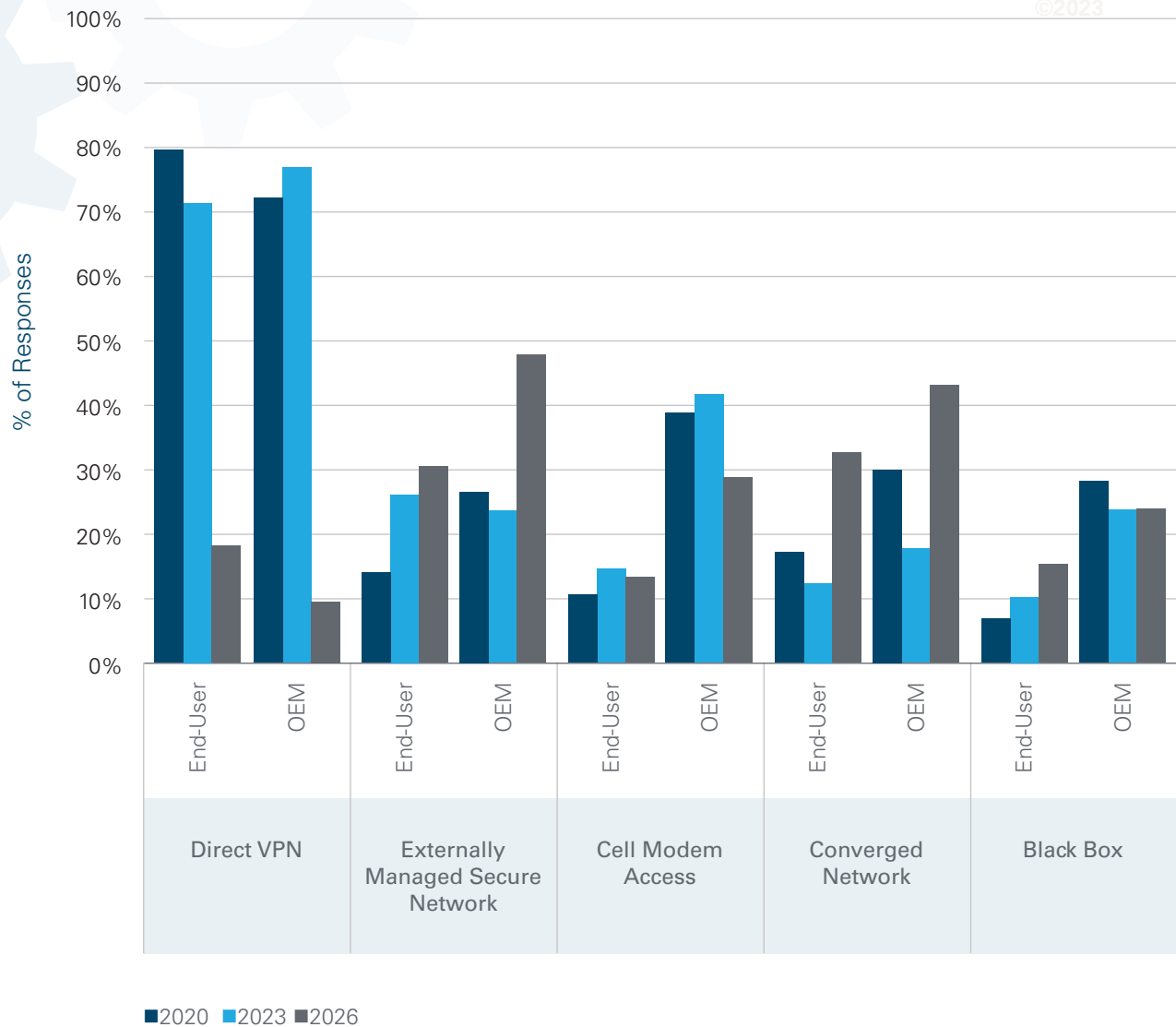
▶ Direct VPN is very much in the lead at present as the chosen method of enabling remote access for end-users and OEMs.

Use of externally managed secure networks to enable remote access is expected to continue to grow (Figure 7), with 30.5% of end-users and 47.6% of OEMs predicting they will use this method by 2026. Compared with current usage, the largest increase among end-users is anticipated in converged networks, which looks set to jump from 12.3% to 32.4% over the next 3 years. In contrast, use of Direct VPN is expected to plummet from 71.0% today to 18.1% in 2026, as other methods providing access to segmented sections of the plant floor network have greater appeal.

Can remote services provide a solution to skills gaps?

As mentioned previously, an inexperienced workforce and a high turnover of staff are posing a significant challenge for many end-users. For many, skills gaps have meant they have had to rely more heavily on support from OEMs for simple mechanical and technical problems that would have previously been handled in-house. Neither end-users nor equipment suppliers want to waste time and money on OEMs sending technicians to plants for minor issues and so this is a significant driving force behind the rising use of remote support. In fact, 79.6% of end-users stated that limiting the impact of skills gaps in the workforce is either somewhat or very important when considering investment in remote services and machinery (Figure 2). Additionally, over three-quarters of end-users (77.8%) said decreasing reliance on on-site technicians was another important attribute.

In terms of its success, **remote support** is seen as a very effective tool in helping address skills gaps by both

End-Users	OEMs
87.3%	**96.8%**

Furthermore, remote training is another service that could help address skills shortages. From our survey, 88.9% of end-users think that remote training is either somewhat or very effective at mitigating skills gaps in their operations. Instructor-led online sessions are seen by end-users as the most cost-effective form of remote training (Figure 8); however some end-users think having instructors in-person alongside machinery remains the most effective form of training. One mid-sized end-user representative said,

> It's such a benefit to see it done in front of you and be able to put your hands on; it gives you a better, deeper level of understanding.
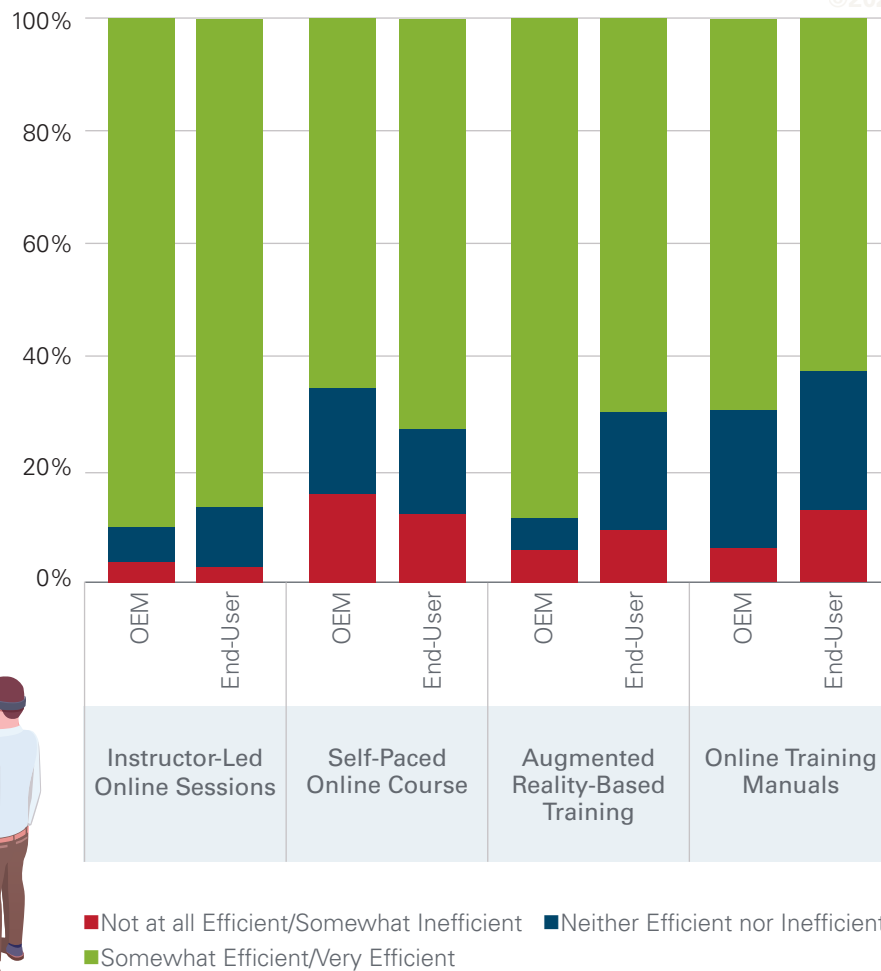
Could augmented reality provide a happy medium?

An emerging technology with the potential to bridge the gap between remote and in-person training is augmented reality (AR), which is an interactive experience whereby users wear a headset/goggles to enhance their real-world surroundings. End-user technicians and operators can be given on-screen spatial markers, step-by-step instructions, and real-time videos while being trained on machinery, and 70.0% of end-users see this technology as either a somewhat or very efficient method of remote training.

Figure 8. End-users' and OEM's perceptions of how cost-efficient remote training services are for training machine operators and technicians.

Legend:
- ■ Not at all Efficient/Somewhat Inefficient
- ■ Neither Efficient nor Inefficient
- ■ Somewhat Efficient/Very Efficient

Chart categories (each with OEM and End-User bars):
- Instructor-Led Online Sessions
- Self-Paced Online Course
- Augmented Reality-Based Training
- Online Training Manuals

▶ Augmented reality-based training was seen as very or somewhat effective by 70.0% of end-users.

Reasons given for reluctance by end-users to embrace AR technology for all training included older members of staff (often the leaders of maintenance teams) being less enthusiastic about its use, with one respondent explaining that **"it definitely takes the right technician on our end with it. We have some older maintenance techs that are just kind of not into that."**

What does the future of remote service training look like?

A hybrid approach is likely to be the most popular option in the near future. This will involve a combination of initial in-person training, where technicians and operators can get involved with the machinery and ask questions directly to the equipment supplier's team, and subsequent instructor-led or self-paced online sessions to consolidate learning. Although not widely used at present, augmented reality is expected to become much more prevalent in the future, as younger members of staff in particular start to implement it.

▶ What is the future of in-person vs. remote services and monitoring?

Current attitudes towards remote services indicate the immediate future for many end-users will be a hybrid combination of in-person and remote provisions.

OEM Support

As the capability to remotely troubleshoot and diagnose mechanical issues improves, more and more problems can be resolved without the need for OEM support staff to travel to end-users' plants. The majority of software-based issues are already being addressed via remote access, whereas mechanical issues are often complex and require a technician to be there in-person. Although these visits are expected to decrease, it seems likely that there will always be a need for in-person support to address a significant number of failures.

FATs and Commissioning

FATs and commissioning are expected to continue to remain mostly in-person, with virtual FATs occasionally being used for repeat purchases or simpler machinery, such as conveyors. Many end-users think it is necessary for their staff to interact with machinery to properly form an assessment. Another use of virtual FATs is for end-users purchasing machinery from vendors outside of the US, as the cost and time of travel is much higher when going overseas. AR has a potential use here and could make end-users more comfortable with performing commissioning remotely.

Training

In the near future, in-person will remain the primary form of training, with both instructor-led and self-paced remote sessions acting as additional training once operators and technicians have already had the opportunity to interact with the machinery and ask instructors questions. Augmented reality-based training will remain a niche option for now, but as the next generation of technicians and operators continue to enter the workforce, it is expected to become a much more popular option.

What does the future hold for the rapidly evolving remote services landscape?

The landscape of remote services in the packaging industry is evolving rapidly, driven by the challenges and opportunities presented by the Covid-19 pandemic. The adoption of various remote services has increased significantly, reflecting the industry's response to workforce challenges or adaptation to the new normal, but certain aspects have gained more traction than others. Remote support emerges as a crucial tool, with its immediate technical assistance proving invaluable, particularly in light of workforce skills gaps. However, not all remote services hold the same weight, as virtual FATs and remote commissioning are still met with skepticism, and many end-users prefer in-person assessments for a more thorough evaluation.

The driving force behind end-users' investment in remote services lies in reducing machinery downtime, optimizing performance, and gaining faster support. The importance placed on predictive maintenance indicates a growing appetite for leveraging technology to prevent downtime, a critical factor for maintaining operational efficiency.

Despite the evident benefits, barriers to adoption persist. Cost, particularly the upfront investment in updating existing machinery for remote capabilities, remains a concern. Cybersecurity concerns are also prominent, although end-users are becoming more adept at addressing these issues, with a shift toward secure methods of remote access.

The role of remote services in addressing skills gaps in the workforce is noteworthy. As end-users struggle with a more inexperienced workforce, remote support proves to be a valuable tool, effectively reducing reliance on on-site technicians. Remote training, especially AR-based methods, could mitigate skills gaps, although resistance from older members of staff poses a challenge.

Looking ahead, the future of in-person versus remote services appears to be a hybrid model. While certain functions — such as remote troubleshooting — may become more prevalent, in-person interactions remain crucial for tasks like FATs, commissioning, and initial training. End-users are poised to embrace a combination of both approaches, leveraging the strengths of each to ensure efficient and effective operations in an evolving landscape.

Glossary

AR — Augmented Reality
CPG — Consumer Packaged Goods Company
Direct VPN — Direct Virtual Private Network
FAT — Factory Acceptance Test

IoT — Internet of Things
OEM — Original Equipment Manufacturer
SAT — Site Acceptance Test

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Vision 2030 is a critical component of PMMI's suite of continuous improvement forums for its members and the consumer packaged goods (CPG) companies they serve. The suite focuses on the discovery, discussion, and solutions to the industry's most significant challenges. Think of these three components as an annual ongoing conversation between CPGs and OEMs.

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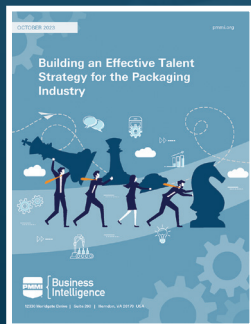
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