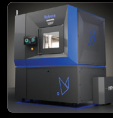




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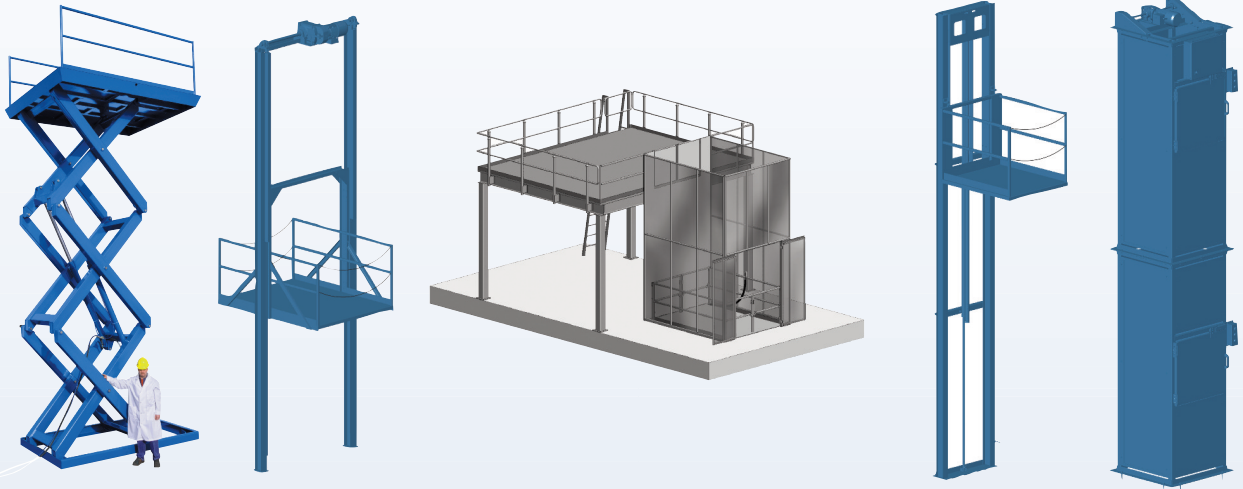
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Migatron Corporation's RPS-429AA-40P-IS2 Intrinsically Safe Ultrasonic Sensor delivers accurate distance measurement and object detection in hazardous locations, with ATEX, IECEx, and C-UL-US certified.

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Extech's BR95 Video Bore-scope provides waterproof inspection through confined and complex spaces, capturing HD images with 3x zoom and optional environmental probes for CO, CO<sub>2</sub>, and RH measurement.



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## The Bill Always Comes Due

My husband and I are in the middle of getting our house ready to sell, and the process has become a tour of every shortcut the previous owners took. We've known about most of them, living with the quirks and dealing with the emergent stuff as it came up. Now that we're preparing to list, we've been working through the smaller things we put off. Some of it has been straightforward. And then there are the things you don't find out until you go to fix it and realize it's a lot worse than it looked.

The latest project involves a set of windows on our pole barn—or what I've been generously calling windows. Whoever built them didn't install actual window units. They framed out openings with untreated 2x4s and plywood, glued a panel of glass in between, and painted the whole thing. With interior paint. On the exterior of a building. We knew the paint was peeling when we bought the place almost seven years ago. What we didn't know, until we went to repaint it, was that the wood underneath had rotted completely through. Our cosmetic issue had turned into a structural one.

So now we're rebuilding it ourselves. We bought treated lumber, started pulling apart the old frame, and immediately hit problem two: not a single measurement on this thing is the same. The frame isn't square, the spans aren't even, and every piece of wood we cut has to be measured individually. There's no such thing as a repeatable cut on this job. Then we learned—after we'd already bought the treated lumber—that you're not supposed to paint treated wood until it's had time to dry out, which in our climate could take upwards of a month. We needed to finish this last weekend. So now we're deciding whether to return the lumber or wait for it to dry. We're also still figuring out the glass cutting.

The whole thing has been a slow-motion exercise in someone else's bad decisions compounding into our present-tense problem. The original builder used the wrong materials. The previous owners used the wrong paint. Nobody treated the wood or thought about what would happen in two, five, or ten years. They just needed it to look fine long enough.

I can't tell you how many times I've seen this same logic play out in an industrial context: a component spec'd wrong because it was cheaper, a maintenance step skipped because nothing had broken yet, a system installed "good enough" that quietly degrades until it takes something else down with it. The details differ but the pattern is the same: someone "optimized" for right now and handed the real cost to whoever came next.

The frustrating part isn't the work. It's that doing it right the first time would have been almost as easy. Treated wood, exterior paint, a square frame. None of that's fancy. It just required someone to think past the sale.

We'll get it done. And when we sell this house, at least the windows will be real for the next owners.

— **Laura Davis**, Editor-in-Chief

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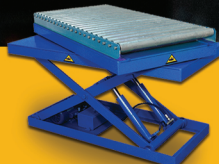
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# Gantry Palletizers Deliver Cobot-Level Pricing With Higher Performance

For plant managers weighing automation options, the choice between cobot palletizers and traditional gantry systems has long come down to cost. Cobots have dominated the conversation largely on acquisition price alone. CODI Manufacturing's **Flex Stack series** challenges that assumption directly, offering gantry palletizer performance at a price point that competes with cobot solutions—without the payload, speed, and durability trade-offs that typically come with lighter-duty systems.

The Flex Stack series consists of two standard models and one customizable configuration. The standard models handle loads up to 44 lb (20 kg) and 66 lb (30 kg), while the Flex Stack Pro scales up to 110 lb (50 kg) and can be tailored to specific production requirements. All units operate at 4 to 10 boxes per minute. The Flex Stack Pro supports twin-pallet configurations, allowing one pallet to load continuously while the other discharges—a practical solution for high-throughput lines where downtime between pallet changes is not acceptable.

The series supports both palletizing and depalletizing and can handle mixed-product pallet builds, giving operations with varied SKUs or fulfillment requirements more flexibility than fixed-pattern systems typically allow. Tier sheets with glue options are planned for future availability. Units are skid-mounted and can be repositioned on the floor via pallet jack or forklift, which matters in facilities where line configurations change seasonally or by product run.

## Built on Festo Mechatronics

The mechanical and control architecture of the Flex Stack is built around Festo components, including axes, multiprotocol servo drives, a Z-axis motor with brake, a hybrid controller, vacuum technology, and CPX-AP-A remote digital I/O. The use of catalog-based, globally supported components is a deliberate design decision—standardized parts mean faster sourcing, lower spare parts inventory costs, and reduced risk of extended downtime waiting on custom or proprietary components.

For operations that want visibility into component health before failures occur, CODI offers optional Festo AX Motion Insights subscriptions for both electric and pneumatic systems. The predictive analytics package monitors motors, drives,



The Flex Stack series of gantry palletizers/ de-palletizers is based on world-class Festo mechatronic technology.  
© CODI Manufacturing

and cylinders in real time, enabling maintenance teams to order replacements proactively rather than reactively. A separate Festo AX Data software option gives IT departments direct access to operational technology data, supporting broader plant digitalization initiatives.

## No Programming

One of the more practical aspects of the Flex Stack is its palletizing software, which runs in a standard web browser—Chrome, Edge, or Firefox—and requires no programming knowledge to operate. A one-click, auto-generate function calculates optimal pack patterns automatically, with built-in plausibility and limit-value checks to confirm the pattern is physically viable before the line runs.

Operators get a 3D view of the pallet that can be rotated, zoomed, and adjusted using a mouse, making visual verification straightforward. The software also monitors and records palletizing process status, giving supervisors a running log of operations.

For facilities that have struggled with the learning curve or IT overhead of more complex automation software, this approach lowers the bar for adoption without sacrificing functionality.

## Labor and Space

Gantry palletizers occupy less floor space than manual palletizing operations and eliminate the ergonomic and worker compensation risks associated with repetitive heavy lifting. For operations currently running manual end-of-line palletizing, the transition to a Flex Stack unit addresses both the labor cost and the injury liability side of the equation simultaneously.

CODI positions the Flex Stack series as a solution for third-party logistics operations, food & beverage producers, and consumer goods manufacturers—industries where pallet load integrity, throughput consistency, and labor reliability are ongoing pressure points. The simple linear mechanics of gantry design also mean less mechanical wear over time compared to articulated arm systems, with maintenance needs that a general maintenance technician can handle without specialized robotics training.

For operations still running manual end-of-line palletizing, the Flex Stack series covers the practical bases: standard components, no-code software, and a gantry footprint that fits where a pallet jack already goes. **NEED**



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**UE Systems, Inc.**

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**AI Device Tracks Every Pallet in Real Time**

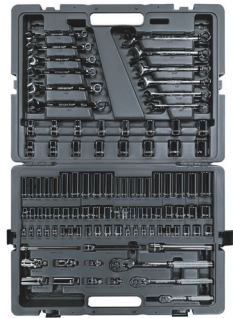
Designed for warehouses running forklifts, reach trucks, and other material handling equipment, **Corvus Trident** mounts directly to existing MHE to automatically capture pallet movement across inbound, putaway, replenishment, picking, and outbound—no manual scanning required. Onboard AI reads multiple barcodes simultaneously, tracks up to three pallet stacks high, and operates without GPS, beacons, or markers.

**Corvus Robotics**

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**Cougar Pro 103-Piece Socket Set Features 60-Tooth Ratchets**

The **Cougar Pro A234** 103-piece socket wrench set includes SAE and metric sockets and wrenches, ratchets, extensions, adapters, and specialty pieces, organized in a carry case. Quick-release oval-head ratchets feature 60-tooth gears and a 6-degree arc of rotation for access in tight spaces. Sockets have an increased contact area to minimize fastener rounding. Combination wrenches have 12-point box ends with corner torque loading. Ergonomic handles, chamfered edges, and engineered tool lengths add comfort and leverage.



**Wright Tool**

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**Milwaukee Tool**

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**Exoskeleton Cuts Shoulder Strain by 50%**

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**Comau**

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**Combo Sweeper-Scrubber Cuts Cleaning Time**

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**Nilfisk**

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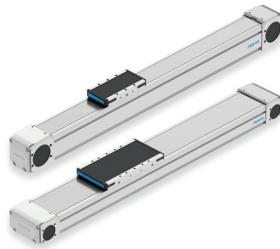
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**Festo Corporation**

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**Glovebox Bag Dump Station Runs Dust-Free**

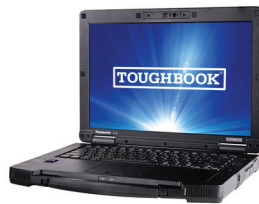
Providing fully enclosed bag opening, dumping, and compaction, the **FLEX-ICON Mobile Bag Dumping Station** isolates bulk materials throughout the entire transfer process. Built-in rubber gloves, a dual-cartridge dust collector maintaining negative pressure, and safety-interlocked compactor doors ensure operator protection. A stainless-steel flexible screw conveyor moves free and non-free-flowing materials downstream, while locking casters allow repositioning across the plant.

**Flexicon Corporation**

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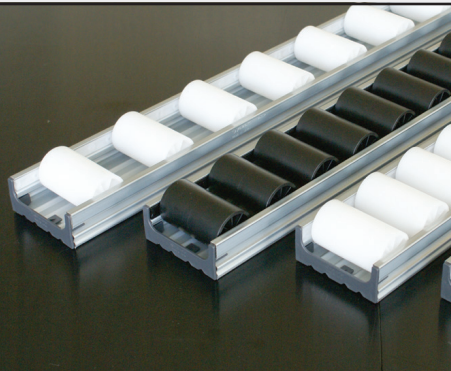
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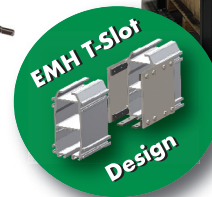
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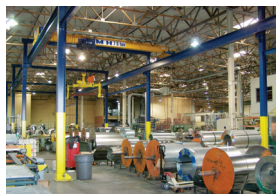
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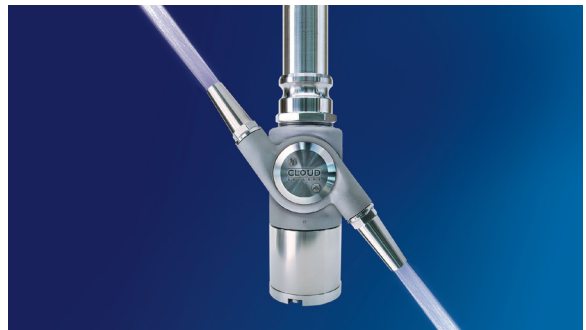
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## A Short Guide to High Efficiency Motor Selection for System Designers

- 22 Hawaii DOT saves nearly \$1 million per year in maintenance costs via streamlined condition monitoring
- 24 How Nestlé USA used AI to improve spare parts search and inventory visibility across its network of factories
- 26 What color is your bearing? (and why that matters)

## HIGH EFFICIENCY MOTOR SELECTION

# Abandon the “one-size-fits-all” approach in favor of balancing motor sizing, energy loss, and operational cost factors.

By Ian Miller, P.Eng.

**W**hen designing industrial equipment or selecting a component for a specific application, a solid understanding or intuition of operating principles is a great asset. This is particularly true when selecting the prime mover, which for many industrial applications is a three-phase squirrel-cage induction motor.

Electric motor selection has a profound impact on energy requirements and long-term energy consumption, so it is key to understand the factors that drive electric motor efficiency and their respective ratings. Beyond operational costs, motor efficiency can deeply affect a system’s functionality.

Thankfully, the process of selecting an electric motor has been made easier by standardization initiatives from associations like NEMA and the IEC. Perhaps the most important standardization was of motor frame size, whose impact cannot be overstated. Likewise, the standardization of motor efficiency classification has greatly simplified the motor selection process. This simplification, however, should not distract from the importance of understanding the fundamental operating principles behind this technology. Rather, it should serve as a tool to improve productivity.

## The impact of sizing on motor efficiency

One complication when discussing motor efficiency can be the sizing conventions typically used. Unlike other devices, motor sizing is based on mechanical output power, not on the energy consumed. NEMA-rated motors are often sized in horsepower (hp), and IEC-rated motors in watts (W). Where

1 hp is equivalent to 746 W, new designers can be excused for confusing energy delivered with energy consumed.

The same could be said for the tunnel vision that can occur during the sizing process. Power consumed and efficiency are often less of a priority than delivered mechanical energy, and any additional operational costs that result are borne by the end user. With designers and equipment manufacturers under pressure to optimize upfront cost vs. performance, operating costs are not always duly considered during the project’s design phase.



**Figure 1.** Technicians install and perform an alignment for a new premium efficiency motor, selected for energy savings on a pumping application. *Courtesy of Motion Repair & Services*

## Types of motor energy losses

When discussing motor efficiency, it also is prudent to contextualize how energy losses are generated. Although a motor's efficiency rating provides an overall basis for comparison, it is the losses inherent to the design that ultimately drive this rating. These losses result from several factors but are often categorized as stator loss, rotor loss, core loss, frictional and windage loss, and stray load losses—all leading to heat generation:

Stator resistance loss is the largest of these contributing factors, followed closely by rotor resistance loss. Both can be characterized by the equation  $P_{Loss} = I^2R$ .

Core losses are primarily caused by the induced eddy currents and magnetic hysteresis resulting from the changing magnetic fields within the motor's core.

Friction and windage losses are attributable to the shaft bearings (friction) and the aerodynamic factors

related to the spinning rotor and motor fan (drag).

Stray load losses are a catch-all category for all other losses that can occur. They are primarily caused by manufacturing defects, material defects and harmonics (resulting from VFD use) and are often dependent on motor loading. These issues can lead to problems of circulating currents, flux non-uniformity or interlaminar currents.

Alternatively, these losses can be categorized as ohmic (stator and rotor loss), mechanical (frictional and windage), iron (hysteresis and eddy currents), and stray (everything else).

## How do motor manufacturers combat efficiency losses?

Understanding the issues that cause efficiency losses leads to the next logical question: What can motor manufacturers improve to combat them? The

**Table 1.** NEMA and the IEC rating conventions.

NEMA	IEC
Standard efficiency	IE1
High efficiency	IE2
Premium efficiency	IE3
Super premium	IE4
No standards	IE5

**Note:** each band of efficiency = 10% less motor loss.  
**Source:** ABB

answer is both simple and complex. In short, efficiency is enhanced by reducing resistance, improving the quality of the materials used, and increasing the accuracy level throughout the manufacturing process. These marginal improvements can have meaningful impact.

Table 1 outlines the IEC and NEMA rating conventions, illustrating how

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they align. Each step in classification will deliver 10% fewer losses. Although NEMA doesn't have a rating comparable with IE5, some motor manufacturers are labeling motors with efficiencies higher than "Super Premium" as "Ultra-Premium."

Motor efficiency increases come at the cost of increased weight and price. The increase in weight can be primarily attributed to efforts in reducing resistance. To accomplish this, larger conductors—and thus more conductor material—are required for efficient conduction within the motor. For equipment designers and manufacturers who integrate motors as part of an assembly, this higher upfront price and additional weight must be balanced against many factors to determine the suitable efficiency class, based on the application's requirements. Although higher efficiency would intuitively seem like the obvious choice, this is not always the case.

**Table 2.** Efficiency ratings for IE2–IE4 classifications.

OUTPUT KW	IE2				IE3				IE4			
	2 POLE	4 POLE	6 POLE	8 POLE	2 POLE	4 POLE	6 POLE	8 POLE	2 POLE	4 POLE	6 POLE	8 POLE
0.12	59,5	64,0	50,5	40,0	62,0	66,0	64,0	59,5	66,0	70,0	68,0	61,0
0.18	64,0	68,0	55,0	40,0	65,6	69,5	67,5	64,0	70,0	74,0	72,0	68,0
0.25	68,0	70,0	59,5	52,0	69,5	73,4	71,4	68,0	74,0	77,0	75,5	72,0
0.37	72,0	72,0	64,0	58,0	73,4	78,2	75,3	72,0	77,0	81,5	78,5	75,5
0.55	74,0	75,5	68,0	62,0	76,8	81,1	81,7	74,0	80,0	84,0	82,5	77,0
0.75	75,5	78,0	73,0	66,0	77,0	83,5	82,5	75,5	82,5	85,5	84,0	78,5
1.1	82,5	84,0	85,5	75,5	84,0	86,5	87,5	78,5	85,5	87,5	88,5	81,5
1.5	84,0	84,0	86,5	82,5	85,5	86,5	88,5	84,0	86,5	88,5	89,5	85,5
2.2	85,5	87,5	87,5	84,0	86,5	89,5	89,5	85,5	88,5	91,0	90,2	87,5
3.7	87,5	87,5	87,5	85,5	88,5	89,5	89,5	86,5	89,5	91,0	90,2	88,5
5.5	88,5	89,5	89,5	85,5	89,5	91,7	91,0	86,5	90,2	92,4	91,7	88,5
7.5	89,5	89,5	89,5	88,5	90,2	91,7	91,0	89,5	91,7	92,4	92,4	91,0
11	90,2	91,0	90,2	88,5	91,0	92,4	91,7	89,5	92,4	93,6	93,0	91,0
15	90,2	91,0	90,2	89,5	91,0	93,0	91,7	90,2	92,4	94,1	93,0	91,7
18.5	91,0	92,4	91,7	89,5	91,7	93,6	93,0	90,2	93,0	94,5	94,1	91,7
22	91,0	92,4	91,7	91,0	91,7	93,6	93,0	91,7	93,0	94,5	94,1	93,0
30	91,7	93,0	93,0	91,0	92,4	94,1	94,1	91,7	93,6	95,0	95,0	93,0
37	92,4	93,0	93,0	91,7	93,0	94,5	94,1	92,4	94,1	95,4	95,0	93,6
45	93,0	93,6	93,6	91,7	93,6	95,0	94,5	92,4	94,5	95,4	95,4	93,6
55	93,0	94,4	93,6	93,0	93,6	95,4	94,5	92,4	94,5	95,8	95,4	94,5
75	93,6	94,5	94,1	93,0	94,1	95,4	95,0	93,6	95,0	96,2	95,8	94,5
90	94,5	94,5	94,1	93,6	95,0	95,4	95,0	93,6	95,4	96,2	95,8	95,0
110	94,5	95,0	95,0	93,6	95,0	95,8	95,8	94,1	95,4	96,2	96,2	95,0
150	95,0	95,0	95,0	93,6	95,4	96,2	95,8	94,5	95,8	96,5	96,2	95,4
185	95,4	95,0	95,0	93,6	95,8	96,2	95,8	95,0	96,2	96,5	96,2	95,4
220	95,4	95,4	95,0	93,6	95,8	96,2	95,8	95,0	96,2	96,8	96,5	95,4
375- 1000	95,4	95,8	95,0	94,1	95,8	96,2	95,8	95,0	96,2	96,8	96,5	95,8

Source: ABB



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Table 2, based on the IEC 60034-30-1 standard, outlines efficiency ratings for IE2 and higher classifications. One thing that should stand out immediately is that the larger the kW rating, the higher the baseline efficiencies. This is due to economies of scale, as energy losses will not scale up in direct linear proportion to the motor's power ratings. It is helpful to also remember that a motor's efficiency will likely be dynamic throughout its loading curve. Peak efficiency will typically occur somewhere between 50% and 100% of the loading range.

**Two examples of weighing efficiency factors when selecting an electric motor**

To help illustrate some of the factors that must be balanced when specifying a new motor, let's consider a hypothetical example where our application requires a motor that can deliver 15 kW of mechanical energy. Based on the data in Table 2, if we select a 4-pole motor, it will mean 91% eff (efficiency) for IE2, 93% eff for IE3, and 94.1% eff for IE4. To examine a continuous-duty application, we will assume the application runs 24/7 (8,760 hours per year) with a \$0.10 per kWh cost. Comparing and applying the above efficiencies, that would mean:


$$kW\ Hrs = (Rated\ kW \times\ hours\ of\ operation) /\ eff$$

**Table 3.** Potential savings calculations for different motor efficiency classes.

CLASS	EFFICIENCY	KW HOURS	ANNUAL ELECTRICAL COST	POTENTIAL SAVINGS
IE2	91.0%	144,396	\$14,439.56	--
IE3	93.0%	141,290	\$14,129.03	\$310.53/yr
IE4	94.1%	139,639	\$13,963.87	\$475.69/yr


If we estimate the equipment's service life to be 10 years or more, this application could easily pay for itself with the IE4 motor's energy savings. However, these savings are typically only realized by the end user. Buyers can face real-world limitations that create split incentive structures. Perhaps their capital projects or maintenance budget is limited. Or, maybe the buyer is not tied to operating budgets and is thus not motivated by potential savings. Perhaps this is for a mass-produced application, and the competitive nature of the market means reducing upfront costs is the key consideration. Or, it is a mobile application, and weight is most important, or the motor's duty cycle is less than 30 minutes a month. As you can see, specifying a motor is not as straightforward as it appears.



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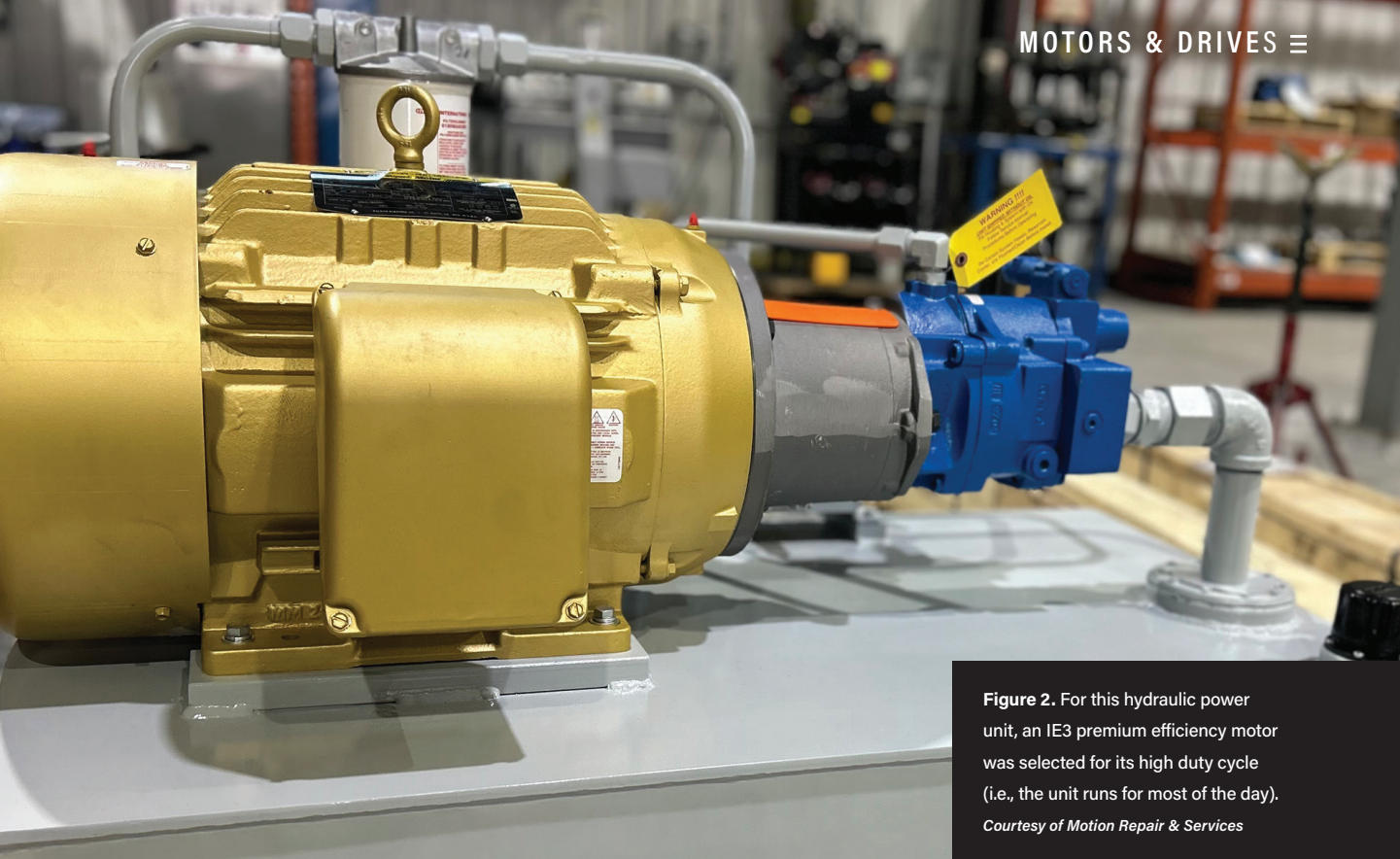
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**Figure 2.** For this hydraulic power unit, an IE3 premium efficiency motor was selected for its high duty cycle (i.e., the unit runs for most of the day).  
Courtesy of Motion Repair & Services

Also, when selecting a motor for existing applications, it may seem intuitive to simply replace an existing failed motor with a higher-efficiency model—but that is not always the ideal solution. Consider a second example, a fan application that has been in service for several decades, where the original motor ran at or below NEMA Standard efficiency (or IE1). For such an application, it is critical to consider that higher-efficiency motors typically run faster (have less slip).

For fan applications, this speed difference can't be overlooked, as fan and pump loading are governed by affinity laws (i.e., effects by changes in motor speed). For our application, a 1% increase in speed can lead to a 3% increase in loading. Therefore, when upgrading from a 1740 rpm motor to one at 1760 rpm, the power increase can wipe out any potential savings from upgrading efficiency ratings.

Rather than a single swap, a holistic review of the application could be warranted, particularly for higher-horsepower applications. In such a review, you may find that the application was oversized from the beginning or that a v-belt could be upgraded to a synchronous belt to further improve efficiencies. Given the age of the application, it might also be utilizing a magnetic

***What can motor manufacturers improve to combat efficiency losses? The answer is both simple and complex. In short, efficiency is enhanced by reducing resistance, improving the quality of the materials used, and increasing the accuracy level throughout the manufacturing process. These marginal improvements can have meaningful impact.***

motor starter. Installing a VFD in combination with the motor and upgraded belt drive provides a multi-faceted approach to upgrading the design while substantially reducing power consumption.

### **In conclusion**

As with most design-related topics, there is much nuance, and a “one-size-fits-all” approach is rarely the ideal strategy. Understanding the first principles and the factors that govern equipment operation is critical. As equipment designers develop and grow, they build a fundamental

understanding of these operating principles—which evolve into designing with a more simplified and elegant approach. When evaluating motor efficiency classes, this foundational understanding should always be your governing principle. **PS**

Based in Calgary, **Ian Miller, P.Eng.**, is a division manager for Motion Repair & Services. With 20 years of industry experience, his current responsibilities include oversight and development of 12 repair/service centers focusing on fluid power, automation and material handling. Miller is passionate about providing top customer service through technical expertise and added value. For more information, visit [motionind.biz/4dT5v03](http://motionind.biz/4dT5v03).

# Firefighting Is Not a Maintenance Strategy

*Condition monitoring is key to helping maintenance teams take back control, especially when teams turn data into action and close the feedback loop between workers and systems*



**Ares Panagoulis** is Director of Condition Monitoring & Asset Reliability at Hydro Inc., where he works directly with customers to analyze data to improve rotating equipment maintenance strategies, increase availability, and reduce downtime. He can be reached at [apanagoulis@hydroinc.com](mailto:apanagoulis@hydroinc.com).



**Robert McCowan** is Director of Sales & Commercial Strategy Centaur - Condition Monitoring at Hydro Inc., where he leverages his expertise in industrial systems and reliability. He can be reached at [rmccowan@hydroinc.com](mailto:rmccowan@hydroinc.com).

**PS:** Let's start with a general question. Let's say you're building a condition monitoring program from scratch. What are the foundational building blocks that you have to get right before you install a single sensor?

**RM:** If you start looking for more problems, you're going to start finding more problems. Having a plan of action and creating a hierarchy of responsibility really helps. Without teamwork and organization, you're going to be left with a bunch of problems and not know where to start.

Before you deploy any sensors, create a critical asset list. Taking a phased approach makes issues more manageable upfront, then repeat the process until all critical equipment is monitored.

**AP:** We need to define what the goals are before we say what sensors we need, how many are required, and what areas of the plant we are going to focus on. Too often people come at it from a reactive standpoint, and they're not defining the goals upfront.

**PS:** We hear a lot about AI doing the heavy lifting for data analysis. But there's a human element that has to be in place for these programs to be successful. Why is the human element still the critical missing link?

**AP:** I'm starting to think that the human is irrelevant based on all we hear about these days. It's just AI, AI, AI.

We're big believers in the human element. There's no doubt that machine learning and pattern recognition are making leaps and

bounds. But what does AI know about the context of the machine? And what will it do to execute recommended work orders?

There's still a dire need for (1) translation of the data, and (2) subject matter expertise. We think the best approach involves AI but also uses subject matter expertise and machinery context. Too often people go to the allure of, "AI is going to tell you exactly what to do." We're just not there yet.

*"We need to define what the goals are before we say what sensors we need, how many are required, and what areas of the plant we are going to focus on. Too often people come at it from a reactive standpoint, and they're not defining the goals upfront."*

**RM:** Are you really going to subject your critical equipment to evaluation by an AI system? If you pull a machine for repair and the AI got it wrong, you're using resources trying to fix problems that didn't exist to begin with. We don't want to identify problems without having them verified by a human who understands your equipment.

The system also can't make judgment on what it can't see. If it doesn't have adequate data fed into it – process data, environmental conditions – it's missing key elements to how that machine's operating under different conditions.

**PS:** One of the outputs of these programs are dashboards that show data in real time. Is there a risk that these dashboards can make technicians, especially digital natives, less likely to walk the floor?

**RM:** A lot of old school methodology was do your routes, walk by your equipment. If you're around rotating equipment long enough, you know how it should sound, feel, even how the floor vibrates. But this manual route takes a lot of time and it's inefficient.

Dashboards can make you lazy, but they can also give you a laser focus. You can see problems in real time and say, 'something's not right here, let me go to that asset.' Just like some will use AI and become stronger because of it, that's the same for dashboards. If you use it appropriately, it's going to make you more efficient and give better visibility into issues you didn't pick up the traditional way.

**AP:** 10 years ago, we were convincing folks to utilize this new technology and bring digital efficiency into their work. I wonder if in 10 years we're going to be convincing digital natives that they should go out and get a sense for what the equipment feels like.

It's about finding the right balance- utilizing data to manage assets with less labor, but not replacing the information you get from being next to something.

**PS:** Is there a rule of thumb to balance screen time with actual machine time?

**AP:** It looks different for everybody. If you're working in mid-stream with assets up and down a large area, screen time can reduce driving time. But in a refinery where the equipment is easily accessible, you can get out to it more.

You've got to tailor your approach to the resources you have and their skill set. That thinking informs how we tailor Centaur to a customer's needs- do you need support on the analytical side to make sense of the data? Or do you need onsite support to execute what the data is telling us? Everyone's a little bit different.

**PS:** I've seen it come up time and again where people set their baselines and are suddenly flooded with alerts. What is your process for filtering out that noise, identifying signals that warrant opening a work order, and minimizing "alert fatigue"?

**AP:** There's often a break-in period where you need to tailor what those baselines are. We're coming out of an age where people are relying on standards for what "good" looks like.

That's a first-process way to get rid of a flood of alarms that lead folks to turn off the value of these types of systems.

Filtering techniques that use AI can also reduce the amount of alarms. As we've iterated our software, this has helped tremendously- I'd say it's driven down nuisance alarm volume by about 80%. So it's a combination of technological approaches and process approaches.

**RM:** That goes back to workflow hierarchy. That way one guy isn't getting every alert for every piece of equipment. There's also going to be a ramp-up period when you learn how the machine works, tailoring alarms to how that machine runs rather than a general standard.

**AP:** Another piece is closing the feedback loop – the back and forth between the user and the system. The more tightly you close that, the more likely you're going to get alarms to a point where they are actionable.

When people don't invest that time, alarms are generated with no action, and you start to lose confidence in the system. Working up front to develop the system goes a long way towards its efficacy down the road. And ultimately, that's what we're after, making an investment and seeing a return through a reduction in downtime or maintenance spend on a certain asset.

**PS:** We'll get you out of here on this one. When a plant invests heavily in a predictive maintenance program and it fails to deliver the expected ROI, what is usually the root cause?

**AP:** It goes back to first principles - what are the goals of the program and for that specific asset? When there is an ill-defined expectation, that is going to manifest as an ROI that either can't be calculated or isn't what we're looking for. If we define that clearly upfront, it sets us up to achieve it.

**RM:** It's like going to the doctor and he says, "you've got a broken leg." If you go home and don't put a cast on it, do you expect that to get better? Our sensors are telling you what needs to be done. But if you don't take the steps to fix it, there is no ROI. We have to turn data into action.

It comes down to that philosophy: condition monitoring technology won't turn the wrench, it's going to show you where to go turn the wrench. With the expertise we have, we're able to advise what needs to be done, but you've still got to take the action. **PS**

*"It's like going to the doctor and he says, "you've got a broken leg." If you go home and don't put a cast on it, do you expect that to get better? Our sensors are telling you what needs to be done. But if you don't take the steps to fix it, there is no ROI. We have to turn data into action."*

# Hawaii DOT Saves Nearly \$1M per year in Maintenance Costs via Streamlined Condition Monitoring

*Roadway damage inspections are increasingly automated using crowdsourced dashcam video, machine learning analytics, and AI-supported reporting.*

By Sheila Kennedy, CMRP

**S**ome maintenance advancements really hit home. Roadway management is a constant challenge for transportation agencies, not to mention a potential source of frustration for motorists traversing the roads, highways, bridges, or tunnels.

The Hawaii Department of Transportation (HDOT) implemented an innovative road condition management and asset inventory solution to efficiently identify and analyze issues so its teams could reduce costs, better prioritize and address maintenance and repairs, and help keep the roadways safe and clean.

The Blynscy solution by Bentley Systems, an infrastructure engineering software company, improves HDOT's stewardship of its critical transportation assets with perpetual real-time visibility into the state of the roads. It crowdsources image collection and automatically detects issues and generates reports on road conditions.

HDOT, working in conjunction with the University of Hawaii College of Engineering, recently invited everyday drivers to become part of the solution. Its Eyes on the Road program makes 1,000 high-resolution dash cameras available free of charge to approved state residents to record the roads they travel on normally each day, enabling maintenance crews to respond more swiftly to issues.

## The unique road maintenance challenge faced by Hawaii's DOT

To ensure safe and clean road networks and reduce traffic fatalities, state and local DOTs have long relied on periodic time-consuming inspection, analysis, and planning processes for conditions such as potholes and pavement cracks, damaged guardrails, large debris and obstacles, overgrown vegetation, faded striping, barrel and cone placement, and sign inventory. Motorists, cyclists, and pedestrians rarely report roadway issues, but when they do, errors or duplicate reporting may occur.

Hawaii's road maintenance challenge is rather unique. Many roads are decades old, and the island state's geography and location expose roadways to salty air, torrential rain and flooding, and the potential for hurricanes, volcanic activity, and mudslides. To keep up, HDOT conducted weekly manual roadway surveys and expanded expensive traffic camera coverage.

In 2022, the State of Hawaii and HDOT sought to determine how much of its monitoring process for 1,013 miles of roadway across Hawaii, Maui, Kauai, and Oahu, could be replaced or automated with comprehensive, crowdsourced dashcam imagery and advanced machine learning models. In addition to accurately detecting diverse conditions and hazards, the solution also needed to incorporate PASER, the Pavement Surface Evaluation and Rating system.

## Automated damage inspection tool deployed by Hawaii drivers is key to achieving more proactive road maintenance

HDOT chose Blynscy, part of Bentley's Asset Analytics portfolio, for its real-time road condition management and asset inventory capabilities powered by machine vision, crowdsourced data, and AI analytics.

Increasing situational awareness with machine vision and automating road assessment processes greatly reduces the amount, cost, and environmental impact of manual work. For agencies, the platform's scalable roadway data and AI analytics



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enable smarter decision making, lower costs, greater stakeholder trust, and clearer budget justification.

First, Blyncsy captured an array of high-resolution roadway imagery across Hawaii's four main islands via dashcams. HDOT then began using the solution's machine learning algorithms to analyze the imagery and identify common and uncommon issues. Using the results, the team eliminated duplicate reports, verified the true condition of the roads and whether fixes were performed in the correct location, and reported the data to different divisions of the organization in their preferred formats. The accumulated information helped to determine how to prioritize and allocate resources for repairs and maintenance.

By January 2026, HDOT was ready to expand its crowdsourcing capability from primarily fleet vehicles to hundreds of privately-owned vehicles across the Hawaiian Islands. Boosting the volume of data collected would enhance visibility and machine learning analytics.

For the Eyes on the Road program participants, their dashcam imagery is uploaded automatically to the cloud through a cellular connection and then analyzed anonymously by AI and machine learning software, enabling HDOT to be alerted to roadway issues in near real time. Helping to spot road problems early—before they become safety hazards—enables prompt prioritization and maintenance based on data-driven decisions.

Moving away from reactive maintenance is imperative. Roadway and striping preventive maintenance are crucial to extending the useful life of roads. Proactive attention to issues such as guardrail damage, debris on the road, and vegetation encroachment lowers the cost and scope of repair work while reducing risk and keeping drivers safe. With Blyncsy providing data on road conditions, PASER scores, and paint line conditions on a weekly basis, HDOT can monitor changes and degradation over the lifespan of the project.

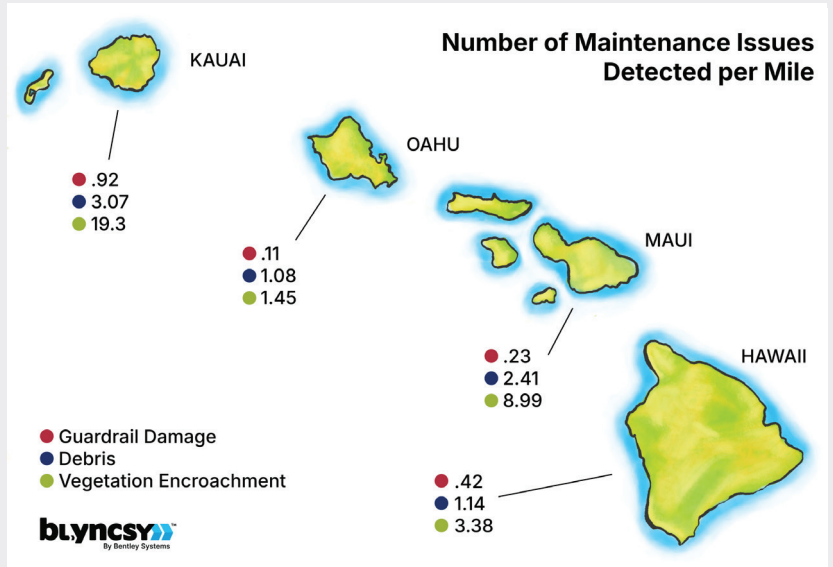


Image courtesy of Bentley Systems.

Bentley's goal is to give transportation agencies real-time visibility into the state of their roadways.

### Hawaii DOT maximizes safety and achieves maintenance savings of nearly \$1 million per year

Blyncsy software and the Eyes on the Road program greatly reduced HDOT's need for manual roadway inspections while enabling safer roads and a significant return on investment. With real-time, crowdsourced dashcam imagery and automated roadway assessments driving data-based decisions, the agency is efficiently prioritizing and planning maintenance and repairs.

The Hawaii DOT is reaping considerable benefits:

- 95% reduction in manual roadway surveys
- 96% potential savings compared to manual or LiDAR-based inspections
- 97% possible savings with roadway preservation vs. reconstruction
- 23,286 pounds of carbon emissions saved per work vehicle per year by avoiding manual inspections

An estimated \$940,000 per year in efficiency savings is gained by detecting more issues faster with the upgraded inspection process. Specific points of value include:

- \$250,000 saved annually by slashing manual inspection hours, mileage costs, and vehicle maintenance costs

- \$320,000 saved annually by avoiding manual cataloging and entry of an average of 930 issues found per week
- \$300,000 saved annually by accelerating paint line visibility analysis and PASER scoring

“The operational insights generated allow transportation leaders to make smarter, fiscally responsible decisions founded on objective data rather than subjective assessments,” explains Mark Pittman, senior director, Transportation AI at Bentley Systems. “This shift enables them to prioritize maintenance where it is most needed, address minor issues before they escalate into dangerous and expensive hazards, and ultimately maximize the impact of every taxpayer dollar.” PS

**Sheila Kennedy, CMRP**, is a professional freelance writer specializing in industrial and technical topics. She established Additive Communications in 2003 to serve software, technology, and service providers in industries such as manufacturing and utilities, and became a contributing editor and Technology Toolbox columnist for Plant Services in 2004. Prior to Additive Communications, she had 11 years of experience implementing industrial information systems. She can be reached at [sheila@addcomm.com](mailto:sheila@addcomm.com) or [www.linkedin.com/in/kennedysheila](http://www.linkedin.com/in/kennedysheila).

# How Nestlé USA Used AI to Improve Spare Parts Search and Inventory Visibility Across its Network of Factories

*By applying an AI-powered tool to spare parts data, SAP search accuracy improved and teams could manage inventory more efficiently.*

By Anna Townshend, Plant Services Managing Editor

**A**t the 2025 Society of Maintenance and Reliability Professionals (SMRP) conference, leaders from Nestlé USA and SPARETECH outlined a maintenance transformation that began with a familiar frustration: finding spare parts in SAP.

“I’ll start with a typical story that I experienced pretty much every Saturday morning,” said Steven Gould, senior engineering maintenance manager at Nestlé USA. “As I’m sitting and drinking my coffee going through emails, I usually find an email or an IM or a text saying: Help. We need this part.”

Not all employees were familiar with how to search in SAP properly, and in some cases, it wasn’t possible for even experienced searchers to find what they were looking for. Corporate maintenance would need to log into SAP, try to decipher the information provided, and search across the company’s many factories for inventory.

Since a major transformation earlier in the year, that scenario has largely disappeared. “I have not had to have that Saturday morning bump into my schedule to go find a part,” Gould said. The parts’ inventory got a structured makeover, focused on data standardization and workflow simplification with the help of an AI-enabled tool integrated with SAP.

## The problem: Factory-specific SAP data silos create spare parts duplication

The project began with a hard look at how Nestlé USA managed spare parts across its network of factories. With different practices across different plants and little visibility network wide, Andy Goldinger, senior expert maintenance engineer at Nestlé, described the core issue with the parts database: “It really became SAP material numbers specific to a plant, not the manufacturer’s part number.” Without the manufacturer’s part number, the parts are no longer searchable in SAP. The



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manual process to build a new material part number in the database took too many steps, and it wasn’t getting done properly. Across multiple facilities this had cascading effects. “That’s why we would have 20 factories stocking the same part with 20 different material numbers,” Goldinger said.

The challenges extended beyond duplication across sites. “As we started digging into it, it wasn’t just duplicates across different factories,” Gould explained. “It was duplicates within a factory, two or three of the same parts at different locations.”

During COVID, inventory levels had risen in response to low supply and long wait times from suppliers. “We started raising our stock levels up to compensate for that,” Gould said. “We’ve never started to bring those inventories down.” The result was inflated working capital tied up in spare parts with limited visibility into what was truly needed or already available.

Adding to the problem was limited cross-site transparency and limited employee access across sites. “They couldn’t see the inventory to a sister factory,” Gould added. From a data standpoint, analysis was nearly impossible. “It was hard to really see usages on a specific component, because everybody had it different in SAP, and they had different SAP numbers,” Gould said. That fragmentation also limited leverage in

supplier negotiations because they didn't have a good handle on true stock numbers and company-wide usage.

## Standardizing spare parts workflow with AI tool

In addition to introducing new technology, Nestlé also needed to address process consistency for entering new component data. "Every factory had their own way of doing it," Gould said. "It might have been Microsoft Forms. It might have been a Power Query. It could have been an old paper sheet that somebody filled out."

The goal became clear: "We standardized that across Nestlé USA to say we have one way," Gould said. The guiding principle was simple: one part, one reference.

That meant defining approval workflows, clarifying who could create new materials, and documenting key processes as a standard. As Gould noted, "This was a big challenge for us because everybody had their own process."

The company also tightened control over new material creation. Only designated approvers at each plant could finalize entries, usually the storeroom supervisor and the maintenance manager. "Only those two people can approve it," Goldinger said. "You can't push through stuff that would create duplications."

To address the search inefficiencies and duplication, Nestlé implemented the AI-enabled tool SPARETECH on top of SAP. When trying to create a new material number, the AI system works by checking for potential duplicates as soon as a user begins entering a manufacturer part number. "The system is actually looking based off of what we already have in SAP for a match," Gould explained. The duplicates show up at the bottom of the screen.

The new system also provides more visibility into discontinued parts. If the factory doesn't have an obsolescence plan or knowledge of what's going to be replaced with the newest parts, SPARETECH can provide that support. It identifies discontinued components and flags future obsolescence dates. "It tells you what's been discontinued, but also give you a future date if there's something that is truly going to be discontinued in the future, so you have some time to react to that change."

The tool also generates standardized descriptions automatically. "It is actually using AI to create the part description in SAP," Gould said. Search functionality was another breakthrough with the AI tool. "It's like a Google search," Gould said. Rather than requiring complex wildcard formatting, technicians can type what they know and refine results dynamically.

Goldinger emphasized the practical value for technicians. "Your technicians don't know SAP material numbers by heart, do they? That's not what's written on the gearbox out there on the information tag. That's the manufacturer's part number," he said.

The tool also integrates catalogs with technical specifications and images. For maintenance teams working from tablets on the plant floor, visual confirmation is critical. "They can see a picture and actually match it up, before they make the trip back to the store," Gould said.

## Measurable results: Improved spare parts visibility and reduced inventory risk across the factory network

Based off some time testing, Nestlé saw major improvements in the measured time to find parts, about 50% faster, Gould said.

Beyond speed, collaboration has improved. "When it comes to that transparency of inventories, the collaboration has been huge for us when it comes to tech stores," Gould said. Teams now communicate across sites to locate inventory and improve master data quality. "It's not about what's happening now in my store. I know my sister factory has it," he added.

Each factory doesn't need to stock every part at each facility. "We don't need to stock those critical spares that are hundreds of thousands of dollars that are sitting on our self, just waiting to be used at some point, maybe, in the future," Gould said. "We can now start looking at that inventory across markets." Working capital reduction is now an active strategy for Nestlé. Rather than stocking high-cost critical spares everywhere, Nestlé can centralize inventory at selected facilities and transfer parts as needed.

"Having this visibility has allowed us to look at inventories as a market versus that individual factory," Gould said.

## Training and governance sustain new MRO data strategy

Nestlé approached the rollout as a structured change initiative, and the simplicity of the tool accelerated adoption, Goldinger said. "After about five minutes of playing with it, you really learn it," he added. Super users were selected at pilot plants and then trained to lead subsequent waves. That peer-driven model helped sustain momentum.

Using a Microsoft Power BI, Nestlé extracts the data to monitor compliance with the new workflow. "Are people using the tool? And we review that now in a lot of our network calls that we have on a monthly basis with the factories," Gould said. On average, use of the tool exceeds 95% on a monthly basis. "They're using this tool because they see the value," Gould said.

The broader goal is to use standardized material numbers and clean data to support smarter stocking decisions across the network. Factories are no longer operating as isolated storerooms. They are part of a visible, collaborative network with standardized data and shared inventory insight. As Gould summarized, "This tool has really helped us make a lot of different people's jobs in our factories much easier."

For maintenance and reliability leaders, master data discipline is an important maintenance strategy, not just shoved off to IT. By standardizing spare parts data and improving visibility across sites, Nestlé is shifting from plant-by-plant inventory management to a coordinated network strategy that supports getting maintenance teams parts faster and better inventory management across the company. **PS**

# What Color Is Your Bearing? (and Why That Matters)

*Heat isn't the cause of bearing failure... it's the confession that technicians didn't act quickly enough when bearing color started changing.*

By Michael D. Holloway

I absolutely love being in factories almost as much as I love being in labs! In a factory it's akin to visiting a new city or town. Anytime I visit a city or town I might end up at the pub that night where invariably I will get into a discussion about what is right and what is wrong with the place I'm at – always respectfully of course!

Same happens in a factory. Every time, someone comes up and shows me a bearing they replaced. I hear it almost immediately: "It overheated." It's said with confidence...finality. Case closed.

But if you've spent enough time on factory floors, tearing down equipment, looking at what failed instead of what people think failed, you start to see a different pattern. The bearing didn't fail because of heat; the bearing failed, and heat was the result. The color left behind is not the cause. It's the confession.

## Every bearing color tells a story

When steel is exposed to elevated temperatures, it forms a thin oxide layer. The thickness of that layer changes with temperature and time, producing colors: straw, brown, purple, blue, and eventually black. Most people see those colors as evidence of overheating. They're right, but only partially.

Those colors are a timeline. They tell you how long the bearing operated in distress, how severe the conditions became, and how far the failure was allowed to progress before someone intervened – or didn't.

### Straw: The First Warning That Gets Ignored

Light yellow or straw discoloration shows up around 400-500 °F. This is where



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the lubricant film is beginning to fail. Not gone, not catastrophic, but unstable. You're transitioning from full film lubrication into boundary conditions. Metal is starting to talk to metal and it's not a happy conversation. Think of it like someone is getting into someone else's business and aggression begins.

This is the moment where the system is still recoverable but it's almost always missed. Why? Because the machine is still running. Vibration might be slightly elevated. Temperature might be creeping up. Nothing looks urgent enough to stop production. So it continues.

### Brown to Purple to Blue: When Friction Takes Over

As the bearing moves into brown, purple, and then blue, you're no longer in a warning phase, you're now in a failure sequence. You have sustained metal-to-metal contact. Friction is generating heat faster than the system can dissipate it. Surface temperatures rise, oxide layers thicken, and the material itself begins to change.

This is where you start to see:

- Raceway distress
- Roller skidding
- Cage instability

At this point, the conversation should no longer be about saving the bearing. It should be about understanding what allowed it to get here.

### Black: The End, Not the Beginning

When you see dark blue to black, sometimes with scale, the system has crossed a line. Now you're dealing with:

- Loss of hardness
- Structural degradation
- Imminent or complete seizure

And yet, this is often where the analysis starts. People look at a blackened bearing and conclude: "It got too hot." That's like looking at a burned-out engine and saying the problem was temperature. Temperature didn't cause the failure, friction did.

### The real question no one asks: "What actually breaks the film?"

Stop asking "if heat isn't the cause, then what is?" The better question is: Why did the lubricant film fail? Because that's where almost every bearing failure begins. Not with heat...not with over-greasing... not with some mysterious event. With the loss of separation between surfaces.

In the field, the usual suspects are remarkably consistent:

- Contamination, especially water and fine particles
- Starvation, not excess
- Incorrect viscosity for the load and speed
- Poor lubricant delivery or distribution
- Mechanical issues like misalignment or improper fit

Notice what's missing from that list: over-greasing! Despite how often it's cited, it rarely shows up as the root cause

when you actually analyze failed bearings in the field. What you see instead is localized starvation, channeling, or simply the inability of the lubricant to stay where it needs to be. An aggressive grease gun pump will generate pressures enough to pop out a seal, then grease is lost and contamination enters.

### What the best reliability programs do differently

Bearing failures rarely happen in a single moment, they develop over time, quietly. First, a small loss of film strength.

- Then intermittent contact.
- Then increasing friction.
- Then heat.
- Then more friction.
- Then material changes.
- Then failure.

All of it happening while the machine continues to run and all of it leaving behind a color trail that tells you exactly what happened, if you know how to read it.

The difference between reactive and high-performing organizations is not that one experiences failures and the other doesn't. It's where they intervene in the timeline. Most plants respond at black, some respond at blue, very few respond at straw.

The best programs are designed to detect and act before color ever appears.

They focus on:

- Lubricant condition, not just presence
- Contamination control as a primary variable
- Proper application, not just specification
- And most importantly, understanding that lubrication is a system, not a task.

### Breakroom Thought

A discolored bearing is not just a failed component; it's a record of what the system allowed to happen. Every shade, from straw to black, is a data point. The question is not whether the bearing overheated. The question is:

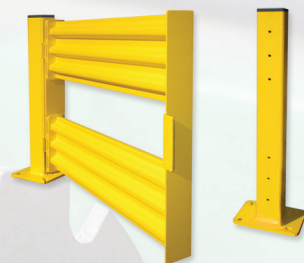
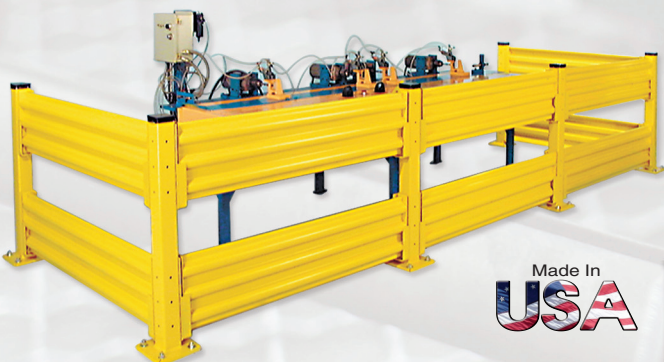
How early could you have known, and what would it take to act then instead of later? Because by the time the bearing turns blue, the decision has already been made. **PS**

**Michael D. Holloway** is President of 5th Order Industry which provides training, failure analysis, and designed experiments. He has 40 years' experience in industry starting with research and product development for Olin Chemical and WR Grace, Rohm & Haas, GE Plastics, and reliability engineering and analysis for NCH, ALS, and SGS. He is a subject matter expert in Tribology, oil and failure analysis, reliability engineering, and designed experiments for science and engineering. He holds 16 professional certifications, a patent, a MS Polymer Engineering, BS Chemistry, BA Philosophy, authored 12 books, contributed to several others, cited in over 1000 manuscripts and several hundred master's theses and doctoral dissertations.

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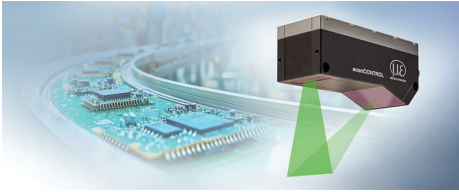
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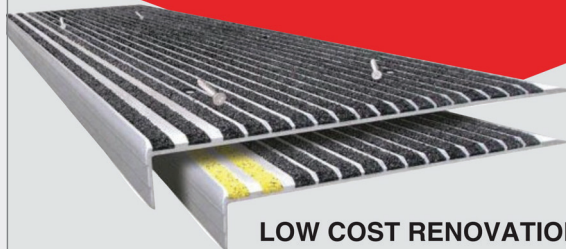
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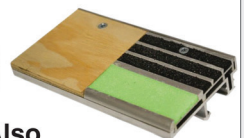
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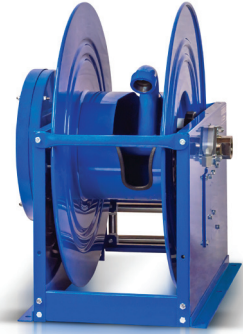
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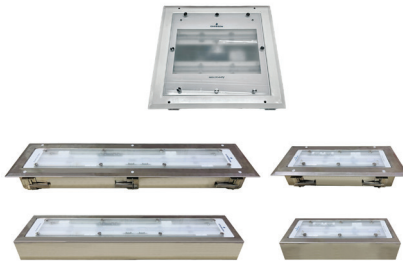
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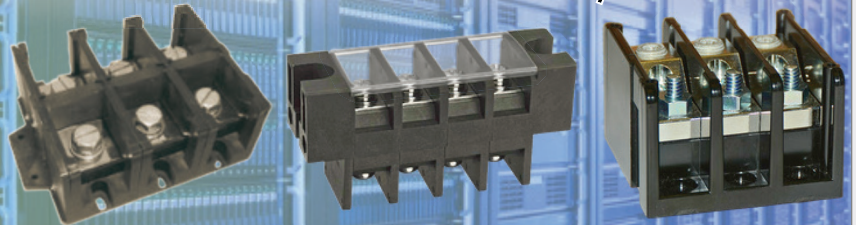
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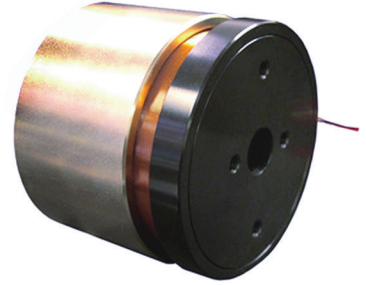
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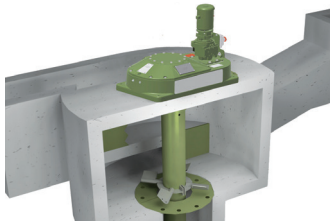
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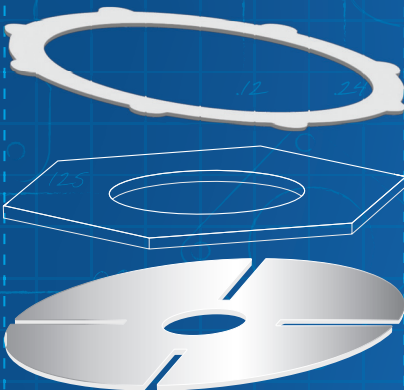
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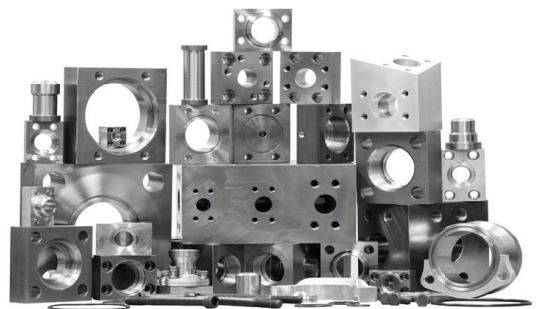
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JUNE 2026



## The **FUTURE** of Warehousing

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THE FUTURE OF WAREHOUSING:

# Five Critical Shifts to Watch

*Discover how advancements like humanoid robots, real-time route optimization, and sustainability metrics are transforming warehousing and transportation.*

By Nishith Rastogi

**Y**our warehouse teams face compounding daily pressures. Routes that worked last quarter don't make sense anymore. Returns are piling up faster than outbound shipments. And the technology you bought two years ago can't keep up with what customers expect today.

Five specific shifts will define how warehouses and distribution centers operate this year. Some will feel incremental. Others will require you to rethink staffing, routing and performance metrics entirely.

The operators who move fastest on these changes will pull ahead. Here's what's changing and how to prepare for it.

## Prediction 1: Humanoid Robots Move from Pilots to Limited Production Roles

The global market for humanoid robots could reach \$38 billion by 2035, driven largely by logistics and manufacturing. If you think these robots are still five years away, you're behind. The first pilot fleets are already deployed in select warehouses.

In 2026, more operators will move humanoid robots from pilot programs to limited production roles. The next phase focuses on three things: scale, reliability and how these robots will work safely alongside your existing teams. Widespread deployment is still a few years out, but the testing phase is happening now.

Warehouse operators need to start controlled trials now. Define clear safety protocols. Figure out which tasks make sense for robots and which still need human workers. The goal is to find where automation complements your workforce, not just cuts headcount.

Tasks like repetitive picking, palletizing and inventory scanning are good starting points. Training your team to work with these robots matters as much as the technology itself. Phase the implementation slowly so your workers can build confidence with the machines.

Start with a single zone or shift to contain complexity. Test exception handling protocols—what happens when a robot encounters an obstacle, when a product doesn't scan correctly, or when safety protocols trigger a shutdown.

The real challenge here is cultural. Success depends on whether your team trusts and understands the robots working beside them. If your workers see robots as a threat rather than a tool, the technology won't deliver results no matter how well it works technically.

Involve your floor workers early in the selection and testing process. Show them how robots handle the physically demanding work while they focus on problem-solving and quality control. Make it clear that robots are there to make their jobs easier, not eliminate them.

## Prediction 2: Reverse Logistics Becomes a Core Operation, not an Afterthought

The resale market is growing 2.7 times faster than the overall apparel market. That growth is creating operational pressure inside warehouses. Returns, resale and re-commerce volume are all increasing at the same time.

Tariffs and delivery costs are pushing more consumers to buy locally or secondhand. That means more products flowing back into your facility, not just out of it. Reverse logistics can't stay bolted on as an afterthought anymore.

Warehouse operators need to integrate reverse logistics into forward operations. Start tracking recovery rate and cost per reverse mile the same way you track outbound metrics. The companies that can move goods as efficiently backward as forward will have a real advantage.

This requires rethinking physical space. Allocate dedicated zones for inspection, sorting and repackaging near receiving to minimize cross-facility movement. You'll need quality grading stations where staff assess condition and route items to resale, refurbishment, or disposal. Staff these zones separately from outbound operations so returns don't create bottlenecks or pile up unprocessed.

The biggest obstacle is data. Circular models only work when your systems can track resale, returns and re-commerce in one place. Disconnected systems create waste instead of reducing it. If your warehouse management system can't handle reverse flow as smoothly as outbound, fix that before volume forces your hand.

## Prediction 3: Route Optimization Has to Respond in Hours, or You'll Lose Volume

AI shopping tools are changing where consumers find products. Instead of searching only on major platforms, buyers can now discover items across thousands of independent sellers with the same ease. Demand that used to concentrate at a few fulfillment hubs now spreads across hundreds of locations.

Orders will come from more locations, in smaller quantities, with less predictable patterns. Your routes need to adapt

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faster than they do now. Currently, it takes an average of two weeks to plan and execute a response to a supply chain disruption. That's too slow when demand can shift overnight.

\$1 spent on agility is worth \$10 on prediction. The operators who can reconfigure routes, capacity and carrier relationships in real time will handle this shift better than those still running weekly planning cycles.

Make reaction time a KPI. Aim to cut response time from days to hours. That means your dispatch teams need better tools, and your fleet management system needs to handle changes on the fly. Carrier relationships will matter more when you need to add capacity quickly or reroute midday.

On the dock, this means more dynamic door assignments and flexible loading schedules. Orders that arrive late in the day can't wait until tomorrow's planned routes if customers expect same-day or next-day delivery.

Clean data is what makes this possible. If your order data, route history and capacity information live in separate systems, you can't move fast enough. Agility without unified data just creates more chaos. Invest in connecting your systems before you try to speed up your response time.

### Prediction 4: Load Factor Becomes Your Primary Sustainability Metric

Last year, 58% of truckloads were driven half-empty. That's a waste of fuel, money and capacity.

Tariffs, trade shifts and rising costs are squeezing margins across the board. Warehouse operators can't wait years for EV pilots or new infrastructure to pay off. You need efficiency you can measure now.

What can you do now? Fill trucks to capacity. Optimize routes to cut empty miles. Consolidate loads before they leave the dock. These changes reduce emissions immediately without major capital spending. Waiting for the perfect green solution means missing opportunities that are already in front of you.

I also recommend auditing underutilized routes and tracking load factor as a sustainability metric. You'll spot patterns you couldn't see before, like routes that consistently run half-full, time windows that create inefficiency and customers whose order volumes don't justify dedicated runs.

Route planning and load consolidation are where you'll see the fastest returns. Your transportation management system (TMS) should already have the data you need. Use it to identify which shipments can combine, which delivery windows can shift and where multi-stop routes make more sense than direct runs. The goal is for fewer trucks to carry more freight per trip.

## Prediction 5: AI Strategy Needs to Define Human vs. Machine Decisions

Only 23% of supply chain organizations have a formal AI strategy right now. This creates problems for when you start adding AI tools to your operations, especially without thinking through where they belong.

Without a clear plan, AI replaces judgment instead of supporting it. Then you end up with systems making decisions they shouldn't or workers ignoring AI recommendations because they don't trust them.

That's why AI should handle repetitive, data-driven tasks like rerouting, planning and execution, while people should focus on relationships, context and problem-solving. The operators who figure out a healthy balance between people and technology will see better results than those who automate everything or resist automation entirely.

Define which decisions can be automated safely and which need human review, then measure performance on both sides. In your warehouse management system (WMS), AI can suggest optimal pick paths and flag inventory discrepancies, but humans should still approve major layout changes or resolve complex exceptions. AI can also optimize slotting and putaway decisions based on velocity and order patterns, but warehouse supervisors should override those recommendations when they conflict with seasonal shifts or upcoming promotions.

In dispatch software, AI builds initial routes while dispatchers handle last-minute customer requests. For labor planning, AI forecasts staffing needs based on order volume, while supervisors account for employee skills, training schedules and team dynamics.

### Start Now, Not Later

These five predictions have one thing in common: They reward speed over

perfection. The operators who adapt quickly using the systems they already have will outperform those waiting for ideal conditions.

Pick one area where your operation is already feeling pressure and start there. Small changes compound faster than you think, especially when the rest of your industry is still planning.

None of this requires a three-year roadmap or board approval. These are operational decisions you can make this quarter. Move on them before your competitors do. **MH&L**

**Nishith Rastogi** is the CEO and co-founder of Locus, a provider of agentic transportation management system (TMS) solutions.

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# Using Agentic AI to Navigate Complexity in Warehouse Operations

By Keith Moore

**T**oday's warehouses have come a long way in terms of automation. From robotic pickers to conveyor belts that operate with precision, many manual operations are now handled by machines. Despite these advances, many warehouses continue to struggle with operational chaos, including missed orders, labor bottlenecks, underutilized docks, and inventory in the wrong place at the wrong time.

That's where agentic AI steps in—not to replace automation, but to orchestrate it. Agentic AI doesn't just respond to commands; it perceives, decides and acts independently to navigate complexity, adapt in real time, and optimize operations across shifting constraints. In the warehouse, this represents a significant leap forward from rule-based automation to intelligent orchestration, aligning labor, inventory and throughput with business goals.

## The Problems with Traditional Automation

Traditional warehouse automation focuses on task execution, like moving items, scanning barcodes, or sorting cartons. These systems follow pre-programmed rules and operate best in predictable environments. However, warehouses today are anything but predictable. Surges in e-commerce orders, last-minute changes to inbound loads, labor shortages, and SKU proliferation have introduced volatility and complexity that rigid systems can't adapt to on their own.

Warehouse management systems (WMS) and warehouse control systems (WCS) operate within silos, managing what they are explicitly told to manage. They lack the contextual intelligence to make trade-offs across systems, prioritize in real time, or adapt plans when disruptions arise. As a result, operators are often left firefighting with spreadsheets and radio calls to rebalance labor, reassign doors, or expedite picks.

Agentic AI adds a new layer of intelligence. It doesn't just do things faster; it does the right thing at the right time, based on what's happening inside and outside the warehouse.



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## Meet Agentic AI

At its core, agentic AI refers to AI systems that can operate as autonomous agents by sensing the environment, making decisions based on goals and constraints, and taking actions that affect the entire supply chain. These systems are designed to collaborate with humans, optimize for multiple objectives, and continually adapt.

In warehouse operations, agentic AI is often applied through intelligent orchestration platforms, which sit on top of existing WMS and ERP systems, functioning as a real-time decision agents. Rather than simply following workflows, agentic AI dynamically generates, evaluates and executes plans to:

- Prioritize customer orders based on SLAs and capacity.
- Assign dock doors based on yard congestion and labor availability.
- Allocate labor across departments in real time.
- Sequence tasks to minimize changeovers or travel time.
- Respond to disruptions—like late trucks or absent workers—with alternative plans.

This is not rules-based optimization. It's continuous, context-aware decision-making that reshapes the warehouse response to meet evolving goals.

## Why Warehouses Need Agentic AI Now

Today's warehouses are complex. Warehouses are highly constrained, dynamic environments with dozens of interdependent variables. Inventory must be picked, packed and shipped in alignment with dock schedules, labor shifts, yard availability and customer priorities. The costs of getting it wrong are significant: missed OTIF targets, excess inventory, demurrage fees and lost productivity.

That's where agentic AI shines. It connects planning with execution and constantly updates the plan based on new data, so the warehouse is always working toward the right priorities, even as things change.

This is especially helpful for high-volume environments, such as 3PLs and food and beverage distribution, where speed and accuracy are critical, and a single missed truck window can disrupt the entire day.

## Real-World Example: A Day in the Life with Agentic AI

Picture this: Two inbound trucks are late. Three warehouse workers call out. A major customer just changed their delivery window. In a typical setup, the WMS flags the issues, but someone still needs to determine what to do about them.

With agentic AI, the system immediately reshuffles priorities. It sends new picking instructions, reassigns labor, updates dock schedules, and even informs upstream systems of the expected changes. All of this happens in seconds, not hours. It's not just reacting; it's also planning based on what might happen.

## Integrating Agentic AI with Existing Infrastructure

Importantly, agentic AI doesn't replace existing systems; it augments them. Agentic AI platforms ingest data from WMS, TMS, LMS and yard systems to create a unified operational picture. They then inject optimized decisions back into the WMS or WCS as executable tasks or schedule updates. The result is more intelligent systems that not only execute efficiently but also choose what to execute and when.

This approach protects existing investments while unlocking new levels of performance. It also builds trust with operations teams, who gain a digital partner rather than a disruptive new system.

## Augmenting Humans, Not Replacing Them

One of the biggest myths about AI is that it will replace people. In reality, agentic AI thrives in collaboration with people. It handles the complexity that overwhelms traditional systems, freeing human teams to focus on higher-level decisions, continuous improvement and exception management.

Agentic AI also provides complete visibility into why decisions were made, what options were considered, and how those choices impact operations. Warehouses never run on blind automation with Agentic AI. Instead, managers have complete transparency and control.

## What Kind of Results Are We Talking About?

Companies using agentic AI have seen some impressive gains:

- +12% labor productivity
- 25% overtime
- +30% automation throughput
- 94% manual interventions
- 42% short ships

But beyond the numbers, the fundamental transformation is a shift in how warehouses operate: Less chaos. Higher throughput. Lower costs.

## Looking Ahead with Agentic AI

As warehouses become increasingly connected, digital and fast-paced, agentic AI is poised to become a standard part of the toolkit. The industry is moving beyond automation for its own sake and toward systems that understand, decide and act in service of broader business objectives.

It's no longer enough just to automate tasks. We need systems that can think, adapt and help us make better decisions, because in today's world, speed and smarts win. **MH&L**

**Keith Moore** is the CEO of AutoScheduler.ai, a WMS accelerator created to help orchestrate poorly coordinated facilities.

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# Bridging the Warehouse Labor Gap: Untapped Talent and Smarter Strategies

*Inclusive hiring practices, tailored onboarding, and supportive technologies improve retention, safety, and productivity in warehouses.*

By James Emmett and Brad Long

The U.S. warehousing industry has been on a wild ride over the past decade. Between 2015 and 2025, the workforce more than doubled to 1.8 million people. But, even with that growth, the labor gap isn't closing; it's widening. By 2032, experts predict the U.S. will face a deficit of 6 million workers in this sector. That's a staggering number.

Warehouses are scrambling to keep up. Many are doubling down on retention efforts and investing in automation to handle growing operational demands. But when it comes to hiring, the math doesn't add up: Open positions far outnumber available candidates... at least among the traditional talent pool.

The good news is that the labor pool is deeper than most think. By looking beyond the usual candidates and tapping into overlooked populations, warehouses can not only fill jobs but also boost retention, productivity and even safety.

## The Hidden Talent Pools You're Missing

Not every employment approach works for every warehouse, but there are a number of underutilized groups that can help bridge the gap.

### Workers with disabilities

"Disability" often brings to mind someone with a visible physical impairment. But, according to the CDC, more than one in four U.S. adults have some type of disability, and up to 80% of those disabilities are invisible, such as speech, hearing, or vision impairments. The Bureau of Labor Statistics reports that only 22.7% of disabled individuals are employed, compared to 65.5% of those without disabilities. That's a huge, untapped workforce.

Many people with disabilities are not only capable of working, they're eager to do so. In fact, some thrive in a structured environment with repetitive tasks, something that's common in warehouses. Autistic individuals, for example, often excel in roles with a predictable routine. And workers with physical disabilities could be solid candidates for supervising automation or handling specialized tasks.

### Candidates without warehouse experience

Some warehouses won't even consider applicants without prior warehouse experience. However, workers from industries like



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retail, food service, construction, trucking and manufacturing often bring transferable skills, such as physical stamina, time management, adaptability and familiarity with safety procedures. These qualities are extremely valuable in a warehouse setting.

Internship and apprenticeship programs can help inexperienced workers build the warehouse-specific skills they need while, at the same time providing employers with an assured, steady source of labor.

### Part-time, temporary and flex workers

Not everyone can—or wants to—work 40 hours a week. Parents, students and retirees often look for jobs with flexible schedules. Seasonal or part-time roles can attract these groups and help warehouses meet fluctuating demand without overcommitting resources.

## The Business Case: Why It Pays to Expand Your Hiring Pool

Hiring from these groups isn't just about filling positions; it's smart business. For example, one major retail pharmacy chain launched a program in 2002 to hire employees with disabilities in its supply chain division. Today, they employ over 2,000 people with disabilities, which accounts for more than 20% of their distribution center workforce.

A 2012 study published in *Professional Safety* compared performance metrics between employees with disabilities and those without. They found that productivity was equal or slightly higher among disabled employees, and turnover rates and safety incidents were significantly lower. Employees who

face barriers to employment tend to be loyal to companies that provide them with opportunities. In a tight labor market, workforce loyalty is priceless.

Safety outcomes are equally impressive. Contrary to common assumptions, disabled workers often have fewer workplace accidents because they often learn to follow established rules and best practices closely. Add in potential financial assistance for training from state and private agencies, and the ROI becomes even clearer: Hiring disabled workers isn't charity; it's a smart, strategic move.

## How to Make It Work

Expanding your talent pool is only half the battle. Effectively integrating these individuals into your workforce is critical to their success and yours. There are a number of strategies you can use to make the transition a smooth one.

### 1. Rethink your hiring and onboarding process

Look beyond resume gaps. Employment gaps might reflect a disability rather than a lack of skill or the inability to transition to a new job. You should also be prepared to adapt your interview process to allow for idiosyncrasies that might be endemic to the individual's disability. For example, some candidates may avoid eye contact or give short answers not because they're disinterested, but because verbal interviews can be challenging for them. This is often the case for people with autism or ADHD. And, once they're hired, onboard new employees gradually. Introduce responsibilities in stages, provide visual demonstrations and check in regularly during the first few weeks.

### 2. Set clear expectations

Clearly defining job responsibilities and expectations is essential for supporting employees with disabilities. Always use precise job descriptions, make detailed checklists and provide structured timetables. Instructions should be straightforward and free of sarcasm or abstract language to avoid confusion for those who might not understand body language and tone of voice. Also, offer immediate, constructive feedback to help employees adapt quickly and succeed in their roles.

### 3. Create a safe, supportive environment

Adapt your existing practices and safety plans to support additional safety and assistance that might be required by disabled workers. Establish a clear management structure and designate a specific point of contact for guidance. Promote consistency and understanding across the workforce to foster inclusivity. Implement contingency plans for managing stress. And ensure open, reliable communication channels so employees can easily ask for help when needed.

### 4. Adapt your communication style

Everyone has ways to communicate that work best for them. For example, many workers with hidden disabilities are visual learners. Whenever possible, supplement verbal directions

with written or pictorial guides to reinforce understanding. Use silence strategically and give employees time to process instructions before repeating them.

## How Lift Truck Technology Can Support Your Success

Lift truck design and technology, including training aids and operator assist solutions, can improve overall efficiency and make warehouses more accessible—not only to employees with disabilities but to your entire workforce. Examples include:

**Training simulators:** Simulators provide safe practice environments that can help identify support needs before employees operate real equipment.

**Ergonomic designs:** Lift truck features such as cushioned floors, lower steps and adjustable seating improve productivity overall and can help accommodate workers with physical challenges.

**Electric lift trucks:** Electric forklifts help create a sensory-friendly environment, producing less noise and fumes than their internal combustion counterparts.

**Lights and alarms:** Equipping warehouses and equipment with pedestrian lighting and audible alarms enhances visibility and awareness of nearby lift trucks.

**Lift truck fleet telemetry:** Forklifts equipped with telemetry can provide real-time data that highlights operator training gaps and provides insights into improving warehouse layouts.

**Active interventions:** Operator assist technologies that can apply automatic interventions to maintain stability and enforce lift truck rules throughout the facility can help reduce risks and create safer areas for pedestrians.

## Dipping Your Toe into a Deeper Labor Pool

The warehouse labor gap isn't going away anytime soon. But by broadening your hiring strategies and making thoughtful adjustments to your operation, you can make your talent search easier. And the good news is, you don't need a massive overhaul to make it work. Start by:

- Securing buy-in at all levels of your organization, from leadership to floor supervisors.
- Initiating referral programs to tap into your existing workforce's networks by having them recommend potential candidates.
- Partnering with disability organizations, veterans' groups and specialized hiring agencies.
- Building flexibility into recruiting and training systems to accommodate individual needs.

Tapping into underutilized talent pools doesn't just fill jobs—it strengthens your workforce, improves retention and boosts productivity. In today's competitive market, that's not just good business. It's essential. **MH&L**

**James Emmett** is founder and CEO of disability inclusion consulting firm James Emmett and Company. **Brad Long** is global brand manager with forklift manufacturer Yale Lift Truck Technologies.

# MODEX 2026: All AI, All the Time

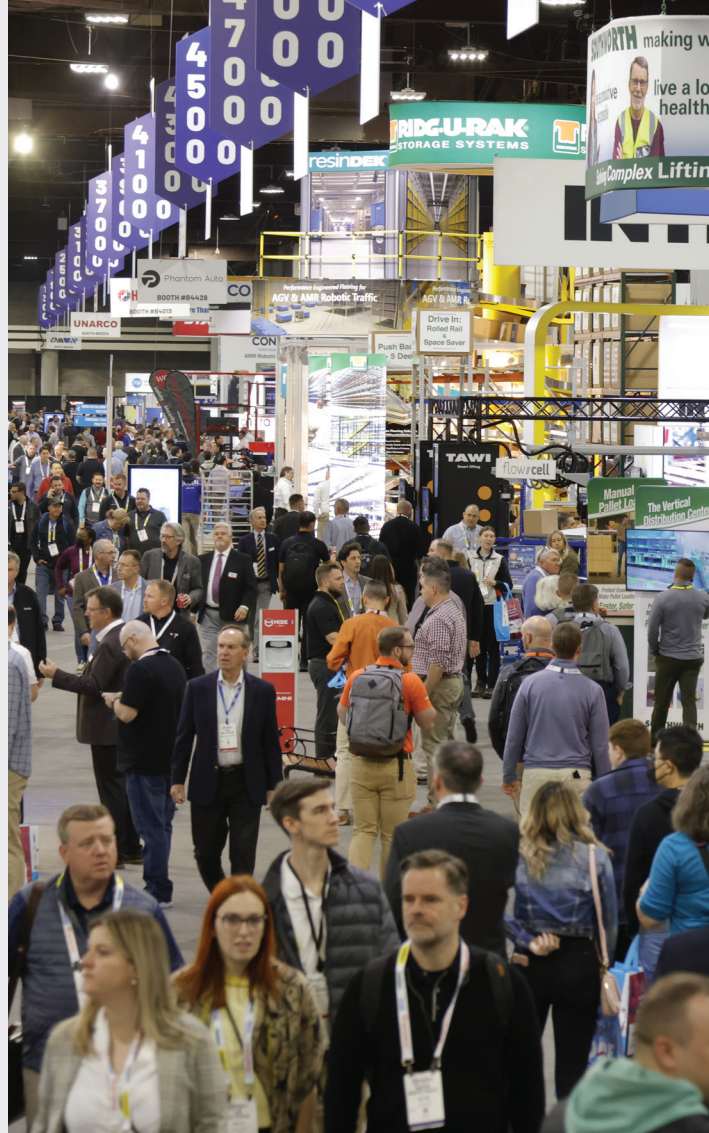
*Despite its long-standing presence, AI's true potential in supply chain management is only now being recognized.*

By Dave Blanchard

**A**rtificial intelligence (AI) has been around a long, long time, dating back as a going concern at least to the mid-1950s, with research into the field going back even further. AI emerged as an industry focused on real-world products and applications in the 1980s with the introduction of Lisp machines, expert systems, neural network devices, speech recognition, and intelligent agents. Eventually the emergence of low-cost computing, increasingly advanced processing chips, and the near-ubiquity of search engines and smartphones drove the idea of an “AI industry” onto the backburners since everybody was already using AI (Alexa, Siri and Google are all based on intelligent technologies), so it no longer seemed much of a talking point for tech developers to mention the AI embedded in their solutions. In fact, as recently as 10 years ago, when trade association MHI and consulting firm Deloitte presented the MHI Annual Industry Report at MODEX 2016, “artificial intelligence” wasn’t even included as one of the emerging technologies most likely to have an impact on supply chains in the coming years.

Of course, that’s due as much to marketing and consultant-speak as it is on the actual use of AI. Back in 2016, the MHI-Deloitte report focused on technologies such as robotics, driverless vehicles, predictive analytics, and inventory optimization tools—every one of which relies on AI. But AI’s day in the buzzword sun was seen to have eclipsed by then, so people weren’t really fixated much on it. Times change quickly, though, as we all know. The combination of a global pandemic that drove people indoors and caused them to rethink their need for instant delivery of goods, coupled with the introduction of large language models as a consumer-friendly (and easily understood) application of AI has brought us to where we are today: an AI-everywhere marketplace where the hype still greatly outpaces the reality of what exactly type of competitive advantage companies can expect to gain from the use of AI.

This year, the MHI Annual Industry Report (delivered at MODEX 2026, held as usual in Atlanta) did indeed include AI in its list of disruptive technologies; in fact, AI was at the very top of the list, with 70% of respondents to a survey of



500 supply chain professionals indicating they believe AI has the potential to disrupt their industry. That’s not just for the near term; according to the survey, AI is seen as the most disruptive technology for the next decade, which is somewhat ironic given how long the basic premise of smart software and predictive decision-making has been around. Even more ironic, perhaps, is that the biggest obstacles to AI catching on for material handling and logistics professionals are the lack of real-world business cases and unclear ROI timelines. The survey indicates that 28% of respondents aren’t using AI technologies at all for *any* supply chain purpose. As Mark Twain might have said if he were alive today, “Everybody talks about AI but nobody is doing anything with it.”

Nevertheless, plenty of people were talking about AI at MODEX 2026, including representatives of the 1,100 exhibiting companies, many of whom were promoting AI-based products. The frequent mention of AI as a product feature among MODEX exhibitors was reminiscent of previous shows where buzzwords like the Internet of Things, Big Data, cloud computing and software-as-a-service were the disruptive technologies *du jour*. At a keynote panel focused on the MHI Annual Industry Report, Wanda Johnson, supply chain technology fellow with Deloitte Consulting (and a co-author of



online used car retailer. According to Camille Blake, Carvana’s regional director of logistics, the company uses AI extensively for analytics and insights. AI’s real power, she said, “is turning massive amounts of data into clear signals that help leaders see what’s ahead and act with greater speed and confidence.”

Another user of AI technology is The Walt Disney Company, and according to another panelist, Fred Cox Jr., director of manufacturing at Disney’s Central Shops, “Automation technologies like robotics, AI, automated guided vehicles (AGVs), and wearables are transforming warehouses and manufacturing operations.” But there’s a catch, Cox added. “Organizations are only successful when they design for execution, and they need to have clear end-to-end ownership of the process.” If your current processes are chaotic, he said, automating that chaos will only make things worse.

“Don’t just invest in technology for the sake of technology,” cautioned Stephanie Thomas, a professor of supply chain management at The University of Arkansas. “Invest as much in the execution and the people executing it as you are in the technology.”

Based on the survey results, more than half (56%) of the organizations that responded plan to increase their spending on supply chain technology over the next two years. Roughly half of the companies (48%) said their total spend will be less than \$1 million, but on the other hand, 52% plan to spend more than \$1 million. Curiously, those numbers match up exactly with the ratios from a decade ago, when the 2016 MHI report indicated the same split between those spending less than \$1 million (48%) those spending at least \$1 million (52%). The buzzwords may change, but the pie still gets sliced about the same. **MH&L**

**Dave Blanchard** is editor-in-chief of Material Handling & Logistics, and the author of Supply Chain Management Best Practices (Wiley).

the report), opined, “Those who connect operational excellence, AI-driven orchestration and workforce readiness into a single playbook will not just withstand disruption; they will convert it into sustained performance and growth.”

“The biggest threat we face isn’t disruption,” added John Paxton, CEO of MHI. “It’s the failure to innovate

and the risk of running tomorrow’s operations on yesterday’s equipment and technology.” Which is kind of what you’d expect to hear from the head of an organization dedicated to helping its members sell new equipment and technology.

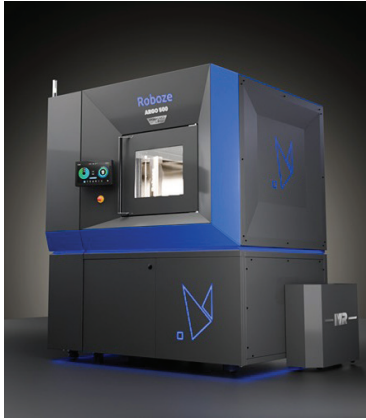
One of the users of the new technology, though, is Carvana, an

## TOP TEN SUPPLY CHAIN TRENDS

John Paxton, MHI’s CEO, also presented a list of the Top 10 Supply Chain Trends, as determined in the 2026 MHI Annual Industry Report:

1. Economic Uncertainty, Inflation and Geopolitical Risks
2. Workforce, Talent Shortage and Changing Worker Skillsets
3. Pace of Technology Adoption, Digitalization and Need for Real-Time Data
4. Supply Chain Visibility, Agility and Resiliency
5. Cybersecurity and Data Security
6. Rising Cost of Capital
7. Inventory Challenges
8. E-commerce Growth
9. Customer-Centricity
10. Reshoring

*\* For the record, Sustainability slipped out of the Top 10 to # 11 this year.*



**Industrial 3D Printer for Aerospace, Defense**

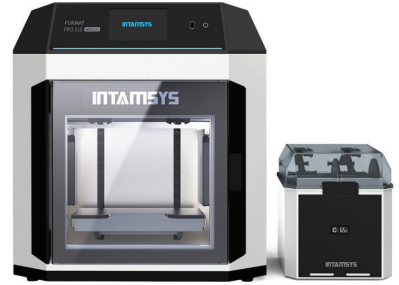
The **Argo 500 Hyperspeed Mission Ready** is an additive manufacturing platform with a 19.7 x 19.7 x 19.7 in (500 x 500 x 500 mm) build volume, 842°F (450°C) extrusion temperature, and 0.0004 in (10 µm) positional accuracy. Integrated active filament drying reaches a -112°F (-80°C) dew point. Compatible materials include ULTEM 9085 and Carbon PEEK.

**Roboze**

More online: [newequipment.com/55375944](https://www.newequipment.com/55375944)

**FFF Printer Runs One Week Without Material Changeovers**

The **Funmat Pro 310 Apollo** is an FFF printer for continuous PAEK and engineering-grade thermoplastic production. The IDEX dual-nozzle system prints at up to 8 in/s (200 mm/s), with dual 3 kg active-drying filament boxes supporting up to one week of uninterrupted printing. Chamber temperature holds stable up to 212°F (100°C). Compatible with 35 materials.



**INTAMSYS Technology Co. Ltd**

More online: [newequipment.com/55375678](https://www.newequipment.com/55375678)



**3D Printer Handles Magnesium and Reactive Alloys**

The **PA-300 LPPF metal printer** is built around Selective Stepped Laser Melting (SSLM), which stabilizes the melt pool and reduces spatter compared to conventional Gaussian scan strategies. Precision Additive also integrates its AI-driven PAQ Framework to provide real-time process monitoring and automatic deviation correction. Compatible materials include magnesium, titanium, Inconel, tungsten, molybdenum, and cobalt.

**Precision Additive**

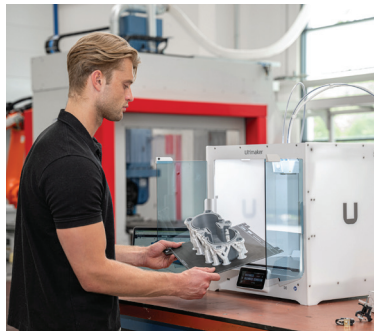
More online: [newequipment.com/55375641](https://www.newequipment.com/55375641)

**High-Speed Dual-Extrusion 3D Printer**

The **UltiMaker S6** is a dual-extrusion 3D printer with a Cheetah motion planner delivering speeds up to 20 in/s (500 mm/s) and 2,000 in/s<sup>2</sup> (50,000 mm/s<sup>2</sup>) acceleration—up to 4x faster than its predecessor. Backward compatible with the S5 series, it supports 300+ materials and integrates with UltiMaker Cura and Digital Factory software.

**Ultimaker**

More online: [newequipment.com/55375925](https://www.newequipment.com/55375925)

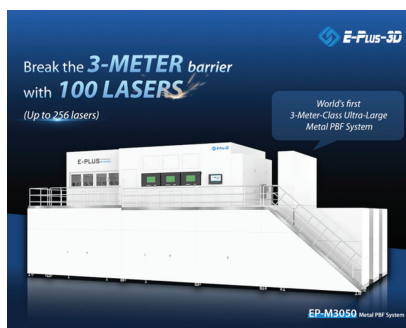


**Material Jetting Printer for Multimaterial Prototyping**

With three material channels for rigid, flexible, transparent, and tough materials in a single build, the **J850 Core PolyJet 3D printer** is suited for functional prototyping, jigs, fixtures, and enclosures. Dual print modes—High Quality and High Speed—balance fine detail down to 14µ (0.00055 in) with faster turnaround for engineering teams.

**Stratasys**

More online: [newequipment.com/55375355](https://www.newequipment.com/55375355)



**Ultra-Large-Format Metal Powder Bed Fusion System**

The **EP-M3050** is a metal powder bed fusion system with a 120 x 120 in (3,050 x 3,050 mm) build area and a customizable Z-axis up to 197 in (5,000 mm). Standard configuration includes 100 lasers, scalable to 256, with print speeds up to 214 in<sup>3</sup>/h (3,500 cm<sup>3</sup>/h). Build chamber options include square, cylindrical, and ring-shaped configurations.

**Eplus3D**

More online: [newequipment.com/55375963](https://www.newequipment.com/55375963)



**7-Axis Cobots for Higher Payload Limits**

Featuring 88 lb (40 kg) and 53 lb (24 kg) payload capacities, the **KR 1240** and **KR 1824** are 7-axis cobots designed for palletizing, machine tending, and material handling. Both models deliver 50% higher joint torque, 40% increased mechanical stiffness, and 20%+ faster wrist joint speeds than prior models. An optional EDGE-integrated controller supports mobile deployments on AGVs and AMRs.

**Kassow Robots**

More online: [newequipment.com/55376219](http://newequipment.com/55376219)



**AI-Ready Robots Expand Medium Payload Class**

Handling pick-and-place, machine loading, assembly, and surface treatment applications, the **KR CYBERTECH 55 lb (25 kg)** and **77 lb (35 kg)** variants deliver ±0.03 mm repeatability with IP67-rated wrists and are mountable at any angle. The newly developed central hand improves rigidity and path accuracy for demanding applications, including photovoltaics. Both models pair with the KR C5 slim controller running iiQKA.OS2 for AI-ready integration.

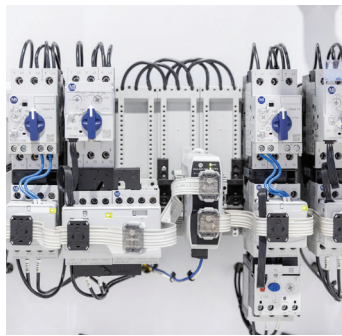
**KUKA Robotics Corp. USA**

More online: [newequipment.com/55377826](http://newequipment.com/55377826)

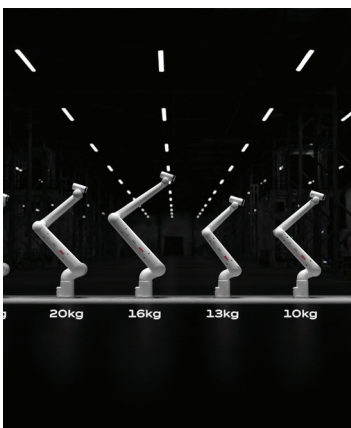
**Expand Motor Control Without Panel Redesign**

Expanded with motor control and power connection capabilities, the **EtherNet/IP In-Cabinet Solution** now connects 140ME Motor Protective Switching Devices and E100 Electronic Overload Relays via a 100-E Contactor communication module. A supplemental power tap maintains stable performance as device counts grow, while compact components allow more devices within the same panel footprint.

**Rockwell Automation, Inc.**



More online: [newequipment.com/55377785](http://newequipment.com/55377785)



**High-Payload Cobot Family**

Bridging the gap between traditional cobots and industrial robots, the **PoWa cobot family** spans 6 payload categories from 15 to 66 lb (7 to 30 kg), with top speeds reaching 19 ft/s (6 m/s). Designed for machine tending, palletizing, screw-driving, and arc welding, it supports no-code programming, plug-and-play tooling, and deploys within 1 hour.

**ABB**

More online: [newequipment.com/55377273](http://newequipment.com/55377273)



**Secure HMI for IT/OT Integration** GOT3000 HMI acts as a secure gateway between equipment and IT systems, integrating data through OPC UA Client, OPC UA Server, and cloud connectivity support. The built-in web browser lets users configure and monitor equipment without a PC, and offers NFC contactless tag reading, USB-C connectivity, USB camera support, and built-in HDMI output. Live video can be recorded and displayed alongside recorded footage to investigate malfunctions.

**Mitsubishi Electric Automation, Inc.**

More online: [newequipment.com/55375343](http://newequipment.com/55375343)

**Mini Lidar Delivers 187° Vertical FOV**

Designed for AGVs, AMRs, delivery robots, robotic lawn mowers, cleaning robots, and agricultural vehicles, the **JT Series** includes the **JT16** (16 channels) and **JT128** (128 channels). Both feature a hyper-hemispherical 360° x 187° FOV—60% wider than traditional 3D lidar—in a compact 55 mm (2.2 in) minimum diameter housing weighing 200 to 250 g (7 to 8.8 oz), consuming as little as 4 W.

**Hesai Technology**

More online: [newequipment.com/55377876](http://newequipment.com/55377876)

Window Height <small>Empowered installation</small>	30 mm
Diameter <small>Compared with similar products</small>	30% ↓
Volume <small>Compared with similar products</small>	70% ↓



**HD Borescope With Environmental Probes**

Featuring a 5.5 mm (0.2 in) IP67-rated camera probe on a 3 ft (1 m) flexible gooseneck cable, the **BR95 Video Borescope** captures 1280 x 720 HD imaging on a 3.5 in IPS screen with built-in LED illumination and 3x digital zoom. Optional CO, CO<sub>2</sub>, and relative humidity probes expand it into a multifunction diagnostic tool for inspections.

**Extech Instruments Corp.**

More online: [newequipment.com/55376915](http://newequipment.com/55376915)

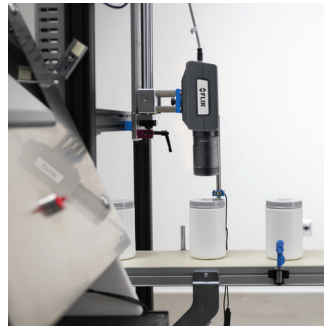
**Edge AI Vision Controller, No External PC**

Powered by NVIDIA Jetson technology, the **In-Sight 6900 Vision Controller** delivers up to 157 TOPS of edge AI processing for demanding industrial inspections without external PCs. Its modular architecture supports interchangeable cameras, lenses, and lighting. Transformer-based Few Sample Classification requires as few as 10 to 20 training images, accelerating deployment across high-speed production lines.

**Cognex Corporation**



More online: [newequipment.com/55376271](http://newequipment.com/55376271)



**Cooled MWIR Camera Built for 24/7 Use**

Featuring up to 27,000 hours of operational life, the **A6450 Long-Life Cooled MWIR Camera** is built for continuous industrial automation, process control, and non-destructive testing. A 125 Hz frame rate captures fast thermal events on moving targets, while GigE Vision and GenICam protocol support enables integration into existing automation systems. Hundreds of on-camera calibration profiles support frequent product changeovers from a single platform.

**Teledyne FLIR, LLC**

More online: [newequipment.com/55377065](http://newequipment.com/55377065)

**pH/ORP Sensor Cuts Maintenance in Dirty Apps**

The **Rosemount 396A** is a digital pH/ORP sensor for dirty, abrasive, and high-solids applications. Its anti-coating reference design with a through-wall reference junction maintains a steady signal even when coated. Modbus digital output supports simplified installation with compatible liquid analysis transmitters, and calibration data stored in the sensor eliminates field recalibration during changeout. Rated IP67 and IP68 for wet and washdown environments.

**Emerson Electric Co.**



More online: [newequipment.com/55376125](http://newequipment.com/55376125)



**Smart Relays Scale to 48 I/Os, No Coding**

Spanning 8 inputs and 4 outputs expandable to 48 I/Os via three expansion modules, the **Altech Smart Relays** snap onto DIN rail in a 3 x 3.5 x 3 in (72 x 90 x 65 mm) housing. Free configuration software requires no prior programming knowledge, while Modbus support enables real-time monitoring across a wide device ecosystem. A companion universal multimeter offers timing ranges from 0.1 s to 100 h.

**Altech Corporation**

More online: [newequipment.com/55378224](http://newequipment.com/55378224)



**Metal Detector Reduces False Rejects in Food**

The **X8-SF** is a simultaneous frequency metal detector for food processing applications, including fresh meat, poultry, and dairy. It transmits and receives multiple frequencies at once to adapt to variations in product conductivity and composition, reducing false rejects caused by product effect. A hygienic design, touchscreen interface, and integrated data capture support traceability and compliance. Includes the Quality Retail Compliance Kit (QRC) as standard.

**Eriez Manufacturing Co.**

More online: [newequipment.com/55376132](http://newequipment.com/55376132)



**3D Laser Cutter Trims Cost-Per-Part 25%**

For job shops and variable production mixes of fewer than 1,000 parts, the **Laser Next Core** 3D laser cutting machine offers axis strokes of 10 x 7 x 2 ft (3,160 x 2,100 x 750 mm). Cost-per-part runs up to 25% lower than market references, with a working volume 58% larger and a footprint 25% smaller than comparable models. An optional welding head extends capability to lap and butt joints.

**Prima Power**

More online: [newequipment.com/55376137](http://newequipment.com/55376137)



**Dual-Station Belt Grinder Boosts Finishing**

Featuring two belt heads for platen, contact wheel, and slack belt grinding, the **2" x 72" Dual Station Variable Speed Belt Grinder** handles everything from roughing to final polishing on a single machine. Belt arms tilt 0 to 90° for quick application changes, and a single-handle quick release allows tool-free belt swaps in seconds. A 1.5 hp variable speed motor and full OSHA-compliant guarding round out the package.

**Palmgren**

More online: [newequipment.com/55377924](http://newequipment.com/55377924)

**High-Precision Twin Turret Grinder**

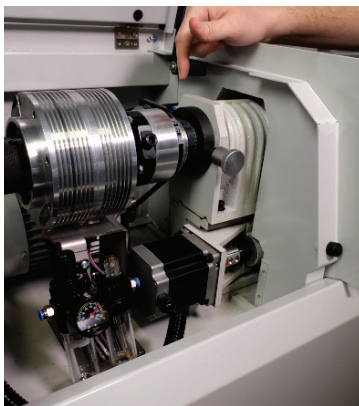
The **Landis TTG 3000** is a twin-turret, multispindle grinder that consolidates ID, OD, face, taper, raceway, and eccentric diameter grinding to sub-micron tolerances in a single clamping. The patented twin-turret design eliminates repositioning across complex geometries. Accommodates up to three spindles; supports conventional, CBN, and diamond wheels. Also performs hard turning and polishing.



**LANDIS TTG 3000**

**Fives Machining Systems**

More online: [newequipment.com/55376590](http://newequipment.com/55376590)



**Collet Closer Automates 5C Lathe Clamping**

Designed for Tormach's 8L Lathe, the **Automatic Collet Closer** provides air-actuated clamping for standard 5C collets, eliminating manual drawtube operation. Clamping force is adjustable via input air pressure for repeatable part retention across runs. The system integrates with the PathPilot control system and includes an optional foot pedal for hands-free actuation.

**Tormach, Inc.**

More online: [newequipment.com/55378183](http://newequipment.com/55378183)



**High-Pressure Coolant Toolholders**

Providing targeted high-pressure coolant delivery through a 3D-printed clamp and secondary DUO JET outlet, the **Jetstream Tooling M-Clamp** toolholder system extends tool life by at least 30% and improves chip control and surface finish in stainless steel and superalloys. Double clamping security, now available for both negative and round positive inserts, combines a center-lock screw with a top clamp for improved stability. A twist function and shared key slot design speed insert changes and indexing.

**Seco Tools, LLC**

More online: [newequipment.com/55378250](http://newequipment.com/55378250)

**Taps for Mass Production Threading**

The **TC180 Supreme** and **TC280 Supreme** are solid carbide taps for large batch and mass production threading applications. Both are made from grade WJ30EL with a HiPIMS-applied coating for effective chip formation and extended tool life. The TC180 handles blind-hole threads; the TC280 handles through holes. Both cover ISO P, K, and N material groups in metric sizes from M6 to M12.

**Walter USA, LLC**



More online: [newequipment.com/55373728](http://newequipment.com/55373728)



**All-Electric Sorter Hits the Mid-Rate Sweet Spot**

The **TrewSort Swivel Wheel Sorter** handles cartons, totes, polybags, and mixed parcel sizes at speeds up to 400 ft/min (122 m/min) in the 45 to 200 cartons/min (12,000 units/h) range. Maintaining small gaps between items, it supports single and dual-sided 30°, 45°, and 90° diverts. Wheel Grip Technology reduces slipping and tracking errors.

**Trew, LLC**

More online: [newequipment.com/55373448](https://www.newequipment.com/55373448)

**Autonomous Stacking for Tall and Wide Cages**

Designed for large container environments, the **VNE40-66 Autonomous Precision Stacking Solution** stacks cages up to 8.8 ft (3 m) wide and 6,150 lb (2,790 kg) at heights up to 22 ft (7 m). Proprietary sensor fusion delivers millimeter-level placement precision, while Smart Retry Functionality detects misalignments and retries automatically—no operator input required.

**VisionNav Robotics**



More online: [newequipment.com/55377775](https://www.newequipment.com/55377775)



**Conveyor Edge Protector Stops Curved Conveyor Jams**

The **Radial Belt Edge Protector (BEP-R)**, designed for curved conveyors, uses a vertical brush to create a flexible barrier at power turns—the

points where parcels naturally migrate toward the outside edge and become wedged between the belt and conveyor structure. Installation allows attachment wherever power turn protection is needed.

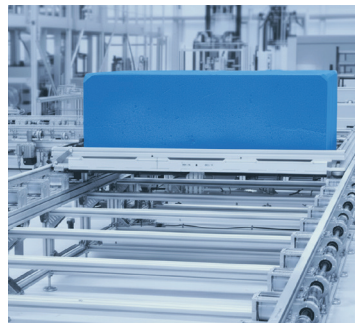
**Flexco**

More online: [newequipment.com/55374353](https://www.newequipment.com/55374353)

**Roller Conveyor for Loads Up to 6,600 lb**

Handling payloads up to 6,600 lb (3,000 kg), the **TS 7plus** is a fully electric, modular roller conveyor transfer system with freely configurable sections including lift/transverse, rotary, and positioning units. Lubrication-free king shaft drive, demand-based segmented operation, and conveyor speeds up to 79 ft/min (24 m/min) reduce maintenance, energy use, and total cost of ownership.

**Bosch Rexroth**



More online: [newequipment.com/55377080](https://www.newequipment.com/55377080)

**Stand-Up Lift Truck with Integrated Telematics**

Designed for high-demand warehouse operations, the **Raymond 4260 Stand-Up Counterbalanced Truck** handles 3,000 to 5,000 lb (1,360 to 2,268 kg) and features a telematics-ready architecture with an integrated iMONITOR display delivering real-time load weight, fork height, and mast tilt data. Standard ComfortStance Suspension, electric power steering, and regenerative braking support extended-shift productivity.

**The Raymond Corporation**



More online: [newequipment.com/55376266](https://www.newequipment.com/55376266)



**Forklift Attachment Cuts Pallet Impact Damage**

Mounting to ITA Class II or Class III carriages without requiring operator behavior changes, the **Pallet Saver** forklift attachment uses a replaceable rubber impact pad to redirect engagement forces from deck boards to a pallet's center strut. Constructed from 0.5 in (13 mm) welded steel, it's available in 4 models with single or double pad configurations for manufacturing, warehouse, and material handling applications.

**Broce Manufacturing**

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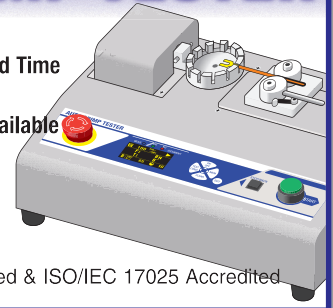
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# PRODUCT GUIDE

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