Smart industry

SPECIAL REPORT

The Smart Industry 2024 Crystal Ball Report

Here, we've gathered our annual predictions from an esteemed group of industry thoughtleaders.



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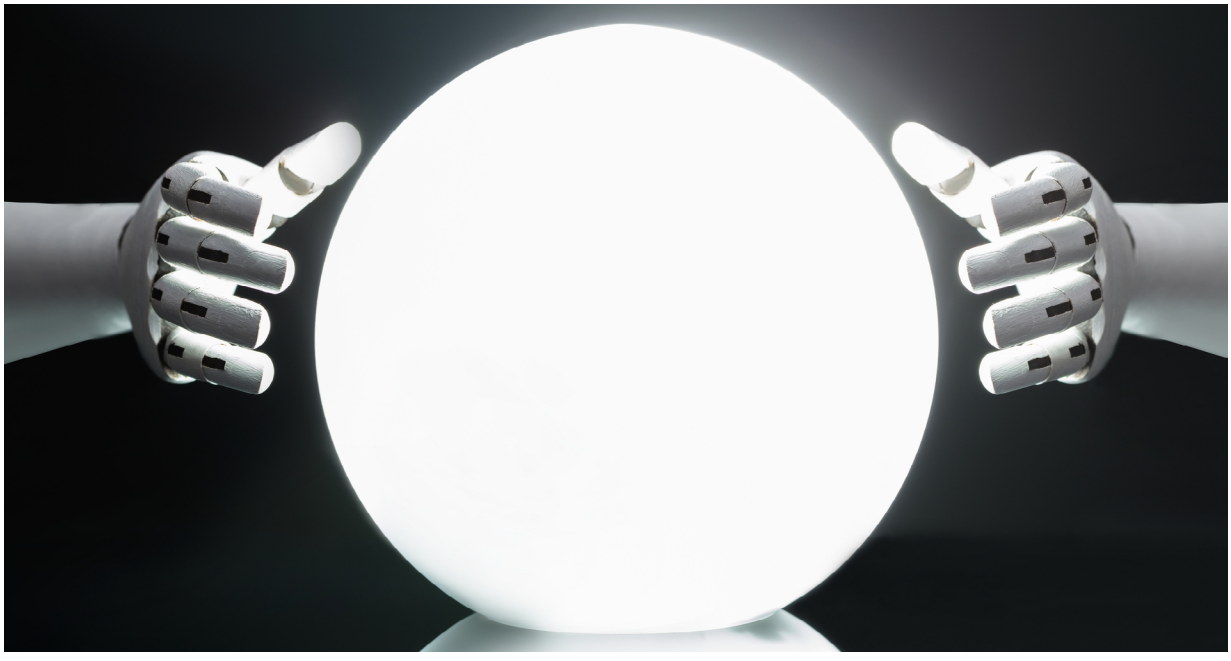
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The Year of AI (Continued)

Our latest Crystal Ball Report predicts the manufacturing utility of artificial intelligence, noting that it has both skeptics and cheerleaders, depending on which recent survey you read. But the technology will, no doubt, keep emerging in 2024 as digital transformation in industry evolves and gains even more buy-in than it already enjoys.

By Scott Achelpohl, managing editor, Smart Industry

A colleague has had the habit lately of noting the "hype" and "buzz" that, in 2023, surrounded a topic we at *Smart Industry* cover thoroughly—artificial intelligence—and its utility for industrial IT and OT.

SI is all about the OT/IT space, so this new technology has, indeed, gotten a lot of attention (maybe too much?). Well, buckle up; in 2024, AI likely will receive even more—as several contributors to this year's Crystal Ball Report in the following pages note again and again.

Perhaps 2023 was the "Year of What AI *Could Do* for Manufacturing," where 2024 will be the "Year of What AI *Is Doing* for Manufacturing."

THE AI SURVEYS SAID ...

Surveys of industrial stakeholders don't offer a clear yay or nay on AI for manufacturing.

Results of Rootstock Software research released in December, the company's "State of AI in Manufacturing Report," found a clear majority (82%) of 350 surveyed manufacturers in the U.S., the U.K. and Canada plan to increase their budgets for AI in the next 12 to 18 months, with 24% planning substantial increases of 26% to 50%.

More than 70% of respondents to Rootstock said they have implemented some form of AI into their operations already. Automation software is the most used type of AI at this stage (60%), the company's research revealed, though manufacturers are exploring other types, including predictive AI (37%) and generative AI (35%).

Another study put out in December, the latest Sikich Industry Pulse, unearthed some skepticism by comparison, as one-fifth of surveyed manufacturing execs said they had no plans—none whatsoever—to introduce AI into their operations. More than 60% of them were unsure if AI will add any benefit to their companies or have researched AI but have not found an appropriate use case. Less than 20% told Sikich that they had begun to implement AI technologies in their operations.

So why are some skeptics while others in the same space are cheerleaders? This could be because not enough is known about the utility of AI for industry, even with all the buzz in 2023. A lot has been reported about ChatGPT, but the uses and pitfalls of AI in manufacturing are still coming into focus as the calendar turns into 2024. Crystal Ball Report has a lot of answers, and *Smart Industry* will have more throughout the new year.

DIGITAL TRANSFORMATION MOVES FULL STEAM AHEAD ...

Meanwhile, digital transformation in manufacturing overall might have had a breakthrough year in 2023—and this momentum looks like it will carry over into 2024.

New research released by SI's sister brand, *IndustryWeek*, indicates a "renaissance" underway for manufacturing, as one speaker put it during an early November webinar, sponsored by industrial software development vendor

HighByte. *IndustryWeek* research reviewed during this online event showed buy-in for digital transformation growing steadily, with 86% of surveyed manufacturing professionals reporting their companies moving forward with it and attitudes for this transformation proving largely optimistic.

This optimism and enthusiasm show in the predictions that *SI* received for the Crystal Ball Report, too, and the insights from the contributors extended well beyond AI to other automation technologies, which Kevin L. Finnan, market intelligence and strategy adviser for Yokogawa, the sponsor of our report, details.

A quartet of other contributors, John Louka of CESMII, Rex Ahlstrom of Syniti, Tim Long of Snowflake and Dario Ambrosini of Propel, do add their voices here to the predictions about AI.

And stakeholders Kurt Thomas and Ryan Maltzen of Fortra and Anand Oswal of Palo Alto Networks tell us about cybersecurity in 2024. Peter Swaniker of Sand Technologies has new-year insights on IoT (and AI). Dwaine Plauche of AspenTech and Steve Leeper of Datadobi join *SI* with data management and storage predictions. Goldy Aloysious of Kyndryl covers a lot in this space—cloud computing, machine learning, digital twins, blockchain, the convergence of OT and IT—and oh, by the way, AI.

Speaking of accelerating OT/IT convergence, Adam Gluck, CEO of Copia Automation, adds his 2024 thoughts on the subject as well as what has become known as "industrial DevOps." Brandon Black of Ivanti Wavelink and Matt Wicks of Zebra Technologies check in on warehousing technology topics such as dark networks and cloud migration (Black) and the progress of automation to free humans for higher-value jobs (Wicks). Last but not least, Tacton executives Madeleine Bergrahm and Nils Olsson have predictions for how digital transformation will help sustainability advance in 2024.

This 2024 Crystal Ball Report is my first for *Smart Industry*. Putting it together was part of my continuing education on issues that are important to *SI*'s readers and stakeholders in "smart" industry. Hopefully, it's the first of many CBRs for this editor. Thanks go to the experts (and their companies) who provided insights to this report. The *SI* team hopes all who download the Crystal Ball Report find it valuable, and we'll see you throughout 2024. Have a happy, productive and profitable new year. ◻



Scott Achelpohl



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Various automation technologies about to take off in the new year

AI commands the greatest attention among these innovations, but others deserve their due respect.

By Kevin L. Finnan, market intelligence and strategy adviser, Yokogawa

Emerging technologies are about to pivot through their inflection points and take off. The tech that is now accelerating will begin producing results very quickly. So, what are the five trending technologies you need to watch—those you are most likely to encounter in a big way in 2024?

The accelerating technologies are centered around an emerging concept, ecosystem automation, and its enablers. The latter include autonomous operations software, industrial artificial intelligence, AI-enhanced digital twins and collaborative mobile robots.

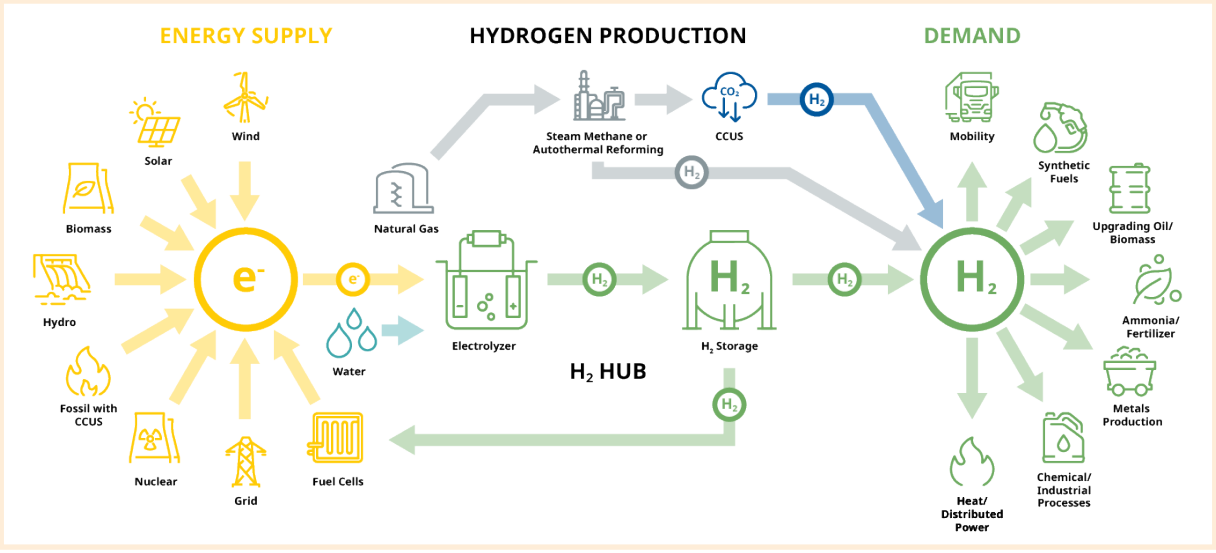
ECOSYSTEM AUTOMATION

An ecosystem is an enterprise, which could consist of multiple facilities that are spread across a broad geographical area—including the entire world and beyond. It could be operated by a single business or multiple businesses. The people involved in the ecosystem engage in collaboration throughout.

An emerging example is a hydrogen hub, or "H2 Hub." The H2 Hub consists of multiple processes and facilities at locations throughout a geographical area that is typically regional in nature as opposed to transcontinental or global.

Unlike existing enterprises, which are in the middle of digital transformations, the hydrogen ecosystem is a greenfield, which can begin operations with transformative technologies in place.

Globally, H2 Hub projects are just underway. In the U.S., the Department of Energy has recently selected seven projects to receive a total of $7 billion in federal funding to, according to the department's press release, "advance hydrogen's role in a decarbonizing economy."



A hydrogen ecosystem includes a hydrogen hub (H2 Hub) as well as, conceivably, the electrical grid that supplies energy to it and consumer applications on the demand side.

AUTONOMOUS OPERATIONS SOFTWARE PLATFORMS

Today's technologies allow for unprecedented levels of automation, including remote and unmanned operations. An ecosystem could entirely automate its operations, maintenance, incident management and safety. As greenfields, H2 Hubs are perfectly positioned for autonomous operations from their inception.

An autonomous operation—or "industrial autonomy"—is the state in which assets and operations throughout possess learning and adaptive capabilities that enable responses with minimal human interaction, thus empowering operators to perform higher-level optimization tasks.

Autonomous operations will eventually enable entire societies to operate as "systems of systems," where multiple, formerly independently operating, and managed systems coordinate together to achieve a purpose that extends well beyond the capabilities of any single system.

Autonomous operations software platforms are currently in proof-of-concept (PoC) and are nearing the pivot to transformational, operating solutions.

INDUSTRIAL ARTIFICIAL INTELLIGENCE

With the hype around OpenAI's ChatGPT and generative AI, in general, AI commands the greatest attention among technologies. Suppliers are already incorporating AI into industrial applications; hence, the term "industrial AI." According to Verdantix, industrial use cases that are already leveraging generative AI, or Gen-AI, include asset performance management, predictive maintenance and supply chain management—all of which are prominent in digital transformation programs in the process industries.

Another AI technology, reinforcement learning, has proven successful for direct control of chemical processes. In 2023, ENEOS Materials Corp. and Yokogawa announced an agreement in which factorial kernel dynamic policy programming (FKDPP), a reinforcement learning-based AI algorithm, would be officially adopted for use at an ENEOS Materials facility.

This is the world's first example of the adoption of reinforcement learning AI for direct control of a plant. By eliminating the production of off-spec products, the autonomous control AI reduced costs in terms of feedstocks, fuel and

labor. This solution has recently pivoted from concept testing to finished product availability.

AI-ENHANCED DIGITAL TWINS

A digital twin is a virtual, digital copy of a device, person, system or process that accurately mimics actual performance. The digital twin aims to be an accurate representation of an asset, which could be an instrument such as a flowmeter or it could scale to emulate an entire plant or enterprise, over its full range of operation and its full lifecycle.

Although digital twins are not technologies of the future—they have been shipping and deployed at end-user facilities for several years—a new generation is about to accelerate. The key enhancement is the use of a variety of AI technologies in addition to the core, digital twin technology. For example, process digital twins use first principles modeling, which incorporates deep knowledge of the inherent chemistry, mechanics and physics. AI can expedite the training of the core digital twin model for faster deployment.

AUTONOMOUS COLLABORATIVE MOBILE ROBOTS

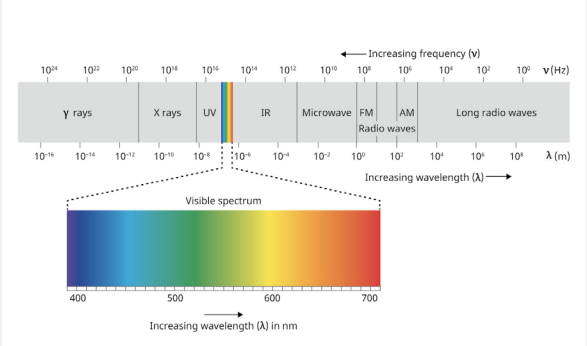
The mobile robotics field is emerging as a key technology for remote, industrial autonomous operations. In hazardous areas or difficult-to-access remote locations, which present high risks and costs (in terms of transportation) to human presence, autonomous mobile robots, categorically including drones, are proving to be very effective.

One advantage of mobile robots is the much wider spectrum rangeability in their sensor arrays vs. human hearing and vision.

Although coordination of multiple robots is complex, a number of proof-of-concept (PoC) tests have successfully demonstrated autonomous operations, and the field has pivoted to orders for and deployments of finished products.

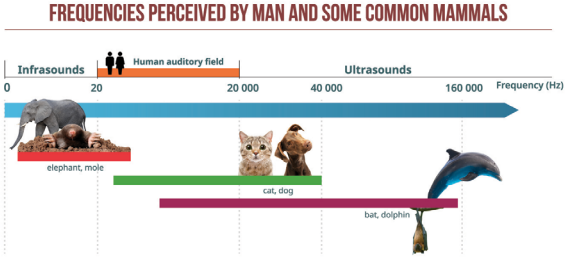
Yokogawa's Kevin Finnan previously was an independent consultant, VP of marketing for CSE-Semaphore and marketing director at Bristol Babcock. He has more than 30 years of experience in several vertical markets and has launched more than 40 products in automation and measurement technologies.

Spectrum vs. Human Visioning



Source: "Introduction to Psychology" at https://saylordotorg.github.io/text_introduction-to-psychology/s08-02-seeing.html

Spectrum vs. Human Hearing



The human ear can comfortably hear sounds up to 80 decibels. Prolonged exposure to sounds above 80 decibels can cause hearing loss.

Source: "Journey into the World of Hearing" at http://www.cochlea.org/en/hear/human-auditory-range



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Propel experts on 2024: AI at a critical juncture, era of 'continuous business transformation' starts

Modern tech stacks will find it easier to leverage artificial intelligence to make impacts in manufacturing IT and OT, as the pendulum swings back toward platforms.

By Scott Achelpohl, managing editor, Smart Industry

Santa Clara, California-based Propel Software, which develops product lifecycle management software solutions among others, is an up-and-comer, recognized as a Deloitte Technology Fast 500 winner three straight years and one of Fortune's Most Innovative Companies in the U.S. Propel's chief marketing officer, Dario Ambrosini, polled company customers and industry partners for predictions, and he learned that artificial intelligence sat at the forefront of their conversations. What else did Ambrosini learn? "The AI inflection point for manufacturers will arrive in 2024. Those with modern tech stacks will find it easier to leverage AI to drive true impacts to both top and bottom lines," he wrote in an email from Propel. What else? "The era of continuous business transformation kicks off," he said of 2024. "Gone are the days of static business processes and tech stacks that are updated every few years or even decades. Instead, manufacturers are embracing continuous transformation where they identify a need or pain, deliver a solution using an agile approach, and quickly move on to address the next problem." Ambrosini said that Propel also learned from customers and partners:

- **The pendulum is swinging back toward platforms.** The current momentum has shifted toward those that, compared to best-of-breed solutions built on different platforms, offer better user experiences, superior economics, and common data sets.
- **High-tech manufacturing will explode in 2024.** "We're on the dawn of the largest expansion in

high-tech manufacturing the world has ever seen," Ambrosini noted.

- **Mexico will become the new China.** "Mexico has reached an inflection point on high value-added manufacturing capabilities for industries such as aerospace, medical device, automotive, consumer products, and textiles," the chief marketing officer said.
- **Sustainability will become the new efficiency driver.** "The chase for environmentally friendly products is more than about saving the earth. It's about finding new markets and buyers that drive revenue growth while improving efficiency that delivers sustainable profit growth," Ambrosini said. □

Perspective on the challenges in 2024 of AI adoption in manufacturing

Where 'clean data' is available in information technology domains, Gen-AI uses should flourish in IT. But there will be headwinds for the once-in-a-generation technology on the OT side.

By John Louka, application engineer, CESMII, the smart manufacturing institute

□ As we enter 2024, there are no bigger buzzwords than "Generative AI"—a once-in-a-generation technology that has the potential to dramatically accelerate the pace of innovation. Executives across many industries are going to race to mold this base technology from a general tool, pre-trained on vast amounts of internet data, to a domain-specific tool that can help propel organizations.

This initial "gold rush" will be marred by high entropy and pilot purgatory as R&D departments start exploring the low-hanging fruit of what Gen-AI can do. There's no doubt this will produce some practical solutions, specifically in IT-centric domains where clean data is readily available. Herein lies the challenge for operational technology, however. A Generative pre-Trained Transformer's (GPT) performance heavily relies on the data set that was used to train it, and this is where the manufacturing industry faces tremendous headwinds.

To be better equipped for the challenges ahead, we need to briefly understand the roots of IT vs. OT. IT systems were designed to scale immensely across vast distances, user counts, hardware platforms and software providers. As a result, techniques enabling scalability and interoperability like object oriented programming and standard interfaces have existed since the 1960s. OT evolved from relay racks, later evolving into ladder logic controlling individual machines, lines or processes that rarely communicated with the outside world. As a result, OT data is disparate, orphaned and lacks the standardization in terms of protocols, interfaces and data formats to develop unified systems.

TRANSFORMING THE OT DATA SWAMP

A manufacturer's efficacy in transforming their OT data swamp into a properly contextualized knowledge graph will dictate how quickly they can board the Gen-AI train. This knowledge graph can be a powerful representation of a shop floor that leverages industry-driven information models with relationships defined between manufacturing entities, providing a framework for organizing and interpreting complex

data across a supply chain. Curating this training data set will be key in deciding which adopters make it out of the trough of disillusionment and into the slope of enlightenment on the analyst hype cycle.

Furthermore, with the current trend in employee turnover and the loss of experience in a retiring workforce, this knowledge graph is becoming ever more important for an organization's continuity. Relying on oral lore for the impartment of knowledge is no longer a safe bet.

Considering the transformative potential of Gen-AI, everyone must embrace converting disparate OT data into something more palatable, fostering interoperability and standardization, to help seamlessly integrate new solutions across a manufacturer's enterprise. GPTs have the potential to catalyze the adoption of IT methodologies and velocity of deployment within the OT world, and I think this is where the most successful companies will start focusing their efforts. ◻

John Louka describes his role as being a glorified puzzle-solver. Within CESMII, he helps make sure the technical team develops solutions with their Smart Manufacturing Platform that eventually can be commercialized. Louka joined CESMII from Rockwell Automation.

In 2024, Gen-AI to drive need for 'clean' data

Artificial intelligence will disappoint manufacturers that don't have a clear-cut use for the technology and don't have information in usable enough shape to be useful.

By Rex Ahlstrom, chief technology officer and VP of innovation and growth, Syniti

◻ I've got these five predictions for what's coming up in an exciting 2024 regarding generative AI, data management and architecture, and the intersection between the two.

INCREASED ADOPTION OF GENERATIVE AI WILL DRIVE NEED FOR 'CLEAN' DATA

The foundation of generative AI is data. That is, to function as desired, data is what provides the basis for this new technology. However, that data also needs to be clean. Regardless of where you're pulling the data from—whether you're using something like modeling or a warehouse of your choice—quality data will be essential. Bad data can lead to bad recommendations, inaccuracies, bias, etc. Having a strong data governance strategy will become more important as more organizations seek to leverage the power of generative AI in their organization. Ensuring your data stewards can access and control this data will also be key.

THE SHIFT TO DATA FABRIC WILL ACCELERATE THANKS TO AI

When I surveyed the landscape at the end of last year, I anticipated that more organizations would move from a data mesh approach to a data fabric to help break down information silos and make data available to business users more quickly. We haven't quite seen as fast a transition, but this trend is certainly accelerating and, in 2024, this trajectory will be driven largely by increased adoption of AI and other self-discovering technologies. While there's been a lot of discussion around data fabric in recent years, it will become a bigger goal for organizations thanks to the emergence of more advanced AI.

TO MEET DESIRED CUSTOMER OUTCOMES, THE LARGER PLATFORM PLAY WILL GAIN TRACTION

In today's economy, it's no longer

enough just to sell tools and solutions. Customers are increasingly demanding that vendors be able to demonstrate a stronger connection between their offerings and ROI. That will be the way to justify spending. As a result, more organizations will be moving away from an endless amount of point solutions to a platform approach. And that means vendors that only focus on one thing, or one point solution will have more incentive to try to be acquired or expand into an all-encompassing platform through partnerships.

GEN-AI WILL QUICKLY MOVE FROM THE PEAK OF INFLATED EXPECTATIONS TO THE TROUGH OF DISILLUSIONMENT

There's a lot of hype right now around generative AI, to put it mildly. However, all this hype means that for some organizations, adoption of this technology is more of a matter of "keeping up with the Joneses" rather than because it is truly the best solution for a specific problem they are trying to solve for. As a result, we're likely to see a lot of money invested in failed Gen-AI projects—hence, the falling into the trough of disillusionment. It's the shiny new object, and many CIOs and other senior leaders may feel pressured to be able to say they have a Gen-AI program in place. The key to limiting these failed projects will lie in really ensuring that your organization understands the specific reason for using Gen-AI, that it's tied to a defined business outcome and there's a method established for measuring the success of the investment.

DATA QUALITY WILL START TO BECOME AN EXECUTIVE-LEVEL TOPIC

Ownership of data and data quality are core to business success but are still too often ignored or overlooked by the executive and board levels of most organizations. We can see this in the disconnects around perception vs. reality. Over 80% of executives we surveyed think they trust their data, but the reality is that there are still a lot of people that are doing a lot of work to get data quality to a level where the data can be consumed and used. As data quality takes on greater importance, it will escalate to an executive-level conversation. ◻

Syniti is an enterprise data management platform provider and assists clients with data migration, quality, replication and matching.

Gen-AI's momentum was palpable in 2023, but this is the year to back up the buzz

Data—whether a company's information is 'clean' and advanced or a work in progress—determines how far a manufacturer will be able to go with this exciting technology.

By Tim Long, global head of manufacturing, Snowflake

◻ The fourth industrial revolution began in the mid-2010s, but the popularization of generative AI and large language models (LLMs) over the course of 2023 added a new layer to the data generation and automation equation. The manufacturing world now has another element to add to their tech stacks—an exciting opportunity, but also a challenge as everyone works to determine how to best implement these new solutions to practically solve challenges and create new efficiencies.

Determining that "how" must start with data. For as much potential as these technologies hold, they're only as good as the data they stand on. For manufacturers that are advanced in their data practices, they may be ready to jump right into the deep end; for those that are just getting started, it's a rallying cry to commit to understanding and organizing their data, lest these companies get left behind.

Either way, this maxim acts as an organizing principle, allowing manufacturers to focus their thinking on how they take advantage of Gen-AI in 2024. This begins with two simple questions: "what am I prepared for and what is my biggest area of potential return?"

Taking that top-down approach, each organization can figure out where they can start to make an immediate impact and build their Gen-AI muscle as it goes from new solution to table stakes for successful operation. As a starting point, that could be as simple as providing a framework and empowering their workforce to begin experimenting with these tools; from a more advanced perspective, it may be building LLM-based apps trained on private data to access and understand the data that you are generating and that is feeding your automated processes more easily.

What's clear is that if 2023 was the year of discovery and early experimentation with generative AI, 2024 will begin truly reshaping the industry at large. Here's how:

GEN-AI REVOLUTIONIZES DATA ACCESSIBILITY, FUELS MANUFACTURING INNOVATION

The intrinsic value of generative AI and LLMs is their ability to distill complex data and analytics insights through conversational language. In addition to answering questions, Gen-AI also is orchestrating analytical workflows, making it easier than ever to troubleshoot manufacturing problems or to optimize the manufacturing process itself.

Through iteration, engineers can explore data, test hypotheses and leverage machine learning and simulation capabilities fully managed with Gen-AI. There has never been a more streamlined or accessible way to digitally identify opportunities and accelerate the continuous improvement process, leading to fewer defects, shorter cycle times and overall reduced production cost.

AI-POWERED EQUIPMENT MAINTENANCE WILL IMPROVE FACTORY PRODUCTIVITY

Manufacturing lines live and die by efficiency and uptime. Already, data empowers predictive maintenance that aims to maximize availability of manufacturing equipment. However, there will always be unforeseen issues that need to be addressed in real time. By understanding the relationship between the data these machines generate and documented equipment procedures, AI-guided troubleshooting and repairs will restore lines back to full capacity faster than ever before.

AI SIMPLIFIES THE COMPLEX CHALLENGE OF DE-RISKING GLOBAL SUPPLY CHAINS

As a result of industry consolidation, many large manufacturers often have multiple ERP systems, whose siloed data has historically obstructed a clear view into the supply chain network. However, as these organizations break down data silos and leverage tools like LLMs that empower business users to find insights from consolidated data, they're able to gain a new level of understanding and offer more transparency, democratization, context, etc. Simplified access to probabilistic techniques, including forecasting, planning and route optimization, will improve supply chain resiliency and efficiency, leading to greater profitability and customer satisfaction.

There's no question that AI is going to be a major driver of how all businesses operate moving forward. But manufacturers that make the link between abstract concepts and physical products have a particularly large opportunity to use it to get a grasp of their data and use it to inform smarter decisions and more efficient operations. ◻

Snowflake offers cloud computing–based data storage and analytics services, termed "data-as-a-service."



Lead the Pack: Strategies for Success in the Automation Era

As automation technologies reach their inflection points and set the stage for unprecedented growth in 2024, Yokogawa is the ideal partner. Our expertise lies at the intersection of enterprise transformation and addresses five pivotal technologies: ecosystem automation, autonomous operations software, industrial AI, AI-enhanced digital twins, and collaborative mobile robots. With a proven track record, Yokogawa continues to empower industrial manufacturing leaders driving efficiency, productivity, and competitive advantage.

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Digital transformation experts talk 2024 trends

AI tops their lists, but so does cybersecurity, OT/IT convergence, the evolution of cloud computing in manufacturing and much more. Our roundtable of eight weigh in.

A roundtable of eight esteemed experts in the realm of digital transformation in manufacturing weighed in for *Smart Industry*'s Crystal Ball Report for 2024 with opinions and predictions on cybersecurity, network security, IoT, AI, data management, cloud computing, digital twins, blockchain, OT/IT convergence and industrial DevOps.

ON CYBERSECURITY

On cyber defenses, two experts from Fortra, which is a vendor of cybersecurity and automation software solutions, offered their predictions for the new year.



Kurt Thomas, technical product manager for Fortra's Powertech solutions:

"Due to the increasing use of automation by attackers, we will see attacks increasingly being directed not just at large, but also at midsize and small businesses."



Ryan Maltzen, cybersecurity architect at Fortra:

"Generative AI-based technologies and other similar technologies will make a broader splash into the various cybercrime markets. With deepfakes and other identify-falsification methods on the rise (and with reduced complexity), we will start seeing these used more frequently in mainstream phishing-style attacks, in cyberbullying, extortion and for other purposes. The need to be able to properly identify and attribute these falsified creations will be a hot topic and should gain a large amount of focus as the malicious uses rise in quantity and quality."



Anand Oswal, senior VP of products, network security, at Palo Alto Networks, also weighed in on the subjects of cyber defenses and network security:

"Adoption of zero-trust principles for OT environments will expand. Until malware ceases to ravage the industrial space, the defense-by-border approach will continue to fail. For those not willing to wait, look to intelligently bring the zero-trust approach into your controls layer where standard IT technologies operate and ransomware flourishes. While the lower Purdue levels are often not yet capable of full zero trust, and may not be ready for many years, a hybrid model combining proper zone controls on the floor and zero trust in the carpeted space can work. They will have to as the inevitable introduction of IT technology and practices will not turn back."

Oswal also added: "In 2024, we'll see the debut of 'evil' digital twins. Companies are constantly investing in emerging technologies like digital twin technology to create virtual models or representations of physical objects to help an organization simulate real situations and their outcomes to help with decision-making. While this technology is helpful for identifying problems before they occur, experts have already indicated this is increasing companies' exposure to cyberattacks.

"For example, the data could be corrupted, manipulated or even stolen to use for iniquitous purposes. In 2024, we anticipate a publicly disclosed cyberattack involving a digital twin that will lead to either a loss of intellectual property, a pivot into a physical environment or other disruption due to the digital twin's model being wrong. As attacks like this become more prevalent, OT cybersecurity will be a key consideration for OT enterprises using digital twin technology."

ON INTERNET OF THINGS, OR IOT



Peter Swaniker, chief technology officer at Sand Technologies, a global information technology services and consulting company:

"In 2024, we will see manufacturers leaning toward integrating their existing IoT solutions rather than buying new commercial solutions or building custom ones. This integration approach empowers companies to maximize their current investments and identify new innovations based on systems and data they already own. AI will play a huge role in this regard, as it enables manufacturers to quickly analyze vast amounts of data and glean actionable insights accordingly—without making huge investments in new or custom tech. They will also find advantages in working with their established solutions and customizing specific elements to align with their distinct requirements, rather than starting over from scratch. This approach will facilitate their strategic planning process for sustained long-term growth and help them develop the agility to quickly adapt to evolving market demands."

Also from Swaniker, regarding artificial intelligence specifically:

"Additionally, in 2024, AI will evolve from a boardroom discussion to an essential and practical tool to enhance the capabilities of digital twin technology and accelerate digital transformation across industries. Digital twins have been the engines of IoT; in 2024, they will morph into AI-enabled drivers that enable industries to understand the quality of their data better and faster than ever. IoT sensors, producing vast amounts of data feeding into the digital twin, need a measure to ensure the data is accurate. AI can 'de-noise' data, allowing manufacturers and other organizations to make informed decisions, respond with greater agility and certainty and support their sustainability goals by identifying additional ways to help reduce their carbon emissions."

ON DATA MANAGEMENT AND STORAGE



Dwaine Plauche, senior manager of product marketing for AspenTech, a provider of software and services for the process industries:

"Data management is a pervasive challenge among industrial organizations. Too often, data is siloed and inaccessible to the people that really need it for data-driven decision-making. In 2024 and beyond, IT and OT teams will prioritize digital solutions that make industrial data more centrally accessible and contextualized, to provide insights for things like predicting and remediating equipment failure, improving production

optimization, determining capital allocation and much more."

Plauche also added: "By giving decision-makers access to actionable information any time, any place and on any device they choose, industrial orgs will make it possible for teams to collaborate in real-time, and most importantly, ensure insights are scalable and repeatable across the business. Having a strong industrial data management strategy will be an important competitive differentiator in 2024 as new priorities, like sustainability, become more pervasive."



Steve Leeper, VP of product marketing, Datadobi, which specializes in unstructured data management and storage:

"The trajectory of storage technology is also poised for a significant shift as the year 2024 approaches, with declining flash prices driving a broad-scale transition toward all-flash object storage systems. This shift is expected to result in superior system performance, catering adeptly to the voracious data appetites and rapid access demands of AI-driven operations. As flash storage becomes more financially accessible, its integration into object storage infrastructures is likely to become the norm, offering the swift performance that traditional HDD-based object storage and scalability that NAS systems lack."

Leeper added: "The landscape of data management will undergo a profound transformation as the relentless accumulation of data heightens the necessity for robust management solutions. According to Gartner's projections, by 2027, it is expected that no less than 40% of organizations will have implemented data storage management solutions to classify, garner insights and optimize their data assets, a significant leap from the 15% benchmark set in early 2023.

"2024 is set to be a pivotal time for data management, with a shift toward API-centric architectures for meshed applications gaining traction."

ON CLOUD COMPUTING, MACHINE LEARNING, AI, DIGITAL TWINS, BLOCKCHAIN AND OT/IT CONVERGENCE



Goldy Aloysious, principal architect, data and AI, for Kyndryl, an information technology infrastructure services provider:

Aloysious said: Cloud computing and different models of cloud services are able to store new types of data, including streaming, batch and machine data. ML and AI have brought in new capabilities like computer vision, predictive maintenance of equipment, quality inspection, etc. Domain of edge computing and edge analytics has transformed the value of IoT device and sensor data. Digital twins and AR/VR provide newer and more efficient customer engagement experiences. Automation helps cobots and drones run more efficiently. Blockchain technology provides opportunities for smart and intelligent supply chains, contracts and managing authenticity of products by avoiding counterfeits.

Why are these technologies trending now?

"These technologies are important to the manufacturing world now because they drive efficiency, streamline and organize data and promote resilient supply chains," Aloysious added. "Above all, these technologies help create a more connected infrastructure."

He continued: "Manufacturers understand that adopting these digital technologies reduces bottom-line expenses and improves employee experience around safety, training and adherence to health and safety regulations - all of which can positively impact brand value and newer business models that can lead to newer revenue streams."

What's going to help digital transformation and the OT and IT convergence?

"Data is critical to the digital transformation of manufacturing industries as well as the integration of IT and OT systems to promote operational efficiency," Aloysious added. "Defining clear areas of responsibility is an important factor in helping OT and IT convergence. Verifying the accuracy and completeness of generated data and having responsible data governance practices are fundamental to leveraging data-driven insights."

ON INDUSTRIAL DEVOPS



Adam Gluck, CEO of Copia Automation, which builds industrial DevOps tools for controls and automation engineers:

"Factories now run an exceedingly high amount of software that control production lines, coordinate robots, route materials, aggregate data and more. Managing this complex technology stack requires standardized processes and tooling. DevOps practices borrowed from enterprise software development are a natural fit for industrial automation engineering, offering superior control, visibility and backup.

"In 2024, industrial DevOps will become a more broadly recognized term. OT teams will adopt solutions that allow version control, continuous integration and delivery, test automation and collaboration for automation code development and delivery to the factory floor. By aligning developers with business goals, enterprises can quickly eliminate silos, accelerate innovation and reduce risk."

ON ACCELERATING OT/IT CONVERGENCE:

Gluck: "Historically, IT and OT have been siloed within manufacturing organizations. But the growing complexity of industrial software is forcing greater integration. OT teams recognize the need to adopt IT strategies like agile development, cloud platforms and automated CI/CD pipelines.

"In 2024, cloud adoption will hit an inflection point across the OT sphere. Data management and application development will increasingly shift to the cloud to leverage scalability and accessibility. At the same time, edge computing and hybrid architectures will expand, allowing for fast identification and containment of software problems, rapid responses and reduced recovery times. By processing and analyzing data locally on-premises while also connecting to the cloud, manufacturers can take advantage of enhanced speed and security." ◻



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Tacton execs see 'customer-centric' digital transformation approaches in 2024

Two executives from the Software-as-a-Service provider for global manufacturers predict industry in the new year will continue to embrace the digital evolution of their businesses with conditions that it must make their commitments to sustainability easier.

By Scott Achelpohl, managing editor, Smart Industry

What trends are manufacturers going to be watching in 2024?

According to Deloitte, "manufacturers should continue embracing digital transformation to contribute to a competitive and resilient future and to help tackle ongoing manufacturing challenges. Technology is poised to play a significant role in supporting manufacturers in taking on the challenges they may face in 2024. With a persistent search for efficiency and focus on building resilience across the organization, many manufacturers look to continue to pursue their digital transformation objectives."

To that end, two executives from Tacton, a 25-year-plus software and Software-as-a-Service (Saas) provider for global manufacturers such as ABB, Daimler, MAN, Scania, Siemens, Xylem and Yaskawa, shared their own insights with *Smart Industry* about how manufacturers will use technologies

to support customer-centric approach in manufacturing, make environmental commitment easier and simplify the sale of even the most complex manufactured goods.

ENVIRONMENTAL COMMITMENT BECOMES THE NORM IN 2024

Madeleine Bergrahm, sustainability manager at Tacton, said a commitment to sustainability took root in 2023, and "we see that trend continuing and gaining speed in 2024. Carbon footprint goals and regulations continue to be a critical focus for companies worldwide."

She added: "Based on interviews with customers, we've seen manufacturers at risk of losing revenue if they cannot provide [environmental, social and governance] data as part of their quotes. Without ESG data, the risk is up to 5% reduction in revenue. But with the inclusion of ESG data, there's a potential for approximately 25% increase in revenue."

Bergrahm also said: "In the coming year, manufacturers that adopt technology to track and direct environmentally friendly supply chain and manufacturing practices with related ESG reporting will be best equipped to meet buyer demands and be able to showcase to their boards and investors the impact their products and processes have on the environment. Understanding environmental footprints will become the norm for manufacturers to not only report the environmental impact of products to regulatory organizations, but also inform their prospects on choosing optimal solutions with readily available carbon emissions data for configured products."

CONSUMERIZATION COMES TO MANUFACTURED GOODS

Nils Olsson, Tacton's chief customer officer, said manufacturers are striving to simplify the process of purchasing personalized goods, leading to the convergence of e-commerce and manufacturing.

"Increasingly, B2B buyers expect the same level of ease and personalization they enjoy when shopping for personal items online. Advancements in visualization technologies and augmented reality have made it easier for B2B buyers to enjoy the same easy customization and one-click purchase journeys that they're accustomed to in the B2C realm," he said.

Olsson added: "With the help of visual product configurators, buyers can make informed decisions more quickly and easily, while sellers can effectively showcase their products and increase conversions. This benefits both parties in the B2B e-commerce space. While making configuration adjustments, buyers will be able to view real-time previews of how products will appear and perform. In addition, they can offer input on product availability, compatibility and costs as well as ideas for promoting additional products and complementary items."

MANUFACTURERS EMBRACE THE CUSTOMER-CENTRIC APPROACH

Manufacturing is changing rapidly with customers demanding a B2B buying journey that mirrors their daily purchases, Olsson said. "Buyers of complex manufactured goods are no different than buyers who purchase consumer goods: Whether they're buying a semi-trailer truck or a pair of sneakers, they all want fast, easy and accurate buying experiences. As a result, manufacturers of highly configurable manufactured goods and services have started adopting various levels of technologies to help improve their customers' buying journeys."

On the topic of customer-centricity, he added: "Heading into 2023, 45% of manufacturers we surveyed said they wanted to improve the customer experience. As we round the corner into 2024, we've seen that number increase substantially as manufacturers across the globe are searching for ways to transform their operations to engage with customers when and where they want." ◻



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2024 will see more automation in manufacturing to free humans for higher-value jobs

Matt Wicks, senior director of product management for robotics automation at Zebra Technologies, advises: Put more machines on the terminal floor to free up humans for more value-added tasks.

By Scott Achelpohl, managing editor, Smart Industry

Matt Wicks, senior director of product management for robotics automation at Zebra Technologies, checked in with *Smart Industry* before the end of 2023 with his predictions in the area of manufacturing robotics for the new year and his insights focused on the increased move toward more automation.

MORE AUTOMATION, MORE AUGMENTATION FOR HIGHER-VALUE HUMAN ROLES

"Warehouse operations are ripe for automation and a greenfield for robots. Only a handful are rumored to be nearing full ("dark warehouse") automation," Wicks told *SI*. "Few are employing automation tools at the level needed to augment labor shortages and shorten fulfillment lead times."

"A high cost of capital will impact all ROI calculations," he continued. "However, current turnover rates leave little to no room to slow down investments. Business-critical use cases still need to be performed, if no labor is available, they might be divorced from traditional pay-back calculations and drive even more automation."

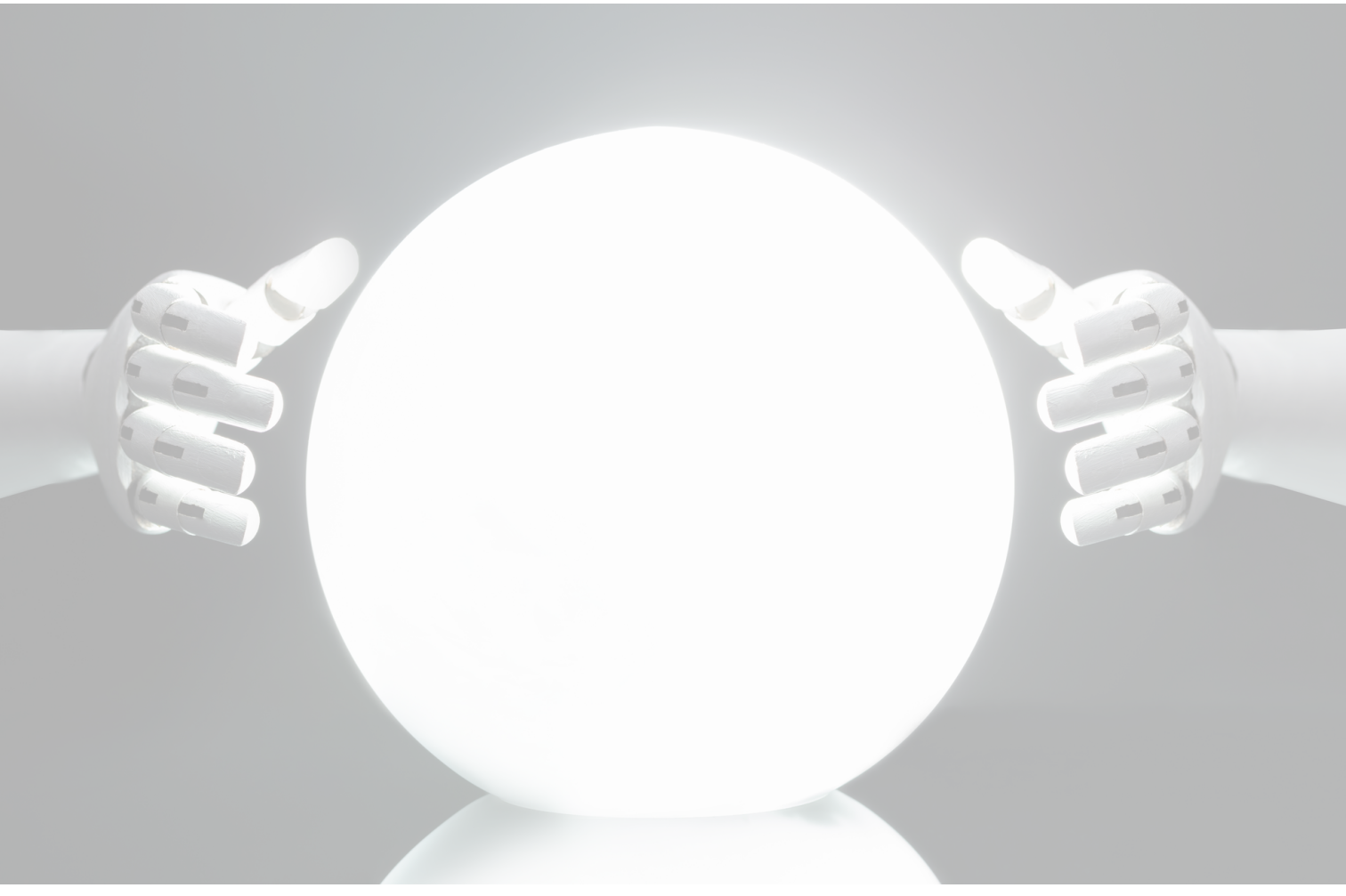
He added: "Warehouse workers will take on the higher-value tasks that require a human touch—decision-making and dexterity that only humans can deliver."

ALIGN WAREHOUSE ROBOTICS NEEDS WITH ASSEMBLY LINES, RETAIL

"As retailers respond to fluctuating consumer demand, it also impacts manufacturers; they will need to work to align their technological

capabilities so storage and loading areas are in lockstep with production lines and retail stores," Wicks remarked. "Robot-powered automation will lead the way alongside critical mobility, scanning, printing and location technologies. Automated pick-to-light, voice and automatic storage and retrieval systems (ASRS) along with sortation and conveyors will remain staples."

Wicks added: "Warehouse leaders will utilize their front-line workers for customer-centric tasks focused on quality assurance and accuracy, cost control and space utilization. Prioritizing customer order accuracy, returns, expedited put away, trailer loading and utilization over moving materials across an expansive warehouse footprint will prevail when given the choice and the deployment of autonomous mobile robots into the environment. In fact, the more the low-value-added work is removed from the process with automation, the more important it will be to equip labor with the right technology." ◻





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Shift away from dark networks, embrace of cloud migration should continue at warehouses

Ivanti Wavelink's Brandon Black provides technology predictions for 2024 on the supply chain and warehousing technology.

By Scott Achelpohl, managing editor, Smart Industry

What should be new in warehousing and warehousing tech in 2024?

Brandon Black, senior VP and general manager of Ivanti Wavelink, a supply chain software vendor, provided insight into the new year for *Smart Industry* readers recently, much of it having to do with cloud and how his customers are trying to move away from siloed "dark networks."

"Five years ago, warehouses were reticent to move to the cloud from a dark network. However, as warehouses adopt more smart technologies and automated tools, the need for connectivity extends beyond the traditional confines of the warehouse walls," Black said in emailed comments.

"Operations leaders realize the imperative of connecting workers back to enterprise systems even when they are performing tasks in remote locations, pop-up warehouses, etc. In 2024, we will see leaders shifting their mindset and embrace cloud-based access to apps, and further welcome the potential of 5G connectivity to enhance their warehouse operations."

ON CONSOLIDATING WAREHOUSE VENDORS TO KNOCK DOWN SILOS

"Warehouses, supply chain and logistics companies leverage various devices, which means

numerous endpoints that require protection and management. With the introduction of new technologies in the warehouse such as smart assets, companies transitioning from old hardware to new hardware may need to adopt a new MDM solution to secure all their devices in addition to their existing MDM solutions," Black noted.

"However, companies are overwhelmed by the various vendors and fragmented MDM solutions. 2024 will see industry leaders seeking innovative strategies to dismantle these operational silos and optimize processes by consolidating both vendor relationships and MDM solutions. The ultimate aim is to establish a unified 'single source of truth' for seamless operations."

ON HOW AUTOMATION, AI, ROBOTS WILL ATTRACT A NEXT WAVE OF WAREHOUSE WORKERS

"The new generation of warehouse workers want to work alongside robots, leverage AI for efficiency and automate mundane tasks. These solutions are attractive to younger workers because they offer flexibility, independence and career advancement," Black noted. "Without them, millennials and Gen Z are not inclined to work in the warehouse because the majority of their lives have been centered around technology. Solutions need to be tailored to them such as rugged devices that reflect a smartphone interface instead of a green screen. At the risk of being left behind, warehouses must embrace technology and innovate like never before."

ON HOW WAREHOUSE WORKERS WILL CONTINUE TO EMBRACE AMRS

"While designed in part to make the jobs of warehouse workers easier and more efficient, autonomous mobile robots have sparked fear of replacement and at times frustration with capabilities. However, in 2024, we will see employees start to recognize the value of AMRs and embrace them to advance their careers, learn new skills, increase their output and better manage their time," Black predicted.

"By leveraging AMRs, employees can save time and ultimately finish the job faster—helping with employee job satisfaction and warehouse productivity. This will allow employees to see the value of AMRs and begin to build trust with the technology." ◻

