PRODUCTIVITY SOLUTIONS FOR DISTRIBUTION, WAREHOUSING AND MANUFACTURING

MODERN MATERIALS HANDLING®

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October 2019

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Shopify to acquire 6 River Systems

SHOPIFY, A LEADING multi-channel commerce platform, has announced an agreement to acquire 6 River Systems, a leading provider of collaborative warehouse fulfillment solutions, in a transaction valued at $450 million.

In June, Shopify introduced its Shopify Fulfillment Network. According to a release, this acquisition is a critical step to accelerate the network's growth, while 6 River Systems will also continue to build and sell their solution for warehouses.

With the acquisition of 6 River Systems, Shopify will add a team with decades of experience in fulfillment software and robotics, including experienced leaders from Kiva Systems (now Amazon Robotics). Adding 6 River Systems' Cloud-based software and collaborative mobile robots called "Chuck" to the Shopify Fulfillment Network is expected to increase the speed and reliability of warehouse operations by empowering on-site associates with daily tasks, including inventory replenishment, picking, sorting and packing.

Dematic announces strategic partnership with OPEX

DEMATIC ANNOUNCED a partnership agreement with OPEX Corp. that enables Dematic to act as an integrator of Sure Sort, a small-item sorting system.

The agreement expands the omni-channel order fulfillment offering of Dematic and provides customers with more options that bring productivity and efficiency to item order consolidation. As a system integrator/solution provider, Dematic will apply and implement Sure Sort as a subsystem within an overall Dematic system. For OPEX, the agreement will allow more markets and customers to realize the benefits of the Sure Sort solution. The agreement is for systems implemented by Dematic in North America.

Sure Sort is a robotic small-item sorter that functions as an automated order consolidation method for batch picked items. It is often required for e-commerce order fulfillment and retail store replenishment applications, and maximizes efficiency and accuracy during the order consolidation process while minimizing order processing time, labor required and the amount of floor space needed in the distribution center.

Körber acquires majority stake in Cohesio Group

THE INTERNATIONAL TECHNOLOGY GROUP Körber has strengthened its Business Area Logistics Systems by acquiring a majority stake in the Cohesio Group. The Australian-based company is a leading integrator of voice-directed and autonomous mobile robotics solutions.

The Cohesio Group, headquartered in Melbourne, established itself as one of the leading providers of voice-controlled and robotics software solutions for the logistics industry, particularly in the Asia Pacific region (APAC). Cohesio will complement the business area's existing voice solutions business with its brand Voiteq. This strengthens one of the world's largest and most experienced Honeywell Vocollect voice integration teams. Cohesio has also pioneered the deployment of autonomous mobile robotics solutions in the region.

"With Cohesio, we are underpinning our claim to 'market leadership through technology leadership' in the future-oriented fields of voice and robot technology," says Stephan Seifert, chairman of the group executive board at Körber AG. "We are also expanding our presence in the particularly fast-growing markets of the APAC region."

Columbia/Okura announces new cobot strategic alliance with Universal Robots

Columbia/Okura has announced a strategic alliance with Universal Robots that will allow it to deliver a more extensive range of robotic palletizing solutions, including collaborative palletizing applications.

Columbia/Okura has been working on the development of miniPALTM, a mobile, collaborative palletizing product integrating Universal Robot's UR10e for some time. This new product range of palletizing "cobots" is planned to launch immediately.

"The partnership between our two companies allows Columbia/Okura to provide a safe and economical palletizing solution to clients who are facing labor shortages, many of whom may also be new to factory automation," says Brian Hutton, president of Columbia/Okura.

The new collaborative product offering has several significant client benefits. It takes less than a full day to set up, requires no previous programming experience, provides a payback in an average of 8 to 10 months, and is easily moved and re-deployed to new processes. With the introduction of a collaborative palletizer, employees can be re-deployed to work on higher value tasks where their time and skills are better served.


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PRODUCTIVITY SOLUTIONS FOR DISTRIBUTION, WAREHOUSING AND MANUFACTURING

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COVER STORY

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MICHAEL LEVANS
GROUP EDITORIAL DIRECTOR

From cutting edge to conventional

Over the last few months, we fine-tuned our coverage to touch on some of the running themes that drive warehouse and DC operations. In July, we devoted the majority of the issue to software and technology; in August, we offered our annual lift truck issue; and last month, we put the spotlight on the ever-increasing importance of packaging.

This month, *Modern*'s editorial staff stretched its wings to showcase a breadth of coverage that tackles everything from the cutting edge to the conventional, offering a 30,000-foot view of some of various trends making their way into the market.

To kick us off, executive editor Bob Trebilcock takes a look at the growing area of micro-fulfillment—the concept of turning urban brick-and-mortar locations into fulfillment operations (page 18). "I started working on this story thinking that I'd be writing about an emerging trend," he says, "mostly because no one had really said much about it to me. However, I discovered it's already here."

You may have already benefitted from a micro-fulfillment operation if you've purchased online and opted to pick up at a store. Grocery was certainly the earliest adopter, but now we're seeing other retail segments like Big Box stores implementing solutions to turn their locations into mini-DCs to serve a hyper-local market.

"I also learned that, just as in traditional warehousing, there's a diversity of solutions out there—from voice, to manual picking to mobile robots, to highly automated sortation and goods-to-person picking—all scaled down to fit in the backroom of a grocery or Big Box retail store," adds Trebilcock. "It's an exciting development, one that's bringing in familiar names and new players to the industry."

Another development we dive into this month is how artificial intelligence (AI) and the Internet of Things (IoT) are evolving and making their way into our day-to-day worlds. "These next-generation technologies are no longer just 'visionary' talking points," says contributing editor Gary Forger. "We are now at the point where these powerful tools are very much for real and are knocking on the warehouse door."

Starting on page 24, Forger dives into the current state of AI and IoT, tracks the providers putting some muscle into development, and shares how DC operations will benefit from answering that door and letting them in.

"The greater purpose of IoT and AI is that, when combined with warehouse management system software, warehouse execution systems and even work execution systems, they make it possible for a DC to move from being forecast driven to being demand driven," adds Forger. "That will lead to operational excellence."

And while those two stories ride along the cutting edge, senior editor Josh Bond reminds us that some of the classic approaches to warehouse and DC management still very much apply in our modern world (page 40).

"The fact remains that far more operations run in a more conventional manner, characterized by lift trucks for pallet movement and minimal automation," says Bond. "Yet, they're still looking to squeeze out every ounce of efficiency and productivity. These practical best practices should help achieve those goals."

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MANUFACTURING

Deloitte/MAPI: Smart factories key to tripling stalled labor productivity growth rate by 2030

More than 86% of survey respondents believe smart factory initiatives will be the main driver of manufacturing competitiveness in the next five years, though only 51% are making or have made investments.

BY **MODERN STAFF**

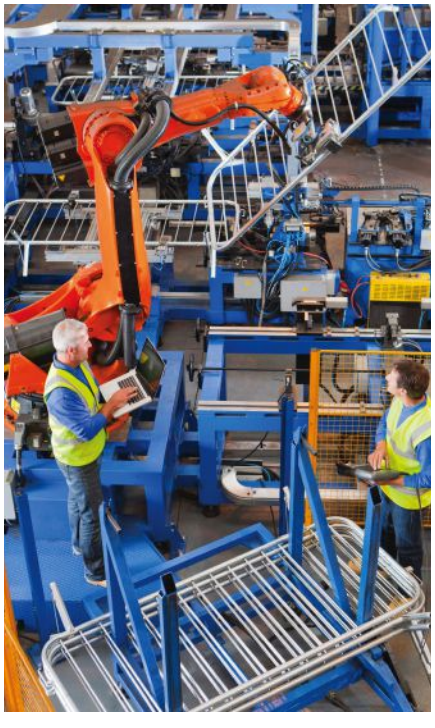
A NEW REPORT FROM DELOITTE and the Manufacturers Alliance for Productivity and Innovation (MAPI) suggests smart factory initiatives could potentially ignite stalled labor productivity growth, predicting a three-fold improvement in labor productivity over the next decade.

In the spring of 2019, Deloitte and MAPI surveyed more than 600 executives at manufacturing companies with headquarters in the United States and a global factory footprint to help quantify the impact of smart factories on key business metrics, including manufacturing productivity. Data analysis, economic forecast modeling and executive interviews with manufacturers concluded that smart factory initiatives could be the key to manufacturing competitiveness.

U.S. manufacturers seeking boost in productivity

Although 2011 is considered the unofficial start of the fourth industrial revolution, the report indicates U.S. manufacturers have reported zero average growth in labor productivity over the past five years—despite continual improvements in equipment, software and management approaches. As the industry grapples with a labor shortage, among other challenges, the study and forecasting model suggests smart factories could be key to boosting stalled labor productivity and unlocking overall productivity gains for manufacturers.

"Manufacturing output may be 11% of U.S. gross domestic product, but its total value chain for the economy is three times that," said Stephen Gold, president and CEO at MAPI. "Digital



transformation will likely only increase manufacturing's importance and competitiveness. This new research provides excellent insights for manufacturing leaders trying to propel their digitalization journey, regardless of the current state of their operations."

Smart factory initiatives could

lead manufacturers to experience labor productivity increases of 4%, as per the study, which represents a three-fold improvement over the past decade's average annual growth rate of 0.7% (2007-2018). Notably by 2030, the compound annual growth rate (CAGR) of U.S. labor productivity is projected to be near 2.3%, a level last seen in the 1990s.

"Smart factory initiatives are delivering on many of the promised benefits of the fourth industrial revolution," said Paul Wellener, vice chairman and U.S. industrial products and construction leader for Deloitte. "Combining digital technologies with the automated solutions of the past is expected to jump-start manufacturing productivity and set a new trajectory of growth for the sector. For companies looking to capitalize on smart manufacturing as a key competitive advantage, now is a crucial time for action."

Manufacturers harvesting real business value from smart factories

Implementing smart factory initiatives appears to be paying off for early adopters. Self-identified in the study as "trailblazers"—the group is investing as much as 65% of this fiscal year's budget on smart facility initiatives, which has led to twice the level of gains to labor productivity compared to other peer groups.

The report finds smart factory initiatives are accelerating business value creation. Companies report up to 12% gains in areas like manufacturing output, factory utilization and labor productivity after they invested in smart factory initiatives. And, manufacturers with smart factories will likely surpass traditional factories with 30% higher net labor productivity in 2030, and thus potentially higher profits.

Implementing smart factory initiatives is helping to build resiliency and is often viewed as a competitive advantage. However, while more than 86% of survey respondents believe smart factory technologies will be the main driver of manufacturing competitiveness in the next five years, only 51% of respondents are planning investments or have implemented smart factory initiatives.

Digital solutions for smart factories

Of those survey respondents who said they were investing in smart manufac-

turing, quality sensing and detection is cited as the most common smart factory initiative, with approximately 50% of respondents saying it's currently in use. Foundational technologies, such as data analytics, Cloud networking, robotics and automation are well invested (approximately 90% of respondents are currently investing or plan to invest in these technologies), while promising interest is evident in emerging technologies, including active and passive sensors, Internet of Things and vision systems (greater than 80% of respondents are currently or plan to invest in these technologies).

One of the biggest challenges of smart factory adoption identified by respondents is that many organizations do not take any action on smart factory investment and initiatives. Nineteen percent of respondents have not thought about smart factory transformation, and 30% are thinking about it, but currently not planning any initiatives.

Operational risk was cited as top of mind for manufacturers regarding smart factory initiatives, followed by strategic and financial risks. Additionally, cyber risk was a concern across the board, given its exposure despite digital maturity.

FUEL CELLS

Plug Power and ENGIE partner globally to expand use of fuel cells

Plug Power, a provider of hydrogen engines and fueling solutions enabling e-mobility, has signed an agreement with ENGIE, a global energy and services provider in the the field of energy transition, combining their expertise and capabilities to accelerate the adoption of hydrogen and fuel cell systems.

As a part of the agreement, Plug

Power is partnering with ENGIE to identify mutually beneficial markets and customers, packaging Plug Power's fuel cell technology with ENGIE's hydrogen infrastructure, renewable energy and service programs to deliver cost-effective hydrogen energy solutions. This partnership allows global customers to easily implement hydrogen technology into their operations, seamlessly purchasing hydrogen fuel cells and accessing clean energy.

By combining Plug Power's leadership in hydrogen fuel cell systems and ENGIE's international leadership in deploying renewable hydrogen solutions, this agreement will facilitate adoption of hydrogen as an efficient, productivity-enhancing clean energy source for forklifts and throughout customers' logistic chains, especially within distribution centers, ports and airports.

Plug Power brings industry expertise, with 28,000 deployed fuel cells and more than 270 million run hours in mobility applications, including Fortune 500 customers such as Amazon, BMW and Walmart.

"We're excited to partner with ENGIE and to accelerate market penetration for hydrogen fuel cells around the world," said Plug Power CEO Andy Marsh. "Given the global commitments to meet the targets of the Paris Accord, we and ENGIE believe there's a tremendous opportunity for expansion of hydrogen and fuel cells to provide a clean, efficient energy alternative to fossil fuels."

DATA CAPTURE

Barcoding Inc. and FactoryFour announce strategic nationwide partnership

Barcoding Inc., a leader in supply chain efficiency, accuracy and connectivity, announced a nationwide partnership with FactoryFour to deliver combined solutions to the manufacturing and logistics industries.

Through the partnership, Barcoding will offer its customers tailored automatic identification and data capture (AIDC), Internet of Things (IoT) and RFID solutions that leverage FactoryFour's capabilities, which include real-time work-in-process (WIP) visibility, enhanced quality control and asset and inventory traceability. These solutions will be paired with Barcoding's GoLive Services and StayLive Services to help customers with system design, deployment and execution.

"Barcoding offers a fit-to-purpose WIP tracking and process automation solution with FactoryFour that delivers high ROI with superior reporting and decision support," said Ken Currie, vice president of business development at Barcoding. "This partnership with FactoryFour will provide our manufacturing customers with a seamless, customizable solution as they scale and manage production."

"I was impressed with Barcoding's hunger to innovate and bring new solutions to the market," said Param Shah, CEO and co-founder of FactoryFour. "Pairing our platform with the hardware and services Barcoding provides is a critical step for us to provide premium solutions to our manufacturers."

FactoryFour's software platform is Cloud-based and hardware agnostic, with the built-in capability to integrate with several hardware devices to automate actions in the platform.

Manufacturers can connect tablets, bar code scanners and RFID to automate actions in FactoryFour. For example, an RFID tag moving between readers can automatically update production status in FactoryFour and generate analytics on cycle times, labor productivity and more.

Powering productivity

Fleet owners and forklift OEMs are exploring a brave new world of motive power, where chocolate and vanilla have been replaced with a kaleidoscope of options.

By Josh Bond, Senior Editor

The Great Recession taught an unforgettable lesson in the value spent on forklifts and their operation. Since then, the conversation around forklift power sources has taken several twists and turns. First, a sizable migration began from internal combustion to electric, then fuel cells and lithium-ion alternatives became more broadly viable, and now driverless forklifts are in the mix.

"We continue to see triple-digit growth in lithium-ion, and thin plate pure lead (TPPL) is coming on really strong, so customers are seeing a kaleidoscope of options," says Steven LaFevers, vice president of emerging technology for Hyster.

LaFevers cites three trends driving innovation in the motive power space. The first is increasing customer desire for access to a comprehensive suite of power solutions. Second, with an eye toward minimizing the need for a forklift operator to care about how the unit is powered, an ever-growing interest is in integrated operator systems, including sensors and safety systems, telematics and operator-assist technologies like automatic braking and speed control. The third revolves around driverless or automated forklifts.

"There's an evolution," LaFevers says. "When we started to invest in telematics, companies wanted to monitor and understand damage. Now, with LIDAR and sensors to avoid damage, the trend we're seeing is a shift from monitor to prevent. They want to avoid things that can hurt staff or production."

As fleet expenses and waste came into sharper focus, a heavier burden was placed on operators in terms of productivity and power management. Consider the latest fast-charging technologies, which require disciplined adherence to charging schedules.

"There are Fortune 500 companies whose operators are failing to plug in forklifts 40% to 60% of the time," LaFevers says. "Some are set up so they need to charge every single break, and any application with that kind of tolerance is set up to fail. If you are a lithium, fast charge or TPPL customer and don't follow the regimen, you will pay two to three times the cost and achieve literally the same power delivery."

LaFevers recently visited a site with nine large, power-intensive charging stations for lithium-ion equipment. Of the trucks parked in the charger bays, only one was plugged in. "That's a piece you have to ask yourself: What is the likelihood that the operator will fail to charge?" he says. "Then change your math. It starts to really put some holes in the payback model."

Holes in data collection practices present opportunities to find and quantify efficiencies. LaFevers explains that some customers have advanced warehouse management and labor management systems with very visible data sets. Many have an equally robust fleet telematics data set.

"But between the two there are some major black holes until you tie them together," he says. How much time elapses from when an operator clocks in to the time he gets on the truck? Do you know how much time it takes to make a pick, but not the travel time to the pick? "There is an unquenchable appetite for data, but at the same time customers don't always have time to do anything with the data. So they want data providers who are more and more versatile and can make data easier to understand."

Josh Bond is Modern's *senior editor and can be reached at jbond@peerlessmedia.com*

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Trim your corrugated and consumables inventory

Here are two ideas to help your operations work through the clutter by managing all your inventory and minimizing the space needed to stage and store it.

By Gary Forger, Contributing Editor

In all likelihood, you've heard about the decluttering craze. Lead by author and decluttering expert Marie Kondo, it has gained attention worldwide. Heck, there's even a Netflix series about it.

Now, it's possible your spouse or even a good friend has suggested you try it at home. So be it. But if your boss suggests you find a way to declutter your packaging department, that's another story.

So, we got on the phone to the folks at Videojet. And fortunately, both Brock Young and Babak Durrani have some ideas about how you can take a page from Marie Kondo's book. Both are product managers immersed in direct case coding and laser reactive marking and they have some ideas for you.

To begin, Durrani and Young are quite familiar with the issues here. First, you could well have a large inventory of preprinted labels and ink. There's also the matter of too many different boxes, each a SKU unto itself, with different alpha-numeric text and codes for specific products. As you well know, there's the matter of managing all that inventory and minimizing the space needed to stage and store it. That's clutter.

Now, there's no way to get around having to inventory corrugated boxes, if that's what you use to ship product. There is some relief if you right-size boxes. Experts estimate that the typical shipping box is 40% too large. But that's another story.

Clearly, you don't need all those labels or pre-printed boxes. Better yet, here are two viable and cost saving and viable options: large character marking and laser reactive marking.

Large character marking (also known as direct case coding) allows you to print alpha-numerics and bar codes (both 1-D and 2-D) directly on the box as it moves down the packaging line. Data can be changed from box to box, explains Young.

The technology has been around quite some time and has steadily improved. It's now

capable of printing at resolutions up to 180 dpi on porous and semi-porous surfaces. Better yet, Durrani says direct case coding can help streamline purchasing requirements and help reduce a manufacturer's unique case inventory.

For instance, winemaker Henri Bourgeois uses it to mark his cases of French wine. Bar codes and the product name are printed on two adjacent sides of each case at a rate of 14 boxes a minute on three lines. The winery ships 150,000 cases a year. Cheers to large character marking.

Laser reactive marking is a whole other animal, says Young. This technology first applies a translucent patch to the packaging, whether it's a corrugated box or plastic container. The system then targets a laser on the patch, which reacts to the beam resulting in a readable and unique combination of bar code and alpha-numerics. In other words, laser reactive marking eliminates the need for ink. Once applied, the patch is basically impossible to remove, adds Durrani.

While much newer than large character marking, laser reactive marking has proven itself across several industries from consumer goods to pharmaceuticals. And it, too, can claim cost savings over preprinted packaging.

So, there you have it—decluttering in the packaging department. And, you didn't even have to watch Netflix or read the book.

Gary Forger is a contributing editor with Modern *and can be reached at grforger@gmail.com.*

MICRO-FULFILLMENT may be coming to a grocery store near you

Forget 500,000-square-foot—or even 50,000-square-foot—distribution centers. Materials handling automation and technologies are the next trend in brick-and-mortar fulfillment.

BY **BOB TREBILCOCK**, EXECUTIVE EDITOR

The scene looks familiar to anyone who has walked through a facility handling automated e-fulfillment: Associates at a goods-to-person workstation pull product from a donor tote delivered from a shuttle system and use them to build customer orders received online.

But there's a twist: This isn't your typical 500,000-square-foot distribution center, or even a 50,000-square-foot distribution center. Rather, the solution from Takeoff brings together Takeoff's software with a shuttle system from Knapp in a 10,000-square-foot space in the back of a grocery store.

In a typical installation, Takeoff manages some 15,000 SKUs in the shuttle system, including a refrigerated lane, representing about 80% of the items most often ordered by customers online. The fastest moving items are picked manually from shelving adjacent to the shuttle system, while store personnel pick bulky items (think toilet paper or dog food), fragile items (think bottled water), frozen foods, deli items, produce, and seafood and meat as well as the slowest moving products from store shelves. Those items are married with orders in the back.

According to Lucia Brower, Takeoff's chief of staff, the company can implement a solution in less than 20 weeks after the space has been prepared. Once it's in operation, "we can typically fill an order for 60 items in a matter of minutes rather than an hour for an associate to go through the store with a cart," Bower says.

The industry calls it micro-fulfillment. It could be the answer retailers and grocers have been looking for to quickly and economically fill Buy Online/Pick Up in Stores orders, or BOPUS. While grocery is the earliest

adopter, other retail segments, including Big Box retailers, are investigating different solutions to turn their brick-and-mortar space into mini DCs to serve the local market.

The drivers for this trend: Pure play e-tailers, and the 3PLs that work with them, are building out networks to get closer to the customer for next-day and same-day delivery. Meanwhile, grocers and retailers want to capitalize on the infrastructure they already have in place in their stores. But, that doesn't come cheap, notes Matt Inbody, Dematic's chief disruptor. "Grocers tell us it costs about $5 to get the typical order to the curb if you or I pick the order," Inbody says. "They're spending about $15 to pick an order that you or I place online for pickup in the store. That $10 gap is often tied to labor." That $10 gap also represents a good chunk of the grocer's profit margin on an order. With micro-fulfillment, a grocer "can still have a DC that serves a city, but now they have 20 or 30 retail locations in an urban area that can serve as their forward pick location," Inbody says.

Both 3PLs and solution providers are getting in the game. That was evident in our feature on Rakuten Super Logistics in the September issue of *Modern Materials Handling*. Similarly, Tel Aviv-based CommonSense Robotics is building highly automated, multi-tenant micro-centers in urban areas that the company says are less than 6,000 square feet. And, other system inte-

Grocers and retailers are piloting semi-automated, voice-enabled pick-to-cart solutions (top) as well as pick-to-robot solutions (bottom) in the store, in back rooms and dark stores.

grators are bringing solutions to the market to compete with Takeoff and Knapp, including Tompkins Robotics, Dematic, 6 River Systems, IAM Robotics and Swisslog and AutoStore, which are developing a solution for a grocer. Expect more to follow.

At the same time, this is an emerging space. While Takeoff is in talks with a number of grocers and has implementation projects on the calendar, currently six sites are up and operating in North America and Australia, according to Bill Stenger, who is the director of food solutions for Knapp. But, hey, that's six more than the other solution providers we spoke with have in operation as of this writing, at least in the United States.

And, as Stenger notes, having implemented six, Knapp is using that experience to develop iteration 2.0. You get the sense that we're in the "throwing stuff against the wall to see what sticks" stage. "There's a lot of experimenting going on right now," says Tom Galluzzo, chief technology officer for IAM Robotics, which has participated in some of those experiments. "It's safe to say that there's a lot of figuring out what might be the right approach and strategy, and that no one's figured it out."

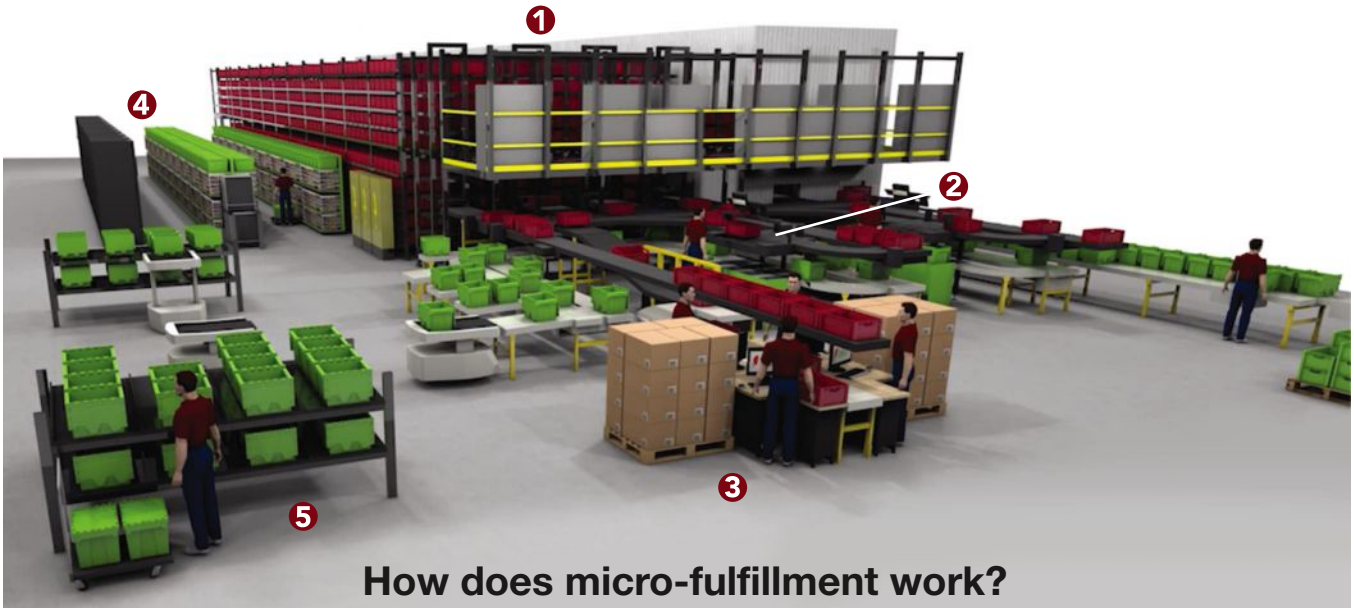
"There's no question that we're beyond the starting gate," adds Kara Ashby, president of Sedlak Supply Chain Consultants. "The technologies are there. Robotics are there. There are mobile apps, and people are ordering online to pickup in stores. Now, the industry is trying to pick the winners and losers and figure out who's going to survive as the market matures."

From *Modern*'s interviews, we identified three emerging strategies, and they're similar to picking strategies in larger DCs: Conventional pick to cart from store shelves; semi-automated pick from shelves in a back room or dark store; and highly automated solutions like those from Takeoff, Knapp, Dematic and Swisslog/AutoStore. Here's how it's all shaping up.

Strategy 1: Good old pick to cart

By all accounts, most micro-fulfillment is pretty basic today. Store associates push a grocery cart through the aisles and pick to paper grocery bags. Taking that one step further, some grocers are now using purpose-built carts that can hold 10 or 12 bags and get more orders from one associate's trip through the aisles. But, that picking is mostly paper based and labor intensive.

The next evolution is to replace paper-based picking with voice for hands-free picking, along with software



How does micro-fulfillment work?

There are several models for grocery micro-fulfillment centers (MFC) coming to the market. The solution from Takeoff Technologies and Knapp, one of the early movers in this space, is pictured above and works like this. Solutions like this will generally fit in an 8,000- to 12,000-square-foot area, which could be the back room of a grocery store or an addition to an existing store. Early adopters are using one MFC to service a cluster of stores.

Totes are inducted into the shuttle system **(1)**. Automation is used for about 80% of the SKUs most frequently ordered by online customers. Typically, there might be two lanes of ambient storage and one lane of refrigerated storage.

Orders are filled at goods-to-person workstations at the front of the shuttle system **(2)**. Once an associate withdraws the needed items from a donor tote, it's automatically returned into storage.

The fastest-moving items can be picked from pallets **(3)** or from a shelf area to avoid constantly replenishing the shuttle system.

Fragile and crushable items, as well as some frozen items, can be picked from shelves and freezers in another work area **(4)**.

The slowest moving items as well as deli, meat and seafood products and some fresh produce may be picked in the store (not shown).

Orders are then aggregated **(5)** and delivered to the front of the store for customer pick up, or loaded onto a trailer to be delivered to other stores served by that MFC.

to optimize the fulfillment operations. Retailers and grocers in Europe, including the United Kingdom, are already using voice, says Andrew Southgate, the global vice president of sales and marketing for Lucas Systems.

"There are two challenges if you're filling customer orders in your store aisles," Southgate says. "You need to stay out of the way of the regular customers who are doing their shopping, which means you don't want an associate staring a lot at the screen, and you want the least travel distance for the picker to speed up the picking process."

The solution that Lucas is bringing to the market does both. Voice directs the order selectors activities on the floor similar to the way voice directs pickers in a warehouse. Voice can be combined with RFID-enabled smart shelves that can confirm the picker is at the right shelf location while a voice check-digit confirms that the right quantity of item was picked, again just like in a warehouse.

The second component is software informed by algorithms that can sequence the picking around cutoff times that ensure that orders are ready when a customer arrives for pickup. The software also uses a digital version of the store layout to optimize the travel path. And, the software can run on a smart watch that connects to the headset by Bluetooth rather than a bulky mobile computer. The Holy Grail, Southgate says, is to use the system for the full gamut of activities in the store, from receiving merchandise in the back room to putting it out on the shelf to filling orders. He adds that no one is doing this now.

Strategy 2: Semi-automation is the next step

The semi-automated solutions coming to market are scaled down versions of the solutions showing up in e-fulfillment centers. They include pick to cart or pick to a robot in the back room or a dark store and may also incorporate automated sortation to quickly consolidate orders.

For example, 6 River Systems is developing a mobile robot and cart solution for

Mobile robotic solutions, like the one pictured here, allow grocers and retailers to sort orders that are batch picked in the store or a back room.

use in a retail back room. The picking process begins when the robotic control system receives a batch of orders from a warehouse management system (WMS). The robot system turns those into customer orders and then determines which SKUs should be put into which grocery bag, based on criteria such as the maximum weight for a bag, crushability and whether items need to be segregated by temperature. Once an associate scans into the system, a robot leads the associate through the aisles in the most efficient manner for the items to be picked. The system displays the exact bag on the cart for a specific item. Picks are confirmed by a scan. While the system could be used in the store, "we're seeing more demand for dark stores and back rooms because the safety considerations are similar to a traditional warehouse," says Fergal Glynn, 6 River's vice president of marketing. In the case of IAM Robotics, which makes autonomous piece-picking robots, the robot would pick from a shelf to a tote and then deliver the tote to a consolidation point.

If the items are batch picked in the store or a back room, the items need to be sorted and consolidated into customer orders. Tompkins Robotics is tackling that problem with a system that uses what are essentially mobile tilt trays that move across the top of a platform to deposit items in the right location for an order. The platform is modular and portable; a standard section measures 1 meter wide by 3 meters long, is on wheels and can be bolted together in different configurations to accommodate the contours of a back room. The whole thing plugs into a standard 20-amp outlet and doesn't require a sprinkler system.

"Someone can pick the items for 200 orders, and have the machine control the accuracy and speed," says Mike Futch, president of Tompkins Robotics. The system also has the capability to sort items that require special handling to specific destination points, such as fragile items or fresh fruit. While the solution was developed for order consolidation, Futch's team is now adapting it for other

A new model?

Micro-fulfillment represents a new order fulfillment model. It also represents a new business model for the solution providers entering this space. "Right now, our model is built around getting a large number of robots into a small number of warehouses," says Fergal Glynn, vice president of marketing for 6 River Systems. "Now, we'll need to get a small number of robots up in running in a lot of grocery stores."

That means managing more implementation projects—projects that need to get deployed and running far faster than the typical 12- to 18-month project in a traditional DC. It might also mean building to stock so systems are ready to go when there is an order. "Right now, we're engineering and manufacturing systems for 50 sites, which is an organizational shift," says Bill Stenger, director of food solutions for Knapp. "We now have a 50,000-square-foot facility to inventory the systems. That's a new supply chain challenge."

These systems are going to need to be supported, since skilled maintenance people aren't generally on staff at retail and grocery stores. "If you're putting a piece of automation in the back of 30 or 40 retail stores, you have to have someone who can show up and keep them running," says Matt Inbody, Dematic's chief disruptor. "Solution providers who already have a service network will have an advantage."

The final hurdle might be how retailers finance the systems: Will the time and labor savings be enough to deliver an ROI? "I think the winning solution will come down to capital versus operations," says Patrick Sedlak, a principal with Sedlak Supply Chain Consultants. "I also think that when it comes to back rooms and dark stores, the robot-as-a-service or automation-as-a-service model is going to have a leg up."

back room tasks. Those could include sorting newly received items according to where they're going to be stored on the store shelf or sequencing orders for a postal delivery route. "We could have a super center receive a batch of items from a distribution center and then sort them into orders to be picked up in the store or sequence route delivery for next-day delivery," Futch says.

Strategy 3: High-speed automation

Order fulfillment is moving to "edge fulfillment," in the words of Dematic's Inbody. He defines that as fulfillment as near as possible to the customer's doorstep, adding that "our job is to look at the pieces of automation that will provide that."

That is leading to highly automated solutions using shuttle systems, in the case of Knapp and Dematic, and robotics in the case of AutoStore. All three solutions incorporate refrigerated storage. "It's very similar to a traditional warehouse, with batch picking, bulk picking and order staging," says Knapp's Stenger, "but it's scaled down to maximize the footprint." Stenger adds that Knapp spent about two years figuring out which SKUs were right for the automation, which should be picked manually and to optimize the size and height of the totes. Frozen food just doesn't work, at least for now. Receiving and replenishment is done in non-operational hours. "Takeoff releases the orders to our control system, and then we pick them based on a pickup window that meets customer expectations," Stenger says.

Companies mentioned in this article

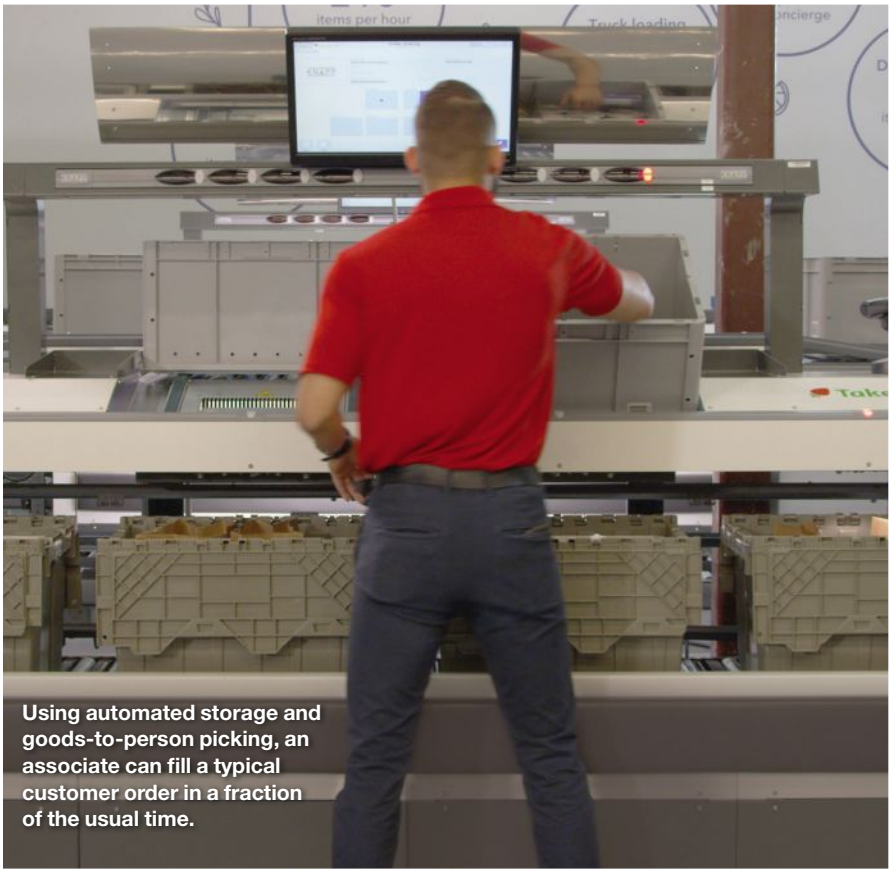
- 6 River Systems
- Autostore
- Dematic
- IAM Robotics
- Knapp
- Lucas Systems
- Sedlak Supply Chain Consultants
- Takeoff
- Tompkins Robotics

Similarly, Dematic announced its micro-fulfillment solution in September at its Material Handling & Logistics Conference.

It is designed to handle grocery, but Inbody says the company is also in discussions with general merchandise retailers—think Big Box—and parts suppliers, like auto parts. "We're not changing what we do," Inbody says, "we're just moving the walls of the DC to the store."

In its first iteration, Dematic is basing its solution off of a shuttle system, but Inbody expects that to evolve to include other technologies in the future. He says his team is also looking at how to prep material back in the DC "in a better way into the store to place it in that 'big vending machine' in the back room. If I can bring the material into the store in pre-configured totes that can slide right into the shuttle system, that's going to make everything work better in the store." Inbody also envisions using the solution to replenish store shelves.

As we noted earlier, this is an emerging area with lots of interest, but also a variety of solutions being proposed. Which solution will emerge as the best is still unclear, as Sedlak's Ashby says. What's clear is that the retailer or solution provider who figures this out will have a competitive advantage when it comes to pick up in store or same-day delivery. "When someone figures this out, there's going to be a leader," says 6 River's Glynn. "Someone doing a pilot today is going to learn from that experience and then get their solution into hundreds of stores."



Using automated storage and goods-to-person picking, an associate can fill a typical customer order in a fraction of the usual time.

THE BIG PICTURE

Where Business Meets Materials Handling

KNOCK AT THE DOOR: AI and IoT are ready for your warehouse

Artificial intelligence and the Internet of Things are making their initial forays into warehouse operations. The expected outcome is DCs able to respond dynamically to current supply chain conditions not pre-set rules. Look for newfound flexibility and an ability to respond to specific customer demands.

BY **GARY FORGER**, CONTRIBUTING EDITOR

Talk about artificial intelligence (AI) and the Internet of Things (IoT) in the warehouse, and the room can get quiet very quickly. Are we at that point already? Are these next-generation technologies for real in the warehouse or just a talking point from some "visionary?"

Quite simply, yes, we are at the point where AI and IoT are real for the warehouse. Both are powerful new tools that better enable warehouse and distribution center activities to keep pace with rapidly shifting supply chain dynamics.

"Don't be bamboozled by AI and IoT," says Nate Brown, CEO of EVS. "Both are being used to solve the same problems as before. They just do it better. IoT provides data not previously available. It's another level of understanding. AI analyzes micro-decisions and optimizes them to a level not previously possible."

"IoT makes no sense without AI in the warehouse," says Sean Elliott, chief technology officer at HighJump. "You need a combination of new data sources, that's IoT, coupled with better solutions, that's AI, to make sense of the data, develop insights and act on that knowledge. The two are front and center for improved operational performance," he adds.

In addition, experts agree the two technologies are essential to accommodating the current shift from forecast-driven to demand-driven DCs.

All of that said, it is still very early in the game for both technologies, says Dan Gilmore, chief marketing officer at Softeon.

Some companies interviewed for this story don't have a commercial offering yet. Others are in pilot. There are others that have offered a product for a short time. Looking forward, JDA, along with its partners, has committed $500 million in R&D over the next three years, says Steve Simmerman, senior director of sales/global partners and alliances.

Clearly, AI and IoT are knocking at the warehouse door. It's a knock you want to answer.

Building out the IoT

Let's face it, warehouses and DCs are under pressure like never before.

"Orders flow in all day long, and it's expected that the DC will take action immediately. The challenge is figuring out how to best process those orders in a timely manner," explains Adam Kline, senior director product management at Manhattan Associates.

As he goes on to say, even with a warehouse management system (WMS) in place those deci-

Data granularity is a key enabler of more efficient operations.

sions are made with set rules, set capacities and set resources. However, there's nothing static about those orders that just dropped. "Current conditions matter most going forward. Not preset rules. Now the systems intelligently balance capacity against resources, aiming to maximize utilization," says Kline.

"AI and IoT team up to make decisions based on current conditions," says Gilmore.

So, where exactly is all that IoT data going to come from? Believe it or not, some of it is already in place in your facility.

Materials handling equipment from conveyors to automatic guided vehicles and automated storage systems and the like all receive and send data about their activities. So do handheld devices from scanners to voice systems.

"Most facilities are bringing in more and more data devices that are developing into a burgeoning IoT network," says Mark Jensen, senior director of product management at Epicor. Many times, simple sensors provide information not previously available for decision making. Smart phones are part of that new network.

Data about people figures prominently, too. "It matters where people are located at a given moment, what they are working on and how can they best be used," explains Justin Ritter, director of project engineering at Lucas Systems.

As Kline of Manhattan points out, real-time locator systems are moving into place to track people and their availability for specific tasks. In fact, several types of real-time locator systems are available, including smart phones, passive radio beacons and RFID.

"Many facilities kind of know where Pete is based on his most recent scan. But when you use real-time locator systems, you know exactly where Pete is at all times," says Gilmore.

There's also the matter of people and robotics, Gilmore adds. He calls it a pairing capability to get both the right person and the right robot to fulfill an order using IoT data. "It's a matter of pairing up the locations and having the two work together to pick and make a run to packing," Gilmore adds. "New thinking is required here."

Building out AI

As Richard Lebovitz, CEO of LeanDNA, says, "while access to data is becoming much simpler, most facilities lack the ability to decide how to use that data and what actions to take. It's all a matter of bridging the gap between the forecast and what's really happening in manufacturing." That's where AI enters.

Brown of EVS offers his baseline definition of AI in the warehouse. "It learns and reacts to the current state, not just a set of pre-set rules," he says. That's straightforward.

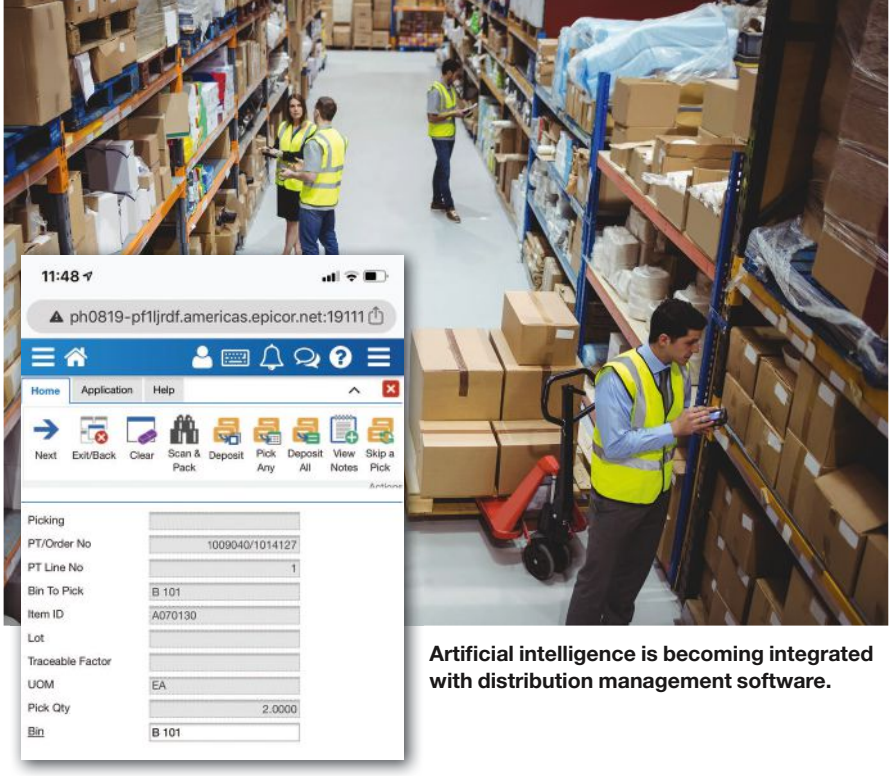
AI and IoT are not two sides of the same coin, explains Elliott of HighJump. "But they do have a symbiotic relationship. The more data about actions and interactions that AI receives, the more it can learn about how to adapt to current conditions," he adds.

While much of the IoT data comes from within the four walls, take the example of a late inbound load. "The DC is alerted by an IoT signal being managed by a control tower that a load will arrive late," says Simmerman of JDA. "AI takes that information and determines the optimal time to release and deploy a specific amount of labor to unload the truck. AI also determines what portion of that load should go directly to fill orders or to storage. Suddenly you have a new level of visibility and intelligence into how to make the DC operate most efficiently," says Simmerman.

Getting to that point really does require the granularity of data that IoT delivers. "Data granularity is the key

enabler to allowing AI to learn as new situations present themselves," explains Graham Yennie, data scientist at Lucas. This particular form of AI is known as machine learning.

He goes on to explain that machine learning can take traditional industrial engineering out of the picture. "For example, engineers can build models and do time and motion studies to develop engineered standards. But it's a time-consuming process. And, it's locked into a point in time. Machine learning simply takes the data and uses algorithms to produce models on the fly based on current conditions. Furthermore, the model can adapt as conditions change. Better yet, AI learns with each iteration," says Yennie. It's all in the name of reducing process optimization costs and improving resource plans.



Artificial intelligence is becoming integrated with distribution management software.

Bringing IoT and AI together

All of that is great. However, there is an even greater purpose to IoT and AI in the DC. The two technologies make it possible for a DC to move from being forecast driven to being demand driven. That is, when they are combined with WMS, warehouse execution systems and even work execution systems. Moving from forecast- to demand-driven operations is a huge but absolutely necessary pivot for DCs going forward, says Lebovitz of LeanDNA.

It's all a matter of coping with the current shift from manufacturing and distribution calling the shots in the supply chain. Increasingly, customers are in charge to the extent that they have now transcended low costs as the primary driver of supply chain efficiencies.

As a result, a range of companies are investigating, piloting and fully integrating AI and IoT in warehouse operations.

Companies such as Lucas Systems and EVS are doing their due diligence to decide how to integrate the two technologies with their existing software packages. Lucas Systems expects to be deep into beta testing by next spring. Meanwhile, EVS is testing customer data with its WMS package.

LeanDNA has incorporated AI with its inventory analytics for manufacturing operations. Its software is used by a range of companies by connecting to their enterprise resource planning (ERP) systems to streamline operations.

Slotting and robotics are key to HighJump's efforts to integrate the technologies with its WMS. Pilot projects are underway in both areas.

Softeon has an emphasis on tracking workers, their activities and equipment such as mobile robots using passive radio beacons. Slotting is also a key focus. Both have been integrated with Softeon's WMS, which is now said to be able to make better decisions and faster.

Both IoT and AI are integrated with Manhattan's warehouse execution package within its WMS. Order streaming, robotics and distribution control have all benefited since the capability was introduced almost 18 months ago.

Distribution management software from Epicor is just finishing beta testing of IoT. Meanwhile, AI is fully integrated into its virtual agent for its ERP system. The Cloud figures prominently here, too.

A little over a year ago, JDA purchased Blue Yonder and its AI capabilities. That has become a backbone in JDA's strategy to digitize predictive analytics to create what the company is developing—a prescriptive state for the self-learning supply chain. IoT is just as integral to its long-term strategy. Control towers, the Cloud and warehouse tasking figure prominently.

It may be early in the use of IoT and AI in warehouse operations. And with all that's calling for your attention day in and day out, it would be easy to overlook this development. But you would be better off if you didn't let that happen.

Companies mentioned in this article

- EVS
- Epicor
- HighJump
- JDA
- LeanDNA
- Lucas Systems
- Manhattan Associates
- Softeon

LEAN THINKING + CARTS = Major efficiency & productivity gains

Here's how one global oilfield service and equipment company replaced its forklifts with carts to achieve major efficiency gains and cost savings while also improving worker safety, engagement and ergonomics.

BY **BRIDGET McCREA**, EDITOR AT LARGE

Last year, Forum Energy Technologies' Stafford, Texas, production plant was getting close to running out of capacity. Part of a global oilfield service and equipment company, the plant makes a variety of valves across seven different brands. Of particular concern was the plant's PBV ball valve production area, which produces trunnion-mounted, quarter-turn ball valves in sizes ranging from 3/4-inch to 36 inches.

Open since 1999, the plant revolved around a traditional manufacturing mindset, where a forklift is used to bring parts to one worker, who proceeds to build all of the necessary items for the valve. Then, a forklift comes back to move the completed ball valve to the next stage. But, that setup didn't work so well when the plant's business increased significantly.

"When business increased, we knew that we needed to improve the product flow in our plant by eliminating waste and reducing cycle times," says David Tummins, plant manager. "We knew that would help us build and finish valves faster than we were doing with the traditional setup."

Bring in the lean

Tummins joined Forum Energy Technologies about two years ago and began to attack the biggest problem, which was a lack of capacity in the facility's existing layout. Several other issues were also on this lean manufacturing team's "to do" list. Safety, ergonomics, productivity and performance topped that agenda.

To address these issues, Tummins and his team asked themselves what the PBV production plant

Left to right: Juan Juarez (production supervisor), Henry Murcia (quality supervisor), David Tummins (plant manager), Jon Cygan (value stream manager).

would look like five years from now and how that vision fit with its current factory setup. "Moving to a larger location was one option, but that's a huge expense," says Tummins. "Instead, we stepped back and looked at how we might be able to put in a system that would enable the flow of product out the back door faster than what we were doing."

Shopping around

Two years ago, Forum Energy Technologies took about seven days to build a standard ball valve from start to finish. The valve assembly process incorporated 15 different forklift handle points and six different ergonomic points. Where smaller items like floating ball valves weigh about 15 pounds, larger products like 36-inch ball valves weigh upward of 40,000 pounds each.

"Obviously, you can't move those heavy products very easily, so that's where we started brainstorming potential improvements," says Tummins. "We focused on how to turn a job-shop project that was handled by a single operator into a more efficient, production-line type environment."

As part of that initiative, which kicked off in May of 2018, Forum Energy Technologies focused on cutting down its use of forklifts and instead using carts that could be easily transported to and from its employees' workstations throughout the course of the day. It also considered conveyors, but after several simulation exercises realized that rotating carts would be the best choice for its manufacturing environment.

Frank Garcia, the flow master, inspects a job of valves before shipping. The finals process has two different types of carts for the various sizes of valves that flow through the area.

Making the switch

Forum Energy Technologies' transition to using carts over forklifts started with a trip to a Milwaukee plant where a team of employees worked with a cart manufacturer (Topper Industrial, topperindustrial.com) to come up with five different prototype designs. Starting with a design that could handle a valve that weighed up to 10,000 pounds, they wanted a cart that could move the heavy item without using a forklift. "Operators needed to either be able to push it by hand or use a pusher," says Tummins, "but not a forklift."

The company also needed a variety of cart sizes and heights to handle its three main production lines. "Operators needed to be able to work at an ergonomic height, regardless of the job size," says Tummins. The carts were also designed with rotating tops, which would allow the operator to "spin" the valve (using a foot release) into the right position versus having to walk around it.

With these "must haves" factored into the cart design, Tummins got approval for the project and the rest, as they say, is history. The carts started arriving on site in January 2019, at which point the company began phasing out its use of forklifts on the plant floor.

As part of that transition, the company also switched over from a "production push" system and over to one that's focused on "production pull," says Jon Cygan, a lean engineer who joined Forum Energy Technologies in November 2018. To make that happen, it implemented lean manufacturing strategies that, rather than being focused on large batch, non-value-added work processes, uses a one-piece-flow high-value-added assembly line process.

"We're no longer creating huge batches and are instead working toward a one-piece flow," Cygan says. "On the very first deployment of this new process, we eliminated significant work-in-process [WIP] inventory." Working their way through the plant's various departments, Tummins and Cygan created "material flow" lanes that effectively reduced batch sizes and whittled WIP down by 50%. "We got there by implementing carts and changing the material flow," says Cygan, who adds that overall production lead times have been reduced to three and a half to four days (from a previous seven days), depending on the type of valve being produced.

"We're talking about a nearly 40% reduction in lead time from job release to a finished valve, not to mention the fact that we've reduced our batch sizes," says Cygan, "thus eliminating waste and saving a lot of money for the company."

Once a job is "rolled" to an operator's work area, it can be worked on immediately without the need for any heavy lifting or maneuvering. Tools are located on the left-hand side of the cart, that—upon completion of the valve—can be pushed into the testing cube without a forklift. "Where the valves once made a half-mile trek on the plant floor during production," says Tummins, "they now move about 600 feet."

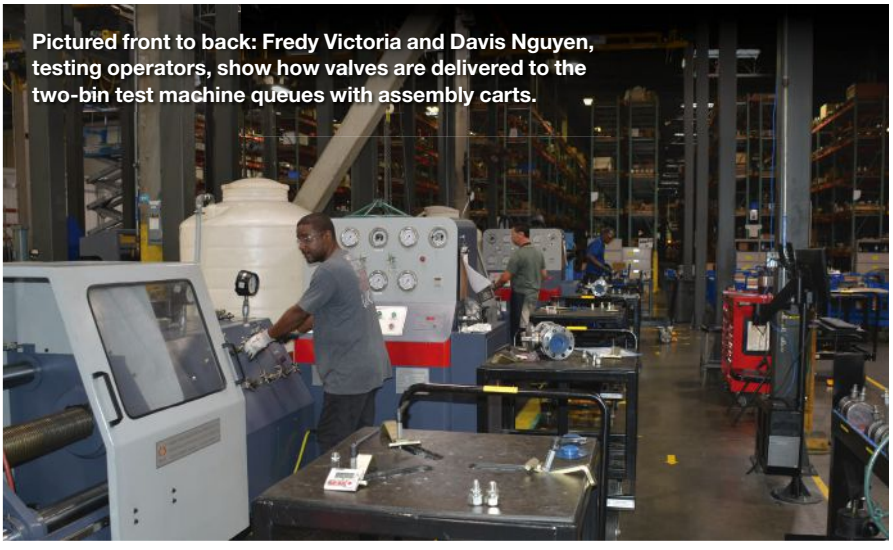
Major productivity gains

To date, Forum Energy Technologies has removed about 90% of the forklifts that were previously moving around the plant's open floor area. Those 15 handle points that went into making a single valve have been reduced to just two, and the trunnion-mounted ball valve capacity has grown by 75% (across two shifts). The company has bumped production on

its floating ball valve line by 50% a shift.

Now using just 75% of its existing floor space—something it was previously running out of—the manufacturer isn't resting on its "lean" laurels. As a direct result of this initiative, Forum consolidated another valve assembly plant into the PBV facility, generating significant incremental savings. According to Tummins, in 2020 Forum plans to take its carts over to the distribution center, where activities will be rearranged into a format that resembles the pit lane on an auto racetrack.

"In our DC right now, we have 14 different industrial forklifts operating," says Tummins. "We want to reduce that by at least 60%. That way, when items get picked, they can be put on carts and create a nice flow-through to the customer's truck."



Pictured front to back: Fredy Victoria and Davis Nguyen, testing operators, show how valves are delivered to the two-bin test machine queues with assembly carts.

The hidden "wins"

Forum Energy Technologies' cart initiative has also led to a number of undiscovered "wins" that don't translate into hard numbers or dollars and cents.

According to Cygan, those rewards include morale improvement, better employee engagement, and various other cultural shifts. "When you give employees different tools that help them do

their job more efficiently and effectively," says Cygan, "they not only go home happier, but they also come back engaged and ready to take part in even more improvement activities."

Importantly, the lean success benefits customers by allowing a more direct line of sight to their needs. Significant reduction in cycle time allows Forum to deliver products when needed by the customer. The lean assembly process, in conjunction with the fact that Forum is one of few domestic valve manufacturers, provides a powerful combination for customers.

Finally, the company also eliminated the top-three safety hazards in its production area, which were: forklift traffic, pressure testing and lifting/rigging. With no forklift traffic to worry about, it also redesigned its pressure-testing process to eradicate potential safety hazards. And, operators no longer have to physically manipulate heavy valves; they just let the rotating carts handle that work.

A 2500 class stainless steel valve on a transport cart. The cart is pushed using the heavy-duty Cart Daddy so operators can easily transport the valve to each operation.

"We engineered out all three of our biggest safety risks," says Cygan. "So, not only was this project great in terms of creating major efficiencies and cost reductions, but our operators are also safer now."

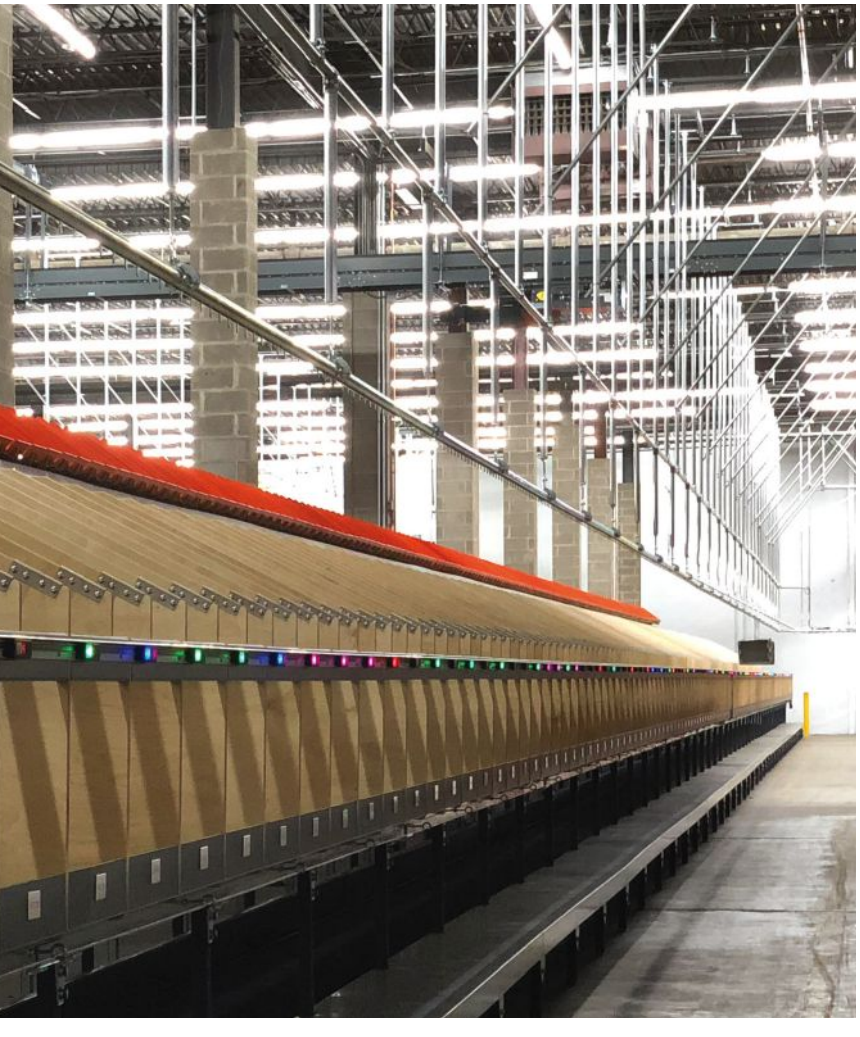
Fulfillment at the *speed of light*

Powered by dynamic, real-time software, light-directed picking and putting technologies have entered a new phase in their evolution.

BY **JOSH BOND**,
SENIOR EDITOR

In the beginning, light-directed picking technology behaved like Christmas tree lights; if one went down, so did the rest on that loop. Eager for a more reliable approach, the industry then adopted bus-based lights, where each light can be individually controlled, relocated or replaced. These still make up the majority of light installations, even as a fully wireless third-generation gains some ground. Emerging on the horizon are an assortment of hybrids, including early versions of augmented reality (AR) picking technologies that could make lights' hardware infrastructure obsolete.

For now, the hardware is not where the action is. Unsurprisingly, software advances are at the center of reshaping light-directed solutions' functionality. Whether for picking or putting, light technologies have entered a new phase in their evolution as they support e-commerce and omni-channel fulfillment.



By leveraging intelligent software and real-time analytics, light-directed solutions offer enhanced productivity, efficiency and adaptability.

Put in its place

For starters, lights are now more commonly associated with putting than picking. The original light-directed technology was designed for pick-to-light order assembly methods, says Ken Ruehrdanz, manager of the distribution systems market for Dematic. It was followed by the *put*-to-light method of order assembly used for retail store replenishment applications.

"Put-to-light is used more often due to the wide market embrace of the goods-to-person methodology," Ruehrdanz says.

Instead of moving through the warehouse to build an order, operators are delivered a single product to allocate (put) to the orders that require that SKU. Ruehrdanz says this approach is popular whether orders are bound for the retail store, industrial user or consumer.

"Put systems have many benefits," he adds. "The major benefit of the put configuration is the elimination of the dedicated pick face. This means no need for slotting and re-slotting the warehouse."

Jeff Holmes, vice president of design engineering for Wynright Daifuku, has also witnessed lights' transition from pick to put.

To support e-commerce and omni-channel fulfillment, the same put wall can support order assembly as well as returns.

"I have experience with very large pick modules with thousands of locations all lit up," he says. "We used to sell thousands of lights, several big projects a year, but haven't seen many recently. Maybe we see one large scale pick-to-light project a year."

Holmes cites the rise of voice-directed picking and other technologies with a low cost of entry and no physical infrastructure, and which in most scenarios get similar levels of productivity and error reduction. The most common light application now is some sort of goods-to-person scenario with a put wall, he says. The system might be fed by shuttles, mobile robots or even batch picking to a unit sorter and then to the put wall.

Holmes offers the interesting example of light-directed returns and receiving, where a book distributor uses put walls for order processing on the first shift, then uses them to process small mixed-SKU cases of returns. First, they scan a book and sort by publisher, then there's a secondary put-to-light area to sort individual books.

"A similar concept could be used for any returns, maybe breaking down returns at the first step by category, then by SKU or zone," Holmes says. "A multi-step, put-to-light process sounds like extra touches, but it can be a big benefit for returns, which are a headache for e-commerce."

Anshul Singh, director of supply chain consulting at Bastian Solutions, says goods-to-person and robotic solutions are eating a significant portion of the pick-to-light market, which nonetheless remains "the most productive and fastest picking system in the industry," he says. Sure, robots can match these rates, he adds, but they are limited by SKU profiles and replenishment rates.

"Goods-to-person are popular because of e-commerce, where you're trying to carry more and more inventory," Singh says. "The biggest risk in e-commerce is consumers switching very easily to another company if they can't find a product. So, companies want to carry more and more SKUs."

Twenty years ago, light-directed pick systems might serve one or two thousand SKUs, and 5,000 was considered a high SKU count. It might still be possible to use pick-to-light for a certain segment of SKUs and RF scanning for the rest, but with e-commerce, there's no longer any guarantee fast movers will stay fast movers.

"Now, things change from product to product. Consumer choice changes, but the main reason is promotions, so it's

MAKING THE CASE FOR

Intelligent Vision-based Sortation & Tracking Systems

This shift in data capture and sensing best practices calls for a full toolbox of solutions and services, led by intelligent, vision-based readers that digitize factors like package condition, label orientation, and bar code read events.

FOR ALL THE STRATEGY THAT GOES into e-commerce success, ultimately it comes down to moving the right items and packages to customers quickly and efficiently. If operations can't identify goods accurately and control the movement of automated material handling equipment with precision and speed, the result is unhappy customers and loss of market momentum.

The challenge is that moving goods isn't as straightforward as it once was. E-commerce orders are typically at the each or item level, not full cases or pallets.

Packaging is changing too. Instead of boxes with uniform dimensions and edges, there is more use of polybags and shipping envelopes. According to research firm Technavio, polybags accounted for over $31 billion of roughly $82 billion global e-commerce packaging market in 2015 and constituted the fastest growing segment.

Operations face other immense pressures. According to MHI's survey-based 2018 Annual Industry Report, customer demands on the supply chain were seen as the biggest industry pressure, with 73% calling it extremely or very challenging. Hiring qualified workers is the second most acute challenge, with 64% rating it extremely or very challenging. The 2018 survey also found that adoption of robotics and automation, which stood at 34%, is predicted to top 53% in two years, and 73% in five years.

Think for a moment, about the impact of these mega-trends. For one, you have smaller, more frequent orders that need to move quickly through increasingly automated facilities, and second, the packaging will more often be smaller bags that can be difficult to detect and handle. The result is that companies need to evaluate whether they have the right sensing, reader and digital image management technology to provide the information needed for effective handling, tracking, and fulfillment over this stream of smaller items.

"In the past, the focus with reader technology was just in getting the scan, typically on a one-dimensional bar code label," says Tom Wik, national product manager, vision and identification with SICK, Inc. "The goal was to get a good read—to move product from here to there. While that's still necessary, now operations need more information about everything surrounding the read, like label condition and orientation, package condition, and how packages are being presented to the reader. That extra information allows you to make your processes more efficient."

Vision-based readers are shaping up a key enabling technology to meet these challenges. While laser-based readers still have their place, vision-based readers are needed to read two-dimensional codes. What's more, the high-resolution digital images that are captured "digitize" what the reader sees and the characteristics of the goods moving through the process.

In this Special Report, we examine how intelligent vision readers and sensors make it possible to fully understand package attributes as soon as they enter a facility and have a digital record of package condition as goods exit—setting the stage for both proper internal routing and efficiencies while also being able to prove package condition as you transfer ownership to customers or logistics partners. •

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- **Industry 4.0: Digitize to Improve**
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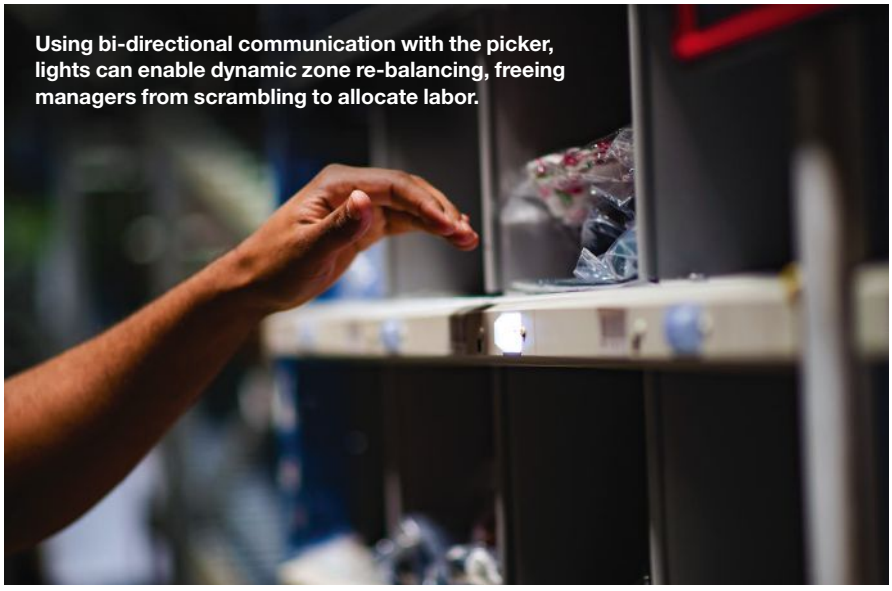
not steady or static," Singh says. "SKUs change, which challenges pick-to-light, but goods-to-person can easily absorb those fluctuations."

If you have a small SKU count with fast movers, it will always be a good fit for pick-to-light, Singh says—unless products are suitable for dispensers, which is the only faster technology.

"The only exception is vision-based picking. If it's successful, it will definitely replace pick-to-light 100%," Singh says. "But the hardware is not ready and operators are not ready to wear something on their head for eight hours without some dizziness and discomfort."



Using bi-directional communication with the picker, lights can enable dynamic zone re-balancing, freeing managers from scrambling to allocate labor.

Lights, software, picking

Dave Simpson, executive director of logistics solutions for SSI Schaefer Systems International, says balancing the work demand and the size of the zone can produce significant efficiencies.

"That's what you're constantly trying to solve, but most people just tolerate the ebb and flow," Simpson says. "In any application where a person sticks to a set zone, you will see half of them frantic and half kind of chilling, with the net effect of less productivity."

One of the benefits of the latest software is the ability to dynamically re-size picker zones based on the actual work volume in each zone. Using real-time insights from processes upstream and downstream, software can rezone to ensure no worker is over- or under-burdened and prevent congestion in picking and packing. Holmes says predictive logic can also look ahead before releasing work to ensure no zones will be overwhelmed.

If lights have multi-colored displays, a picker might be assigned to pick only red, green or amber lights, enabling multiple pickers to work in a zone without stepping on each other's toes. Or, they might use magnetic signs on racks and shelves to designate zone size when they log in or return from a break.

"The old-fashioned way was to have

Distributor maximizes labor efficiency with lights and intelligent software

Mary Kay is one of the largest direct-selling companies in the world. After implementing supply chain software and a new light-directed picking system (Bastian Solutions), the company boosted hourly picking rates by 29% and maximized labor efficiency.

Prior to system updates, the 60,000-square-foot facility averaged 650 units picked per operator per hour. Now operators are averaging 840 units picked per hour. Based on a 1.6 unit-per-line rate, this equates to an average of 525 lines per operator per hour. Since installation, Mary Kay has further improved throughput by 46%, reaching 768 lines per operator per hour.

A single-level pick module uses pick-to-light systems for high-volume, broken-case picking. The new warehouse control system (WCS) manages inventory control and interfaces with Mary Kay's enterprise resource planning system. The human/machine interface (HMI) allows real-time visibility for supervisors.

According to Alex Walder, project manager, vice president and general manager of the New England branch, the new system has increased operator job satisfaction due to system reliability, ease of use and ergonomic design. The system also offers a dynamic zone balancing feature, which has reduced the company's dependence on contract labor.

"Our goal was to find an updated, very flexible and very scalable order system that would allow us to more efficiently process an increasing number of customer delivery service orders—the smaller-profile orders," Walder says. "Order throughput and capacity have increased substantially."

Employees experience a more ergonomic workplace while supervisors now have access to key warehouse data in real-time. Walder says the project is on track to achieve a three-year return on investment.

someone behind you to split work in half," Holmes says. "Now, you can make a smarter decision like maybe five bays for one picker and three for another instead of four each. This also provides immediate feedback and enables you to respond to any issues before you miss a shipping window."

At any given time of day, a person's zone might need to change, and software needs to keep that very fluid and dynamic, Simpson says. "The labor management side of software is becoming more and more important, and not just for reactive steps," he says. "It's easy to tell after the fact you were staffed wrong, but it's better to get ahead of it and have software proactively driving where labor ought to be and how large a zone should be."

In addition to dynamic zone balancing, Ruehrdanz points to capabilities like active order handoff, and operator enter/exit. Active order handoff enables operators to turn over picking tasks to another operator. Operator enter/exit permits operators to be inserted or removed at any point in the system to accommodate peaks and lulls.

Just as picker zones are flexible, so are the lights themselves thanks to the direct connection to each device. If you move a light, says Chris Castaldi, vice president of sales for DMW&H, you have also moved the SKU.

"This plays out interestingly in the warehouse control system because the conveyor understands that move, too," he says. "Move a light and everything else adjusts."

Bi-directional communication with specific lights offers some other neat tricks as well, Castaldi says, like cycle counts and diagnosis of a range of problems.

"Transactional data allows you to see picker performance, change zones, direct each person and monitor them better," Castaldi says. "You can see where logjams are, or see the productivity of a specific SKU. Where should it be put? How do a range of pickers interact with it? What items should be put together? The latest light-directed solutions offer a better integrated solution, better timing and control."

Companies mentioned in this article

- Bastian Solutions
- Dematic
- DMW&H
- SSI Schaefer Systems International
- Wynright Daifuku

Conventional warehouses: SIMPLE, YET EFFECTIVE

As the industry continues unprecedented transformation, some of the classic approaches still hold up—especially when empowered with detailed data.

BY **JOSH BOND**, SENIOR EDITOR

Although *Modern* often writes about the best in automation, the fact is that far more distribution centers operate conventional warehouses, characterized by lift trucks for pallet movement; floor, rack and shelf storage; manual picking; and minimal automation. Yet efficiency, productivity, throughput and accuracy are still paramount.

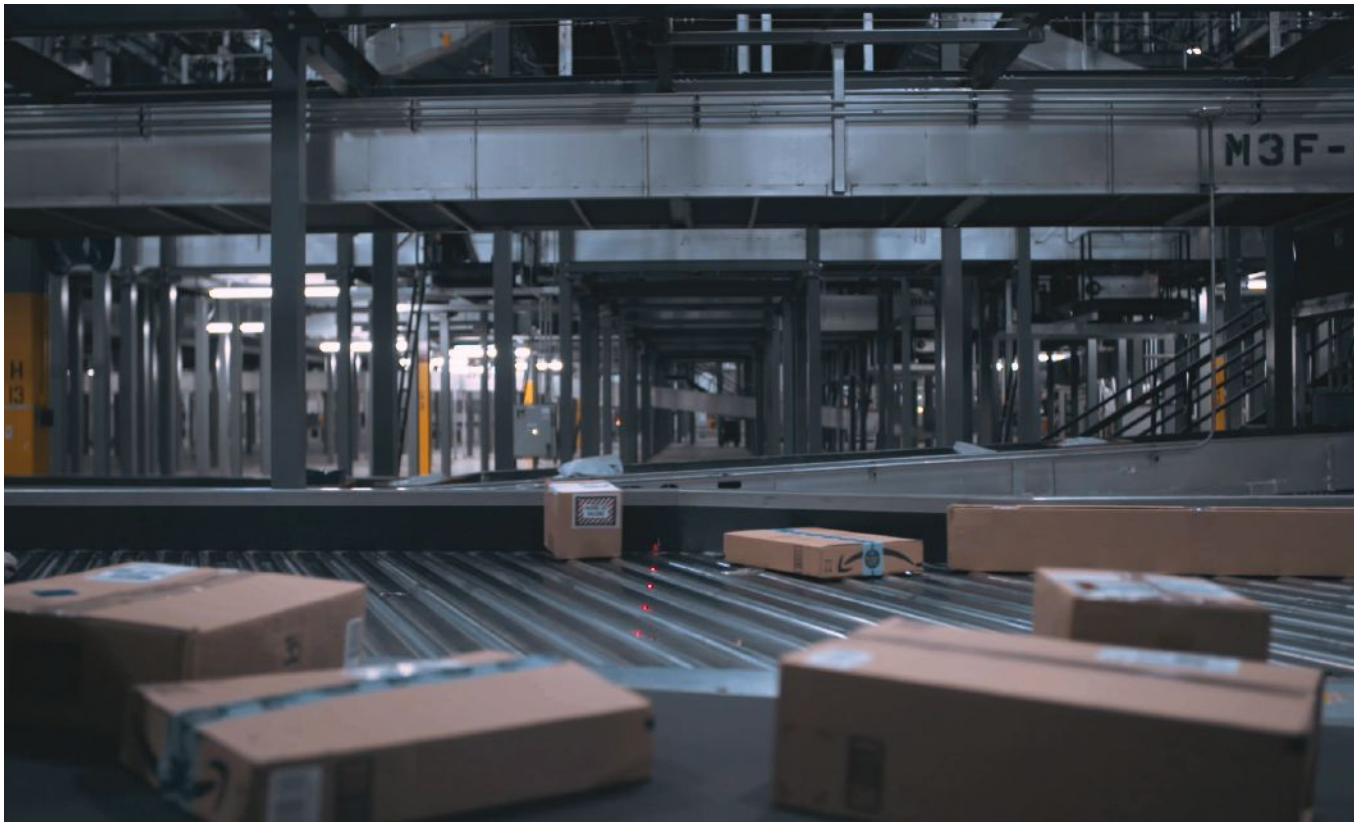
We spoke with some industry experts to assess the best practices from the best operators of conventional warehouses, as well as the opportunities to introduce automation that can make a difference.

Measure, manage, maximize

Whether for new facilities or retrofits, several considerations can ensure a facility will be optimized now and in the future. Norm Saenz, managing director at St. Onge Co., says modeling the inventory profile is the key to selecting the right storage equipment types. Most warehouses require three or more different rack bay elevations, he says, because single-elevation setups typically don't efficiently support all items in a warehouse.

For example, items with 20+ pallets per SKU require more dense storage equipment types to get the most out of the warehouse space. However, if you are consistently receiving partial pallets, Saenz says an elevation with partial pallet location heights makes sense. Regarding floor storage, if you have items that can stack three to five levels on the floor, storage density will improve without the need for a capital investment in rack.

"There are many ways to squeeze more



If legacy software limits a facility's efficiency and nimbleness, an execution software layer can add functionality and postpone larger capital investment.

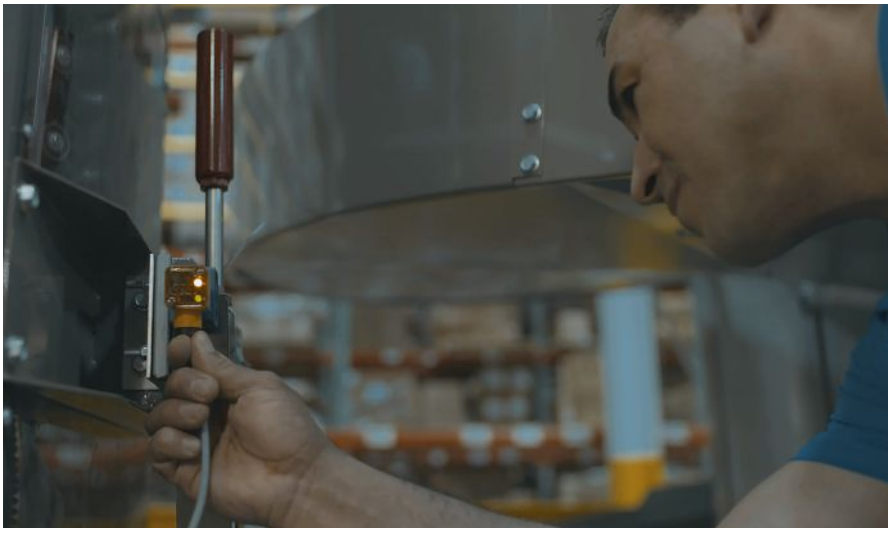
capacity out of your existing warehouse," Saenz says. "Drafting the layout will show the amount of 'white space' in the warehouse for aisles and flue spaces. Balancing the labor efficiency of tunnels or cross aisles versus denser rack designs is also an important analysis."

Then, there's the software angle. Saenz says many warehouses are still operating with a legacy warehouse management system (WMS), including paper-based systems. The practical assessment is to identify your operation's ideal functionality, as it compares to best-of-breed WMS options. Converting these limitations into estimated labor savings and accuracy benefits are the next steps, Saenz says. Build the case for a new WMS or enhancements to your legacy systems. "The chances are good that a legacy system is not optimizing the labor productivity of the warehouse, including task interleaving, directed putaway, labor management, product slotting, etc.," Saenz adds.

According to Justin Ritter, director of project engineering for Lucas Systems, warehouses and distribution centers are constantly evaluating technology. Instead of automation, many are deploying a warehouse execution layer that adds flexibility to manual processes without a large up-front capital investment.

A full-blown warehouse execution system (WES) is normally associated with automated systems, where the WES sits between the WMS, automated systems and people to orchestrate the activities in that facility. What Ritter describes is a layer of execution software that sits between the WMS and the people performing conventional activities. This is valuable to those using a basic, traditional WMS, which isn't always good at things like creating the most efficient pick path to minimize walking.

If pickers aren't system-directed, or rely on an entry-level system, they're not likely to be as efficient or accurate as they could be. One way to address that is with voice software, and the latest generation of voice can serve as a WMS for companies that don't have one, or improve the capabilities of a WMS with limited functionality. In this instance, the voice software acts like a WES, sitting between the system of record and the lift truck operator or order selector to direct activities. More importantly, like a WES in a highly automated facility, the



Collecting item-level data can inform decision making and enable real-time optimization.

solution has optimization functionality to ensure the associate is following an optimal pick path or is picking items in the best sequence for packing or other important criteria like ensuring fragile items don't end up under heavy ones.

An execution layer enables these process changes independent of the mode of picking, Ritter says. So, manual warehouses can move from single-order to multi-order or batches, for example, or scale up without a big capital expense. The execution layer offers process flexibility and optimization that can supplement and enhance the functionality of a WMS.

Ritter outlines the challenges for those using an enterprise resource planning (ERP) system that provides a rudimentary WMS, or a homegrown or legacy WMS. They are evaluating what next step they can take to lower operating expenses, like moving away from paper-based picking, adding automation or upgrading their warehouse management systems.

"Often times that kind of core system change is scary and capital-intensive, even with all the planning. And, there is a risk of failure with any large system upgrade, so many people look for a front-end execution layer to make processes more efficient and productive," Ritter says. "This provides them the capabilities to extend the life of a WMS or ERP to defer a larger investment for six to 10 years."

There are other benefits, too. In a conventional warehouse using paper or RF, the WMS is typically only collecting high-level data about the process. The amount of data is not very large, Ritter says. An execution system, on the other hand, collects detailed information about what's happening in the warehouse and can leverage machine learning and other data tools to improve operations.

"Forget the one-off spreadsheet analyzing volumes quarterly, only to be blown away by seasonal changes," he says. "The marketplace is evolving, and warehouses are looking for tools that do sophisticated data analysis to give real-time recommendations for inventory or labor planning."

Too big, too small or just right

Even without automated systems, conventional warehousing processes can benefit from analytics, which have huge potential to improve operations in the conventional warehouse, according to Saenz. One example is replenishment but, unfortunately, too many have not collected the basic information to make the best use of such software.

Picking the low-hanging fruit

Norm Saenz, managing director at St. Onge Co., identifies some common opportunities for equipment utilization and process improvement.

- Material Flow – pick paths, zone slotting (ABC, etc.)
- Methods – batch picking
- Forward pick area – right-sizing days of supply (balancing pick and replenish)
- Equipment tweaks – adding beams on lower levels for more pick positions
- Mezzanines – one way to gain more space
- Training – normal and exceptions
- Facilities – lighting, conditioning, signage, rack labeling

Other ways to get more storage capacity out of an existing warehouse:

- Stack-rack used for odd sized items currently staged one-high on the floor
- Racking above dock doors for empty pallets and corrugate
- Freestanding mezzanine for operations to free up space for storage equipment
- Product slotting to right-size pick locations
- Double stacking pallets on the top level, if feasible
- Location consolidation for like SKUs with no lot/date code restrictions

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"There are still so many that don't have item-level dimensions and weight," Saenz says. "You have to know product size to replenish effectively. I've always been surprised by the lack of that data. It's not hard, but it sounds overwhelming when you have 30,000 SKUs and know you don't have dimensions. You know you want and need that info, so you just have to start doing it."

Saenz recommends adding a gate at inbound to collect dimensional data. It will slow the process a little, he admits, but an item master database can make a big difference. Even simply breaking products into small, medium and large categories will help.

Ed Romaine, vice president of marketing and business development for Conveyco, agrees. "You want to know weight and sizes of every piece of inventory, and for some operations this is more realistic than others," he says. "But it helps with storage density, pick density, shipping—I can't think of a single part of the operation that doesn't benefit from that information."

Planning and forecasting are essential to identifying the current state of operations and transforming them to meet future challenges.

Taking it a step further, Romaine encourages customers to collect more data than they currently need. "Get as many data points as possible. They might not be important today but later on they will be," he says. "Build the business case of what you are and what you want to be. You can then extend your forecasting and plan ahead."

By overlaying operational metrics and forecasting, it's possible to simulate different capacities and scenarios to see where processes might break down. What happens if a competitor is thrown in our laps? What if business doubles overnight? Maybe you run a great 10,000-order-per-day facility, but what if the next day one manufacturer has not 100 SKUs but 1,000? How will you account for that?

It starts with basic inventory metrics, then labor, throughput, picks, walk time and even ergonomics, Romaine says. Everyone is a little different, but anyone can easily put together a few criteria to watch. A strong continuous improvement group can then delve in and collect even more data.

In responding to a facility's structural limitations, some operators of conventional warehousing are considering automated travel, such as autonomous mobile robots (AMRs) and automatic guided vehicles (AGVs), which Saenz say are being discussed more and more in traditional warehouse planning.

Rush Fullerton, senior vice president, business development at MHS, predicts that AMRs and AGVs will soon be a staple in even the most conventional warehouse. "It's difficult to find a warehouse going up that is not full of automation," he says. "The old-style conventional warehouse has gone by the wayside." One factor driving this trend is the industry's movement away from massive facilities to smaller ones in strategic locations.

"For one, they can't find the labor to fill large mega-hubs, and by the time they build it out, there's so much money tied up in land and infrastructure that the payback isn't really there," Fullerton says. "The biggest issue is lack of labor, which is leading to expansion and automation of new facilities, and in many cases automating old facilities."

Companies mentioned in this article

- Conveyco
- Lucas Systems
- MHS Global
- St. Onge Co.

The mobile supply chain: Six trends to watch

As mobility continues to make its way into every link of the supply chain, here's how our increasingly connected world is affecting operations outside of the warehouse's four walls.

BY **BRIDGET McCREA**, EDITOR AT LARGE

The final electronic logging device (ELD) mandate is looming. E-commerce sales are on a tear. The truck driver shortage persists. Customer preferences and expectations are changing every day. And, the notion of end-to-end supply chain visibility is still a far-off vision for some companies. Any one of these challenges would keep a logistics manager up at night. Combined, they create unprecedented hurdles for those charged with keeping the area outside of the warehouse's four walls running smoothly.

"Several key trends are driving mobility investments that support supply chain operations, and more specifically, in-field fleet/transportation," says David Krebs, VDC Research's executive vice president of enterprise mobility and connected devices. "These include the ELD mandate that came into effect in December 2017 (with a final deadline is December 16, 2019) and the transition by many operators from the legacy Windows-powered mobile device to Android (due to Microsoft's sunsetting of the Windows CE operating system)."

Following are six important trends that are affecting the mobile supply chain right now, and some tips on how companies can not only manage, but even take advantage of these shifts.

Which mobile technologies are vendors supporting?

	Currently Supporting	Planning to Support	No Plans to Support
Proof of delivery	65.8%	18.9%	11.7%
GPS navigation and real-time routing	63.1%	26.1%	9.0%
Dispatch management and scheduling	61.3%	23.4%	12.6%
Parcel delivery and tracking	58.6%	27.9%	7.2%
Signature capture	55.0%	28.8%	9.9%
Electronic signature and capture	51.4%	36.9%	5.4%
Route optimization	46.0%	45.1%	6.3%
Scan product off vehicle	43.2%	33.3%	15.3%
Identify OS&D (over, short, damage) situations and initiate claims process	42.3%	32.4%	14.4%
Fleet management (service and maintenance)	41.4%	42.3%	9.9%
Velocity-blocking (block apps at high speeds)	40.5%	33.3%	14.4%
Baggage handling	36.0%	27.0%	20.7%
Geo-blocking (block apps in given areas)	29.7%	42.3%	16.2%

Source: VDC Research

1. The final ELD deadline is looming.

With the December deadline to switch from grandfathered automatic onboard recording devices (AOBRDs) to mandated electronic logging devices (ELDs) coming into clearer view, carriers and drivers must make the switch in order to remain compliant. According to various industry surveys, many carriers are still holding onto their AOBRDs, an indicator that there may be a last-minute push to get compliant by the end of the year.

As with any technology transition, Krebs says logistics professionals will not only need to make the switch to AOBRDS, but also provide appropriate employee training on the new devices as they are installed. "What we saw with ELD adoption—in particular among less tech-savvy smaller operations—was a drop in productivity as the technology was initially rolled out," he points out. "While not completely unexpected, operators need to be especially sensitive to labor-related issues."

2. The ELD mandate is driving an overall increased interest in mobility solutions.

The December mandate for all AOBRDs to be switched over to ELDs is pushing

more companies to invest in mobility solutions this year. "For anyone who procrastinated when addressing the ELD mandate, and who limped along with interim-type solutions," says Bob Hood, a Capgemini principal and lead for the group's Move Domain practice, "there's obviously a lot more motivation now to be more aggressive in pursuing solutions."

Hood sees this trend continuing right into December, and says it's being driven not only by those companies that are tactically investing in mobility to satisfy the regulations, but also by those that are taking a broader interest in mobility solutions outside of their warehouses' four walls.

3. Shippers also need more mobility to meet their customer demands.

Assessing the "bigger picture" trends and forces affecting supply chain operators right now, Krebs says a lot of activity centers around being able to meet the fast delivery expectations of customers. With e-tailers like Amazon knocking delivery times down to a day (or less, in some cases), both B2C and B2B shippers are feeling the pressure of ever-smaller delivery windows.

"This is having the greatest impact on logistics investment plans, including technology adoption," says Krebs, noting that VDC's most recent research among supply chain technology decision makers found that mobile/connectivity solution budgets are expected to increase by 10% year-over-year to support these goals. "The key investment drivers include increasing visibility and expanding reach of operations, better measuring and optimizing profitability by delivery/fulfillment channels," he adds, "and reducing last-mile delivery costs."

4. There is no shortage of new technologies on the market right now.

Be it 5G cellular network technology, artificial intelligence (AI), wearable technologies, Cloud infrastructure, or machine vision technology, Krebs says there's no shortage of potentially impactful technologies to assess right now.

"According to a recent survey we conducted among transportation/logistics technology decision makers, just more than 80% suggested a high- to medium-level of competitive risk from technology-led disruption to their businesses," says Krebs. "More than 70% of respondents are countering this potential disruption through a more sophisticated use of data analytics and insights and by leveraging data as value-added products or services."

Conversely, Krebs says IT utilization remains a challenge for many supply chain organizations of all sizes, with "lack of internal IT support," "lack of mobile expertise," and "budgetary constraints" as the leading barriers. "The leading and most successful technology vendors are responding by helping prioritize—through experience in target industries—technology investment decisions," says Krebs, "and offering flexibility and ease of use/support for deployment options."

5. Companies want more mobile apps for their drivers.

The days of the onboard computer are dwindling as more companies integrate apps into their mobility strate-

gies. According to Hood, all of those activities (and more) are being managed on handheld devices as opposed to using specialized equipment for the tasks. Those devices include iPhones, Androids and other mobile devices that drivers use for multiple tasks.

"Where historically we've seen a lot of different custom equipment used by drivers," says Hood, "we've now seeing more interest in being able to use the same device for all of a driver's mobility requirements, whether it's point of deliveries (PODs), getting intra-day instructions for the next pickup/delivery, or conducting inspections."

This not only minimizes the amount of communication equipment that drivers have to interact with, but it also costs less money than specialized equipment and doesn't require fleets to be out of service during installation. "Not to say that there aren't still some pieces of customized equipment measuring vehicle performance and other metrics," Hood adds, "but in terms of interaction with drivers, we're definitely seeing a movement toward using more apps."

6. Geofencing is gaining traction in the mobile supply chain.

Using radio frequency identification (RFID) or global positioning (GPS) to define a geographic boundary, geofencing allows users to set up a virtual barrier that, once established, sends relevant text or e-mail messages in relation to the predefined or "fenced" location.

Hood says geofencing is being used in more warehouse and DC yards, where information about trucks entering the space can be captured and factored into decision-making (i.e., what's in the truck, how many employees are needed to unload it, etc.). "When shippers have that data as the truck enters the yard, it can be used to cascade into a series of events," he says, "including pre-receiving activity, dock preparation and DC labor scheduling."

He expects the geofencing trend to accelerate over the next year or so, and says some of that will be driven by the proliferation of Internet of Things (IoT) sensors used for data collection. "There are a lot of IoT-enabled devices collecting massive amounts of information right now," says Hood, "and much of it can be used to automate various yard-related activities that used to be handled manually."

Technological advancement never sleeps

As the mobile supply chain comes into clearer view, expect to see even more innovations making their way into the area outside of the warehouse and DC four walls. And while we're already seeing significant progress in this area, technological advancement never sleeps, which means there's always more around the next corner.

Right now, for example, Hood says the majority of mobility/technology vendors are focused on finding new ways for their customers to leverage data. Before diving into that pool, any ELD laggards should get compliant first, and then begin viewing mobility as a supply chain enabler (versus just a way to meet a mandate). "Once ELD compliance is handled," Hood says, "the focus should be on utilizing mobility to address ongoing human resource challenges and improve overall supply chain performance."

By **Josh Bond**,
Senior Editor

Automation ensures optimal freshness, minimal handling time

Robotic solution enables supermarket giant to optimize the picking of fresh produce.

A family-run chain of supermarkets, Mercadona is a market leader in Spain's grocery retail sector. Founded in 1977, the group has more than 1,600 stores across Spain and employs some 76,000 staff to serve 5 million Spanish households. For its new DC in Guadix, Granada, the company invested in robotic automation for the handling of its fresh produce, which has minimized handling times to maximize product freshness and shelf life.

The new DC was designed to handle 6,000 stock keeping units (SKUs) and shift more than 3.5 million cubic feet of merchandise per month. The facility features zones for various product types: one for dry produce; two for refrigerated products at temperatures of 3ºC and 12ºC; one for frozen products at -23ºC; and a production area for bread. The new robotic storage system (Cimcorp) automates the picking of full crates of fresh fruit, vegetables and meat in the refrigerated zones, where around 300 different SKUs are handled in some 30,000 crates each day. In addition to the robotic system, the system supplier provided crate stackers, the conveyor system and a warehouse control system (WCS) to manage the material flows.

The robotic solution features eight robots that operate on overhead gantries to combine buffer storage and order picking functions into one operation. The robots handle perishable goods in plastic crates in the refrigerated zones.

Although fully integrated with the surrounding manual operations, the system is effectively an island of automation that prepares orders for retail stores, enabling them to be transported to the supermarkets without the need for any further processing. With product pallets going in and store pallets coming out, the island is self-sufficient, taking care of goods reception; put-away; location of stored items; retrieval planning; picking of crates; sorting and assembly of crates into discrete orders; and loading of the orders onto transport units ready for delivery.

The robots store up to 30,000 crates per day and up to 28,675 crates are picked in a six-hour period to replenish the supermarkets. The 300 refrigerated SKUs are handled in one of two sizes of plastic crate that can weigh 10 to 550 pounds, with a maximum stack height of 7.2 feet.

After going live in just eight months, the fast order processing resulted in enhanced freshness and longer shelf life. The automation allows Mercadona to have all store orders ready for delivery to the supermarkets in six hours. The company was so pleased with the solution that it ordered a further system for another of its sites.

The robotic system ensures accurate order picking and enables Mercadona to set its own picking criteria and implement them consistently. This might include, for example, the placement of heavy products at the bottom of crate stacks, or taking into account expiry date or production batch.

Full tracking and tracing is possible, with all movements of goods being communicated to the host system without the need for bar codes or RFID tags. Greater flexibility is provided through the high level of redundancy of the robotic solution; this allows Mercadona to adapt its operations to meet daily, weekly, monthly and seasonal fluctuations.

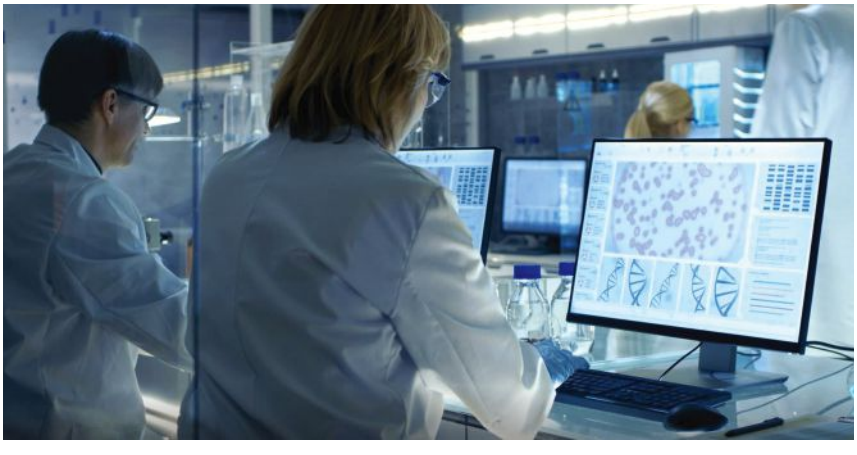
By **Josh Bond**,
Senior Editor

Integrated label software enhances accuracy, speed and compliance

Enterprise bar code labeling system replaces manual label data entry with bar code scanning, centralized label control.

Headquartered in Irvine, Calif., Aspen Medical Products is a leading designer, developer and marketer of spinal orthotics for the global healthcare industry. To support continued growth, the company upgraded its labeling system to integrate with its enterprise resource planning (ERP) system, eliminate manual entry and ensure compliance.

According to Israel Lopez, planning manager for Aspen Medical Products, the company was looking for a labeling system that could better manage



labels, not just design and print them. This was particularly important following expanded distribution in international markets. With its former labeling system, the company had to rely on manual lookups and operator entry to designate "country of origin" on each product label. This process was time consuming and error prone.

"With our former labeling process, we had a lot of production stoppages," Lopez says. "Our IT labeling infrastructure simply wasn't able to cooperate with our ERP system."

The ideal solution would address current labeling issues as well as provide support for a global, multi-user labeling environment—more than 40 different employees around the world needed to access and print desired labels. The company also sought to efficiently serve a lean-staffed label design environment; four employees are responsible for managing labels for more than 350 different products.

The new browser-based, integrated label management system (Teklynx) is a stand-alone labeling system that could be integrated with the current ERP system as well as any ERP system the company might transition to in the future. Global users now print from a central source using standard templates housed and centrally controlled. This provides control over revisions and enables the company to push changes to templates without disruptions.

"In the past, when our contractors in China would make a label, we would send out label copy and ask them to generate a label using their own system and send it back to us," explains Lopez. "This back and forth label creation and approval process could take weeks."

In addition to improved labeling accuracy and reduced label approval time, the company has improved compliance with medical device regulations.

"Five years ago, we averaged three corrective actions a week due to labeling errors," Lopez says. "Now that our operators simply have to scan bar codes, I haven't seen a corrective labeling action all year."

By **Josh Bond**,
Senior Editor

ERP improves operations, customer satisfaction

Manufacturer moves away from manual management toward real-time visibility into order fulfillment and manufacturing workflows.

Stillwell Jacks is a Minnesota-based manufacturer of high-quality hydraulic jacks for customers in the agriculture, construction and automotive industries. After installing new enterprise resource planning (ERP) software, the company was able to automate and streamline order fulfillment and manufacturing processes. Replacing legacy systems, the ERP was implemented company-wide across sales, finance and manufacturing, enabling Stillwell to process up to 30% more customer orders with the same resources.

With a fast-growing business and delivering finished products all across the county, the team at Stillwell quickly realized they needed to ramp-up their overall operations and could no longer rely on their business accounting software package.

"We started out using Quickbooks on the accounting side, but we didn't have a system in place for manufacturing and order tracking," says Zac Stillwell, vice president of operations, who explains how they had to print customer orders and then be sure they didn't get lost in a pile of paperwork. "We worked completely based on memory. In fact, we struggled with keeping track of our orders, and misplacing them could mean costly delays and potentially unsatisfied customers."

With the new ERP system (Priority Software), Stillwell automated its business processes across the board, from the initial order through to product delivery, minimizing manual work at every stage in the process so that employees could focus on more strategic tasks.

"We've taken the manual management out of running the business, which means we can do a lot more with less," Stillwell says. "With real-time visibility into our order fulfillment and manufacturing workflow, the system saves us considerable time and resources, allowing us to book, build and ship more orders."

Stillwell also notes that they were able to make changes to the system and personalize it, attributing the system's ease of use to being well trained by the supplier's team.

"There wasn't anything we couldn't handle ourselves," he says. "Changing the interface, editing reports and creating queries were all very quick and easy to do. This really allowed the system to work for us."

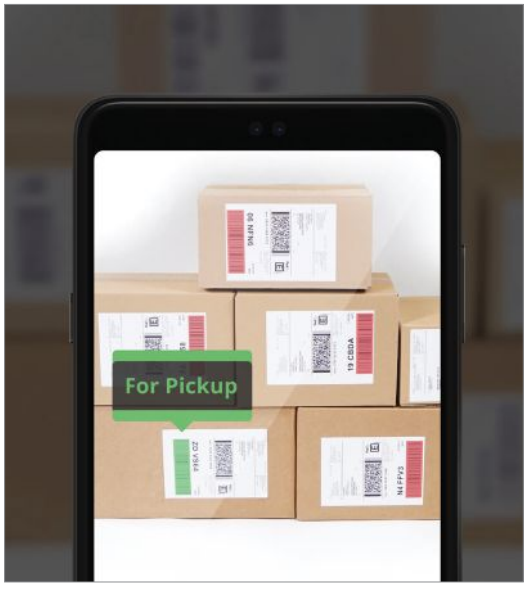
Stillwell Jacks reports accelerated delivery time and increased customer satisfaction.

"Our suppliers now get clear signals when we need to buy material and our paperwork stays organized and is consistent, which makes working with larger customers so much easier," Stillwell says. "We've been able to eliminate the overhead time of many routine tasks to focus our efforts on sales and operations. More importantly, we now have a consistent and professional appearance to our customers and suppliers."

By **Josh Bond**,
Senior Editor

Smart phone bar code scanning technology enhances customer service

Delivery firm replaces bar code scanners with mobile devices for increased operational efficiency and lower total cost of ownership.



Hermes UK is one of the biggest consumer couriers in the United Kingdom, delivering more than 335 million parcels each year for 80% of the UK's top 100 retailers. The company is currently undertaking a digital transformation project with the goal of delivering better and more personalized services for its customers. As part of this initiative, the company has begun phasing out more than 15,000 dedicated bar code scanners and replacing them with smart phones loaded with an Android app over the next three years.

The new mobile bar code scanning and augmented reality (AR) technology (Scandit) offers high-performance bar code scanning on smart phones for verification and proof of delivery. Couriers will be able to scan items, record an electronic signature, verify an ID and take a picture of where a package has been left. The new technology saves time and money, streamlines the entire delivery process, and provides a mobile platform for rapid roll-out of future service improvements that further enhance operations and customer experience.

During the migration period, couriers will also begin using additional software features including AR overlays. This means couriers can scan multiple bar codes at once to search for and find a specific item quickly and view parcel/customer information overlaid on the device screen. The company is already using AR overlays for code identification, delivering efficiency and productivity gains.

"A key component of our digital transformation strategy, known as Digital Futures, is to replace dedicated bar code scanners with smart phones that provide couriers with real-time data to improve the customer experience," says Chris Ashworth, CIO for Hermes UK. "Enabling couriers to carry a smart phone not only helps us to improve operational efficiency, but also improves the working lives of couriers who can now use their own phone, or a Hermes-provided phone, rather than having to carry a bar code scanner."

The project has gone "incredibly smoothly" so far, Ashworth says. The gradual retirement of scanners and roll-out of smart phones has ensured there is no disruption to operations. Because third-party couriers are an extension of brands, the new technology prevents delivery problems that can compromise the retailers' customer relationships.

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Cold chain gets *more sophisticated*

From automation to lift trucks and emerging data networks to track and trace products, cold chain is rapidly changing. It might even become a model others want to emulate.

BY **GARY FORGER**, CONTRIBUTING EDITOR

Cold chain is heating up. No, freezer and refrigerated warehouses aren't getting any warmer. But, there sure is steadily increasing demand for their inhospitable temperatures. And, it's true for food as well as pharmaceuticals.

"The cold storage sector and broader food industry continue to evolve nationally due to a variety of factors including changing consumer dietary and delivery preferences and growth in the frozen food sector," says Lucy Curbin, vice president at the Food Facilities Group of real estate firm CBRE.

Factors here include groceries ordered online,

including meal kits. The Food Marketing Institute expects this segment to grow from just $19 billion today to $100 billion by 2022. That, says CBRE, will cause 100 million additional square feet of cold storage space to be built.

On the pharma side, cold chain drugs will grow 59% from 2017 to 2023, says the industry publication *Pharmaceutical Commerce*. That, too, is resulting in new cold storage capacity. In addition, Amazon's purchase of PillPack should contribute to growth here.

There's also the matter of regulations for tracking food and pharma across the supply chain. The FDA's Food Safety Modernization Act (FSMA) is focused on preventing food safety problems across the board. Meanwhile, the Drug Supply Chain Security Act (DSCSA) is intended to do much the same in pharma. In both cases, cold chain is very much a part of the consumer safety picture.

So, that combination of growth, regulations and consumer safety is having an impact on cold chain. Ask any expert for the leading trend and the word is automation. At the same time, regulatory requirements to track and document the cold in cold chain is resulting in new data networks inside and outside the four walls of the refrigerated or freezer warehouse.

Despite strong gains lately in automation, people are still part of the cold chain equation.

The value of automation

If you think conventional warehouses have trouble finding people in the current labor market, at least double that degree of difficulty for refrigerated and freezer warehouses. After all, who wants to work at -20°F all day? Even if the breaks are frequent.

"Furthermore, the younger generation is even less inclined to work cold chain," explains Tom Steininger, Dematic's market development director for food and beverage. Clearly, automation is the way to go if possible. But, it can be challenging.

"The capital outlay is so significant that the adjustment to the initial investment is huge. Furthermore, the move to automation also fundamentally changes day-to-day operations. That said, the payoffs are substantial," Steininger says.

Beyond the labor savings, automation allows more compact facilities, saving on very expensive refrigeration costs. Steininger says a greenfield automated storage and retrieval system (AS/RS) saves up to 80% in labor, 40% to 60% in space, and 30% to 40% in energy requirements.

Preferred Freezer Services recently opened a 380,000-square-foot freezer warehouse (which *Modern* featured as a System Report in February 2018) that is said to be the largest automated freezer warehouse in North America. It has three freezers that hold up to 200 million pounds of French fries at a time serviced by an AS/RS (Dematic). An overhead monorail delivers and takes away pallets.

Dematic CEO John Galiher says, "My customers are concerned about the rising cost and availability of labor. They're worried about regulation, and, more importantly, they want data to prove that our system is delivering what we say it's delivering." Automation delivers on all of those as it reduces damage and provides an accurate, real-time tracking of product, he adds.

Mike Pitt, director of AS/RS engineering at Daifuku Wynright, talks about a Blue Bell Creameries freezer for its 250 different frozen desserts. The facility has more than 7,700 pallet positions in an 89-foot-tall AS/RS. The new system's building is next door to a

50-foot tall freezer facility with a man-ride storage and retrieval system.

Pitt explains that the reduction of labor as well as the increased timing and reliability possible are critical to overall efficiency. In fact, the number of pallet moves in the facility were greatly reduced with the AS/RS.

Cold chain beyond automation

Not all freezer or refrigerated operations can entirely do without people, especially as e-commerce becomes a bigger factor.

"Let's face it," says Bryan Jensen, chairman and executive vice president of St. Onge Co., "e-commerce has a higher labor content than most other operations and much of that is in eaches." As Steininger of Dematic points out, case picking is growing as grocery stores and others don't need full pallet loads of product in many instances. And that often requires people in the facility.

"In addition, cold chain products are getting swept along with all the other shifts in consumer buying," explains Keith Goldsmith, senior vice president food and beverage for MonarchFx.

That is having an impact on product flow in the cold chain facility. No place is that more noticeable, says Goldsmith, than among small, challenger food brands often as private labels. "Consumers are being drawn to new brands and healthier ones. And at this point, those brands are being managed as cases rather than pallets," he adds.

There's also the matter of direct-to-consumer sales. "They are growing rapidly," says Goldsmith. He includes grocery store foods handled manually by companies such as Amazon Fresh and Peapod along with meal kits from companies such as Blue Apron.

Blue Bell Creameries has automated freezer handling wherever possible.

Lift truck companies in particular are not missing this opportunity. Suppliers such as UniCarriers Americas, Yale, Hyster, Raymond and Crown have all recently introduced trucks for use in cold storage and freezer environments. In some cases, heaters are part of the truck as are special fluids and lubricants for temperatures as low as -40°F. Models range from counterbalanced and high-reach trucks to rider pallet trucks.

Raymond is also focusing on lithium ion batteries for cold chain applications, says Christine Edwards, energy solutions manager. While initially twice as expensive as lead acid batteries, lithium ion has a total cost of ownership over two to three years that is 25% less, she explains. Over a full shift, Edwards says lithium ion has higher performance than lead acid, especially in the final 20% of the charge. That's when lift and travel speeds with lead acid tend to trail off.

As, Chris Merta, Raymond's manager of automation applications, points out, there are few automated lift trucks in the cold chain today. The problem is condensation on sensors used to navigate. However, he "expects that limitation to be solved soon and to see a plethora of automated trucks in cold storage in the next couple of years."

Building data networks

With the FSMA and DSCSA, data networks to automatically track cold chain food and pharma products are on the rise inside and outside the four walls.

"We are at a bit of an inflection point with deadlines in the regula-

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tions," says Steve Simmerman, senior director of sales/global partners and alliances at JDA.

And this is no small undertaking, explains Bruce Stubbs, Honeywell's customer success manager for global corporate strategic accounts. He says a Honeywell survey in 2017 showed that 27% of pharma tracking was on paper. As of last year, that number had dropped to less than 10% with DSCSA deadlines looming.

Paper tracking of food in the food and pharma cold chains is giving way rapidly to electronic means.

"Whether it is food or pharma, the objective is to have greater visibility into the location and condition of the product to ensure consumer safety," Stubbs adds.

One of the first places that companies are turning to are warehouse management systems (WMS).

Modern recently (June 2019) published a System Report about how Nassau Provisions Kosher Foods turned to a WMS (HighJump) to ensure accurate inventory in the right location and more timely deliveries. The software also automatically captures catch weights and expiration dates by scanning serial numbers, eliminating hand-written notes.

While Nassau has been around for 40 years, Good Eggs is an online grocery delivery service including produce and meal kits. About 40% of its San Francisco area warehouse is temperature controlled, both refrigerator and freezer.

Good Eggs also recently installed a WMS (HighJump), explains Craig Moore, vice president of sales at the WMS provider. It also scans bar codes to ensure putaway in proper zones, track inventory against expiration dates and reduce spoilage, Moore says. And with a tag line of "Absurdly Fresh," Good Eggs can't afford to deliver produce any less, adds Moore.

Meanwhile, DMLogic has developed track-and-trace software specifically for pharmaceuticals. Known as STEPLogic Trace, the software is fully integrated with a leading WMS, and provides full compliance with DSCSA, says Matt Deep, DMLogic vice president. "The software tracks and traces pharma by serial number both within the four walls and from supply chain node to node. It also ensures all key data are stored in a single location, the WMS," Deep adds.

Looking forward, Deep says we are in the early stages of building these data networks. He expects the technology to become more robust over the near term. That, he says, will allow the data to be part of not just the supplier's network but shared with customers, too, creating a much higher level of visibility in the pharma cold chain by 2025.

There's also the matter of the cold chain between nodes. For instance, Honeywell offers its Connected Freight solution that allows shippers and logistics companies to monitor goods between nodes. It provides information about inventory in transit, and that's the intent of many emerging solutions.

For instance, Tive offers active tags that monitor the temperature every few minutes during transit. As CEO

Krenar Komoni explains, the tags give real-time visibility into the location and temperature of the shipment while helping companies analyze those variations over time.

Softbox has been working with leading pharmaceutical and telecommunications organizations to enable cold chain visibility of drone delivery medical supplies. As Richard Wood, director of connected digital technologies at Softbox, explains, the Softbox insulated drone payload container uses IoT (Internet of Things) technologies. Temperature data is sent by wireless signal from within the cold chain compartment to an IoT gateway, which then transmits the shipment data to a secure, Internet dashboard portal. The drone flights can last up to 30 minutes and cover in excess of 60 miles, with temperature, locations and security data being collected every 30 seconds.

Similarly, ShipChain is building a platform for temperature-sensitive shipments that tracks temperature and location, says John Monarch, CEO. Temperature-enabled smart tags collect the data, which is sent to the ShipChain blockchain to ensure secure and seamless authentication and chain of custody for pharma and food products, adds Monarch. In addition, a highly scalable blockchain visibility platform secures data as it tracks and monitors shipments.

Clearly, cold chain is receiving quite a bit of attention from many different quarters these days. And with consumer safety high on the list of priorities for the industry, expect to see more in the near future.

Companies mentioned in this article

- CBRE
- Daifuku Wynright
- Dematic
- DMLogic
- HighJump
- Honeywell
- JDA
- MonarchFx
- Raymond
- St. Onge Co.
- Tive
- ShipChain
- Softbox

Collapsible container optimizes bulk beverage shipments

A s transportation costs continue to rise, the recently launched HDMX4048-46 MaxCube container has been specifically designed to maintain a lower tare weight, as more products can now be shipped without weighing out trucks. Aside from maintaining a lower tare weight, the straight-wall container is also collapsible and can optimize bulk beverage shipments. In particular, upwards of eight containers can be stacked when they're collapsed, leading to a 14% rise in return efficiency. And, up to six containers can be stacked when they're filled, resulting in better warehouse utilization. **ORBIS Corporation, orbiscorporation.com.**

Space-saving dunnage material works with handheld totes

A new foldaway, space-saving dunnage material has been introduced. Working effortlessly with the collapsible CF handheld tote series, the dunnage material, along with the totes, offers users a patented combination—one that allows them to ship parts and return collapsible containers without having to worry about removing the dunnage. Compatible with both of the 48 x 45-inch systems available on the market, the CF container system has three bottom designs (smooth, Crosspad and Crosstac), along with an optional lid. Currently, the system has three standard sizes, 12 x 15-inch, 24 x 15-inch and 24 x 22-inch, along with custom sizes that are available for specific applications. **Schaefer Systems International, ssi-schaefer.com.**

Fiberglass reinforced composite totes and containers

Designed to protect parts and machined hardware from damage throughout the manufacturing process, the MFG Tray—fiberglass reinforced composite totes and containers—is now replacing thermo-plastic and steel containers. The containers are more durable and robust than plastic containers, while also less expensive and lighter than steel containers. The composite material is resistant to alkaline solutions, detergents and mild acids, and they can handle operating temperatures ranging from -60°F to 250°F. In addition, the containers are offered in multiple colors, as color matching is available for each customer's unique requirements. **Molded Fiber Glass Tray Company, mfgtray.com.**

Tip out bin set offers small part storage capacity

Due to its small footprint (3-5/8 x 23-5/8 x 11-1/6 inches), the QTB669 tip out bin set offers users ideal storage capacity. Featuring 21 compartments within a rugged polystyrene housing, the bin was primarily designed to store a variety of small parts. To ensure users can easily access their inventory, the bin's compartments are crystal clear and they open to a 45-degree angle. And, the bins can be easily mounted to walls, as they also feature pre-drilled holes. **Quantum Storage Systems, quantumstorage.com.**

Drawers enhance safety and security for inventory and supplies

New drawers allow users to cover, store and protect inventory and supplies. Available in both 12- and 18-inch lengths, the drawers keep supplies and parts secure and neatly categorized. Dividers are available to keep contents tidily separated in drawers; each drawer contains either 8 or 13 divider grooves for fine-tuning the partition size. A back-stop tab ensures drawers can hang securely from shelves when pulled all the way out. The drawers also feature a wide front handle that is easy to grip and perfect for large labels. Ideal for settings ranging from industrial to healthcare, the drawers are versatile. They are stackable when used alone, and they can also be used with Enclosed Steel Shelving, which features a closed back and sides, keeping drawers' contents free of dust and debris. **Akro-Mils, akro-mils.com.**

Custom, heavy-duty stackable steel container

To help a casting company avoid loading heavy castings up and over side walls, an equipment manufacturer designed a custom, heavy-duty stackable steel container that allows for complete access to one end. Featuring a footprint that matches a 48 x 48-inch pallet, the container has two removable sides that were developed to allow operators to close a bin whenever it's half full. Additionally, four-way fork tubes provide stability whenever the containers are stacked or materials are being transferred. **Topper Industrial, topperindustrial.com.**

Tote family ranges in various heights and weights

Ranging in a variety of heights and weights, a new 600 x 400 mm tote family has just been released. The totes are available in six different heights, as their capacities range substantially, from 20 to 150 pounds (with a reinforced bottom). Aside from their range in heights and weights, the totes also have a variety of features that are especially helpful for clients. For example, they provide dividers that create up to eight cells, dollies that allow for easy transport within facilities and integrated pallets and caps, which are used for transportation outside of facilities. **Flexcon Container, flexcontainer.com.**

AS/RS containers for aerospace engine components

To assist mechanics with the storage and retrieval of aerospace engine components, the Space Optimized Solution (S.O.S.) KLAPPA has been released. Combining a bulk container with sliding, customizable bins, the S.O.S. KLAPPA allows mechanics to divide the container space of their engines, so that they can accommodate each engine's parts. Featuring four removable, thermoformed trays, which slide for easy access to parts—and upward of six trays if they remain in a stationary position—the S.O.S. KLAPPA also has a range of dividers. Due to this variety of dividers, it can offer mechanics up to 84 cells for custom-sized part storage. **Georg Utz, utzgroup.com.**

Stacker robot increases accuracy and efficiency

The new flow rack autonomous mobile robot (AMR) replenisher allows organizations to eliminate labor and increase accuracy and efficiency around the clock without the need for breaks or human supervision. The stacker-bot can store and retrieve up to five cases or totes in a single trip. It can retrieve inventory from the floor, shelf or a conveyor level. The stacker-bot can pick and stack up to five levels high or 102-inches tall. Its total capacity is up to 500 pounds per unit or 110 pounds per shelf level. The system travels up to 1.64 feet/second using the shortest path to expedite its pick-ups and deliveries. Likewise, the totes or carton sizes can vary in length from 12.2 inches, 15.75 inches, or 23.6 inches, with a width of 15.75 inches and a height of 3.9 inches. The stacker bot is autonomous. **Conveyco Technologies, conveyco.com.**

New LED lights offer 100,000 hours of performance

The new line of industrial LED fixtures for the North American market are designed for light duty applications such as warehouses, light manufacturing and other large indoor spaces. Backed by a 10-year warranty, the product carries an L-70 rating at 55°C and L-90 rating at 25°C for 100,000 hours of performance. This modular option delivers up to 72,000 total lumen output, making the product the only fixture in its class suitable for mounting heights up to 100 feet. At up to 160 lumens per watt, the product provides a more economical and dependable 1-for-1 and in some cases 1-for-2 replacement for HID and fluorescent fixtures. A 10% direct uplight option achieves above-fixture illumination without the use of diffusers that steal from downlight output. **Dialight, dialight.com.**

New mobile computer boosts productivity

A new mobile computer can boost supply chain productivity by streamlining and error-proofing work in distribution centers and manufacturing environments. With the longest supported device lifecycle available, up to 28-hour battery life, the rugged computer maximizes uptime while providing an easy path for users migrating from legacy Windows to the Android platform. The mobile computer is ideal for applications across the logistics and manufacturing sectors, including receiving, put-away, crossdocking, shipping accuracy, parts/material/work-in-progress tracking and inventory management. The hardware design minimizes cost of ownership by reducing downtime. It is the most rugged device in its class, surviving drops of 8 feet to concrete across the operating temperature range. The 7,000 mAh battery allows the machine to run for 28 hours between battery changes in representative tests, further reducing downtime. **Honeywell, honeywell.com.**

Scissor lift tables can lift up to 6,000 pounds

New scissor lift tables integrate digital scales and conveyors with lifting capacities of 2,000 pounds to 6,000 pounds, making this system ideal for a range of packaging and assembly line filling applications. Manual turntables can also be added for increased operator ergonomics and product positioning. A variety of conveyor tops are available to suit specific project parameters. The supplier works closely with distributors and system integrators to design, build and integrate their equipment into new or existing facilities and production lines. The lift tables also feature easily accessible internal power units, heavy duty cylinders, hand or foot controls, heavy duty tubular frames, heavy duty hydraulic cylinders, and lifetime lubricated bearings to ensure a long service life. **Verti-Lift, verti-lift.com.**

Powered cradle for mobile devices can handle rugged environments

A powered cradle makes sure you never have to worry about battery life in today's fast-paced, non-stop work environments. Meticulously engineered and tested, the new powered cradle introduces a small ergonomic form factor into rugged environments and/or mobile offices of enterprise companies. This product features a patented slam latch technology allowing operators to single-handedly and easily remove the device to effortlessly conduct daily fieldwork as needed. The power cradle can be paired with the supplier's USB iO Hub to enhance the mobile work environment and allow users to add additional peripherals. The weight of the cradle is 1.30 pounds with dimensions of 4.25 inches in width and 4.13 inches in length. **Zebra, zebra.com.**

Intelligent walkie truck battery pack has onboard management system

A new walkie pallet truck with lithium-ion battery pack provides communication that allows data exchange between the truck and the battery pack. This provides operator feedback in the form of fault codes displayed on the truck's control handle, as well as audible and visual alarms if charge is required or low. The onboard battery management system allows the user to schedule charge times, provide notifications when charging is required and monitor charging and usage to prevent overcharging and discharging events. The new walkie pallet truck with lithium-ion battery pack is available in a standard configuration of 24-volt, 78 ampere-hour Light EV Battery Pack. The power pack includes integrated heaters for superior cold storage needs and thermal controls that reduce the risk of damage caused by environmental extremes. **The Raymond Corp., raymondcorp.com.**

Quiet, scalable and portable motor-driven roller powered sorter

The SNS Modular Sortation System supports a range of material including polybags, padded envelopes, small and large parcels. Quiet, scalable and portable, the sorter handles multiple divert points on a single belt for flexible performance. Its safe divert mechanism delivers high performance without exposing personnel to large mechanical pushers. The sorter uses 24 motor-driven rollers for maximum energy efficiency, while its all-electric configuration reduces operational costs by eliminating the reliance on pneumatic solutions and the costs associated with installing, operating and maintaining compressors. Potential applications include shipping, order fulfillment, picking and packing, receiving and reverse logistics. **Solution Net Systems, solutionnetsystems.com.**

Wireless emergency stop

To control machine operation, the Safe-E-Stop is a wireless personal and machine safety device that provides an immediate emergency stop. Worn on a waist belt, the device allows an individual or group to respond to an emergency instantly—without the need to move to a hardwired e-stop location. It easily and efficiently integrates into the existing emergency stop system for simple enhancement and expansion without rewiring safety circuits. It can also be deployed in lockout/tagout operations, enabling testing under controlled and powered conditions. **Cattron, cattron.com.**

Packing station engineered with integrated conveyor

Combining a full-length work area adjacent to a full-length integral conveyor, a new packing station increases the speed at which a container, product or component moves to its next destination. Built on a tandem scissor lift platform, the extra-long packing stations rise or lower to meet the application needs of manufacturing, processing, distribution operations and more. They are offered with lift capacities to 6,000 pounds, platform sizes up to 48 x 220 inches and lift spans up to 70 inches. Other standard features include internal power units, heavy-duty cylinders, safety maintenance blocks, hand controls, lifetime lubricated bushings, and heavy-duty legs. **Verti-Lift, verti-lift.com.**

WMS enhanced with distributed order management capabilities

To optimize omni-channel fulfillment, the supplier has enhanced its warehouse management system with distributed order management capabilities. This enables 3PLs, distributors and retailers to more easily handle complex, multi-faceted fulfillment demands. Using rule-based procedures to determine how best to fill customer orders, the system streamlines the fulfillment process across a range of inventory locations and balances cost with customer expectations for orders to be fulfilled on time and completely. The new integration also enables distributors to source inventory from the most cost-effective locations and ensures optimal order routing that draws on the most appropriate inventory. **Tecsys, tecsys.com.**

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Autonomous delivery robot operating system

The new AutoDelivery robot is powered by the BrainOS commercial operating system for the production, deployment and support of autonomous mobile robots. The tugger vehicle operates across a variety of environments, enabling the seamless transportation and delivery of goods from point A to B. Capable of towing several common cart types, the robot provides easily customized, automated delivery solutions for commercial and retail facilities, as well as warehouses and factories to improve workflows, boost productivity, increase efficiency and reduce interruptions. **Brain Corp., braincorp.com.**

Boost speed, accuracy with pick-to-light devices

The PTL110 Series of scalable, versatile pick-to-light devices improves speed, productivity and accuracy in picking, kitting and related applications. The units feature optical sensor and touch-button capabilities that can be used individually or together to confirm standard pick actions—plus secondary functions. Optionally, an alphanumeric display can be used to indicate part count or provide other instructions. In addition, the LED indicator features 14 colors and various animation options to clearly differentiate multiple conditions. Each device features two M12 connectors for quick and secure installation of multiple devices with no additional cables required. The units fasten to tubes, extrusion and rail with a variety of brackets or standard cable ties. Devices can be quickly moved and replaced with no tools, rewiring or reprogramming required. **Banner Engineering, bannerengineering.com.**

Easily clean bench-counting scale

Cruiser CCT bench counting scales incorporate a contoured platform constructed of durable grade 304 stainless steel, making it easy to clean and keep items on the pan. Ideal for inventory and stock control tasks or check counting during packaging processes, the scale quickly verifies the number of pieces in a container to reduce waste when filling orders or packing shipments. Intuitive software is user-friendly and keeps track of the count, automatically optimizing the unit weight for greater accuracy. Features include three separate backlit displays that simultaneously show total weight, piece weight and count in one convenient location; color-coded keys for fast recognition of the most frequently used buttons; and a level indicator and non-slip adjustable feet to ensure proper scale setup for accurate weighing. **Adam Equipment, adamequipment.com.**

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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15. Extent and nature of circulation:	Average No. Copies Each Issue During preceding 12 Months	Actual No. Copies of Single Issue Nearest Filing Date
A. Total no. copies (net press run)	55,590	53,957
B. Legitimate paid and/or requested distribution (by mail or outside the mail)		
1. Outside County paid/requested mail subscriptions stated on PS Form 3541	49,044	46,734
2. In-County paid/requested mail subscriptions stated on PS Form 3541	None	None
3. Sales through dealers and carriers, street vendors, counter sales and other paid or requested distribution outside USPS	17	17
4. Requested copies distributed by other mail classes through the USPS	None	None
C. Total paid and/or requested circulation (sum of 15B (1), (2), (3) and (4))	49,061	46,751
D. Nonrequested distribution (by mail and outside the mail)		
1. Outside County nonrequested copies stated on PS Form 3541	5,992	6,290
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4. Nonrequested copies distributed outside the mail	397	717
E. Total nonrequested distribution (sum of 15D (1), (2), (3) and (4))	6,389	7,007
F. Total distribution (sum of 15C and 15E)	55,450	53,758
G. Copies not distributed	141	199
H. Total (sum of 15F and 15G)	55,591	53,957
I. Percent paid and/or requested circulation (15C divided by 15F times 100)	88.50%	87.00%

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A. Requested and Paid Electronic Copies	26,057	28,000
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C. Total copy distribution (line 15F) + requested/paid electronics copies (line 16A)	81,507	81,758
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Michelle McKeon (signed), Senior Audience Marketing Manager, 9/30/19

Marc Wulfraat

MWPVL International

TITLE: Founder and president

LOCATION: Montreal, Canada

EXPERIENCE: 32 years working in supply chain consulting and distribution center design

***Modern*: Let's start with an easy one: What is micro-fulfillment, and what are the different flavors you're seeing of micro-fulfillment solutions?**
Wulfraat: Micro-fulfillment is order fulfillment that takes place within a very small distance of the end consumer. Typically, it's in an urban metro market.

***Modern*: We're beginning to see 3PLs develop networks of small e-fulfillment centers of around 50,000 square feet or smaller. Do you think of this as micro-fulfillment?**
Wulfraat: In my vernacular, that's a CFC, or customer fulfillment center. It's a larger facility than a micro-fulfillment center, or MFC, and it covers a wider radius of geography. An MFC is almost always associated with a retail store, either in the backroom of a store, a dark store, or as a 10,000- or 12,000-square-foot addition to an existing store.

***Modern*: Is it primarily for buy online and pickup in store?**
Wulfraat: I'd extend that out one more, because an MFC could also be used for home delivery. Typically, one MFC is serving a cluster of seven or so stores in an area. The system pools the online orders for all of the

customers that would normally shop at those stores. They transfer the totes to the other stores. It's a little bit of a hub-and-spoke model.

***Modern*: What's driving it?**
Wulfraat: The penny dropped for companies in the grocery industry—where I believe MFCs have the biggest opportunity—in 2017 when Amazon bought Whole Foods. Given Amazon's access to cash, it sent shock waves through the grocery industry. The thinking gravitated from "let's see how this pans out" to "we have to do something." There is a first mover advantage to the grocer in an area that does this right because once a customer signs onto your site, there's a very low defection rate.

***Modern*: Why is that?**
Wulfraat: The average consumer buys 320 items religiously. It takes time to set that up in a grocer's Website. But, once you do that, ordering is like clockwork. So, you want to be the first grocer to get the customer's attention. The other reason is that it segregates the inventory of the items ordered most often online. When you're filling orders from the store, you really don't know the status of inventory in real time because the public is touching it. Out of stocks run 3% to 5%. When that happens, you're texting the customer to see if they want a substitute. An MFC operates in an isolated environment. The inventory is pristine and updated in real time. So, the customer order is clean every time, the satisfaction rate is much higher, and you can get an order filled in 10 minutes. And, I should add that the cost is at a price point that most grocery companies will accept. If they have to put a 12,000-square-foot addition onto the store, they're looking at $5 million to do that. If they can fill orders for a cluster of stores, that's doable.

***Modern*: Are we seeing a diversity of solutions, from conventional to highly automated?**
Wulfraat: Yes, there are companies out there using a dark store as an MFC. In those, employees pick to carts and normally pick to four totes at a time. They use a combination of sprinter vans for home delivery and trailers to deliver totes to stores. I think the dark store in Europe will be more pronounced here because of geography. I expect to see automated MFCs in those 50 biggest cities that represent about 50% of the population.

***Modern*: What will it take for this to become a more common model?**
Wulfraat: I think we're already there. What I see when I look at the amount of activity going on in this space is that it's almost as if the big retailers are putting off investments in distribution center automation to focus on MFC solutions. It's now a top priority. We're still very much in the infancy stage of this market, but it's going to be a billion dollar industry in a short time.

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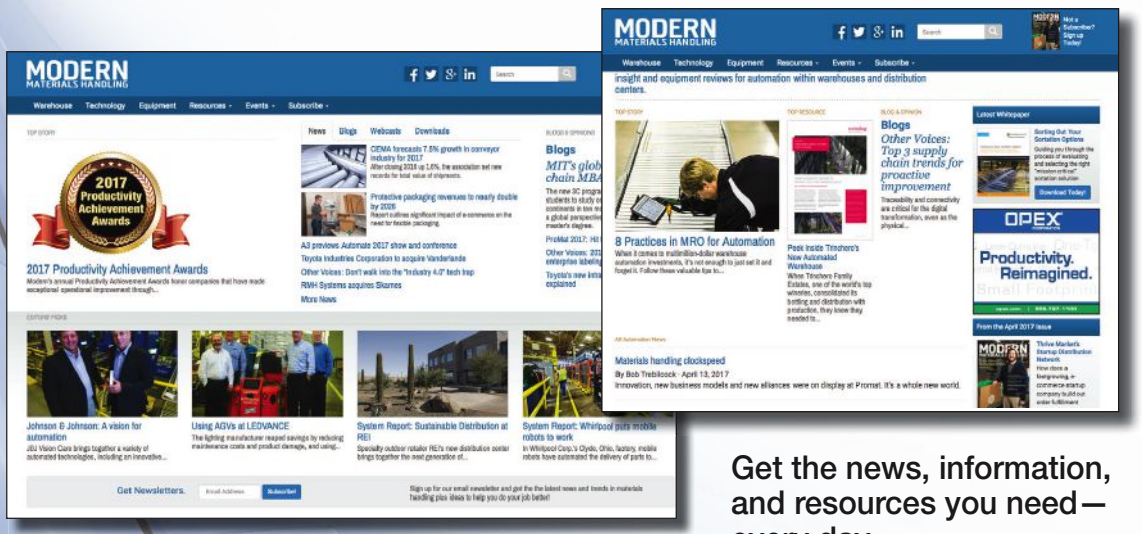

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