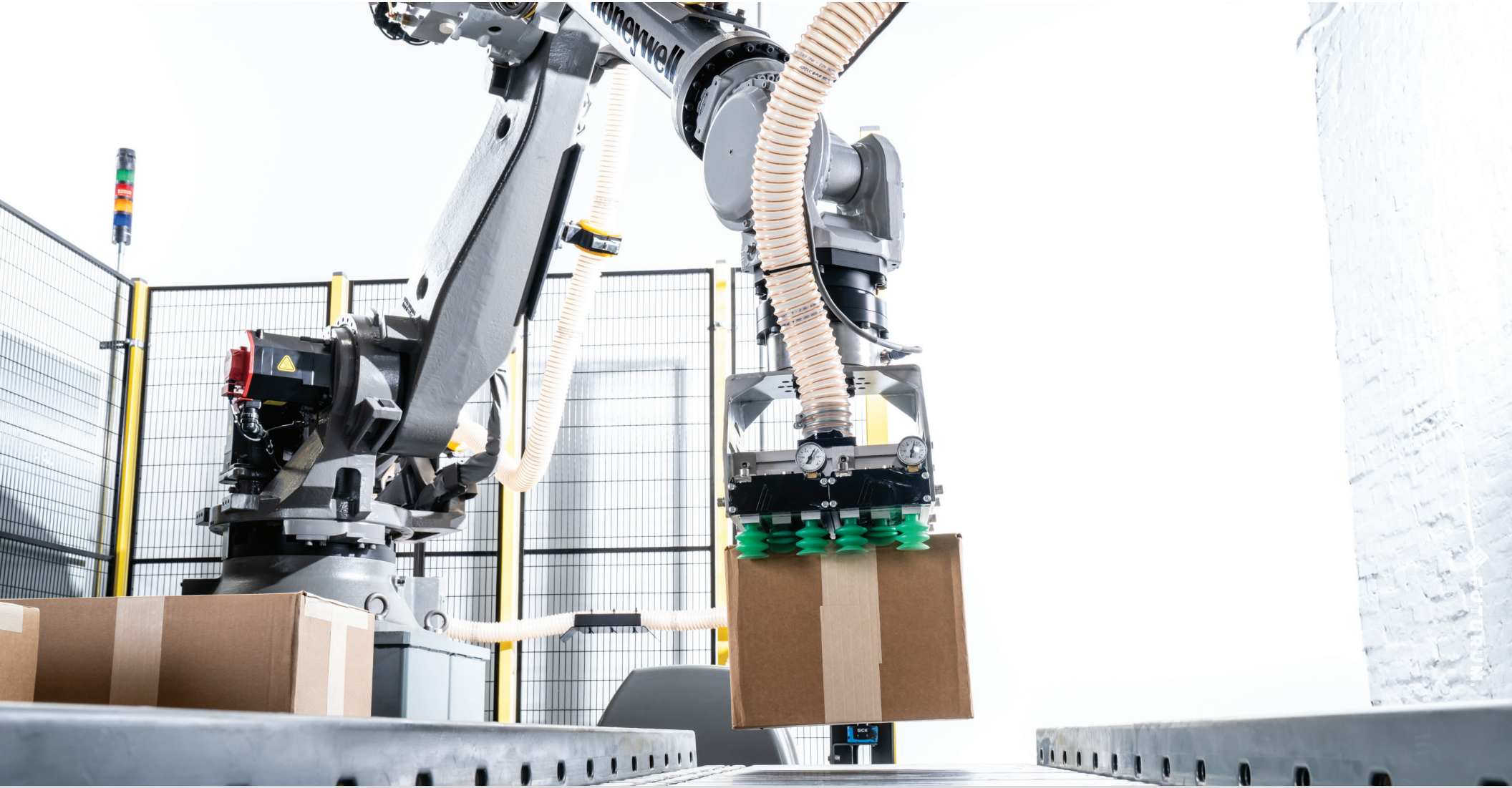
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Warehouse Automation: Future-proofing the Global Economy

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INTRODUCTION

We may live in a digital economy, but online e-commerce sites are just front ends to massive logistics operations responsible for fulfilling the physical aspect of the digital economy. From online orders and home delivery to in-store pickup and on-site shopping, the reality of the digital economy includes a massive web of packaging, shipping, warehousing, and distribution systems that deliver on every brand's digital promise. In fact, without this physical infrastructure, the digital economy would grind to a sudden halt.

> ***"Every day has been a holiday for us since March 2020."***
> *— Automation Lead, Retail & CPG Industry*

Unfortunately, that grinding action occurs all too often today as labor shortages, supply chain issues, and ongoing global events serve to both alter once-predictable consumer demands and significantly destabilize product supplies. In fact, the predictable demand cycles centered around holidays and "peak seasons" of consumer demand have given way to a model where any month, week, or even day can be a "holiday" (with all the stress and fluctuations of a season compressed into a much shorter period).

> ***"Business models are changing and driving the need for more advanced technologies to adapt to a post-pandemic model."***
> *— Automation Lead, Retail & CPG Industry*

In this light, the analyst team at Futurum Research sought to better understand the challenges now facing logistics providers, with a particular focus on warehouse and distribution center (DC) operations and the role automation technologies may play in helping bring stability and predictability to this aspect of the economy. We sat down with a select group of industry leaders with deep, global experience in warehouse operations, automation technologies, and systems implementation to hear first-hand of their experiences and thoughts on the future of warehouse automation.

> ***"Labor issues have made doing nothing a non-option — if automation isn't a top 3 strategy item in the C-suite today your company is going to be in big trouble in three to five years."***
> *— Executive, Autonomous Mobile Robot (AMR) Provider*

Throughout this paper, which is the result of these conversations and our own ongoing research and analysis into digital transformation and automation, we'll share some of the common or shared challenges facing warehouse and DC operations today, such as the disruptive impact of recent global events, how changing consumer behavior is challenging traditional expectations on the type and frequency of products that flow through the distribution channel, and the impact of industry-wide staffing shortages and supply chain challenges.

We'll also share some of the key approaches warehouse and DC operators are taking to overcome these challenges from both process and automation perspectives, as well as offer a series of recommendations that we feel will help warehouse and DC operators maximize the value of their investments in automation solutions today while ensuring those investments continue to drive value over the years to come.

THE DISRUPTED WAREHOUSE

Warehouses and distribution centers have traditionally been labor-intensive operations, relying on vast numbers of employees to load and unload freight carriers, stack or tear down pallets of items, sort or route packages, or place/pull inventory from shelving. Regularly located in rural areas near common carrier transportation hubs, the throughput or capacity of these operations over the past few decades has been, for the most part, predictable and shaped by long-term, recurring holiday and event-based changes in consumer demand.

But that is no longer the case, as several different forces have disrupted the traditional warehouse and distribution center model. It's hard to overestimate the long-term disruptive impact of the ongoing pandemic, global trade issues, and regional conflicts. Even before the pandemic, trade issues and increased tariffs had led to increased cost of many goods and resulting changes in both supply and demand as businesses looked to re-source products and diversify (de-risk) their supply chains.

Here are a few of the major factors that continue to disrupt warehouse and DC operations today:

The Increasingly Digital Consumer. The social distancing requirements of the pandemic fundamentally changed consumer purchasing behavior and accelerated the growth of e-commerce. But it also gave rise to split, or hybrid, delivery requirements spanning online orders with ship-to-consumer and online orders with in-store pickup (in addition to the in-store shopping experience which continues to be a significant channel). This growth, while anticipated, has occurred at an accelerated rate and changed the distribution model or path for products between manufacturer and consumer. As a result, many warehouse and DC locations and capacity configurations are no longer ideal or optimal.

Changing Consumer Preferences. In tandem with changes to how consumers prefer to purchase, we've seen significant changes in consumer preferences for what, how much, and how often they purchase. As consumers have become digital consumers, they are no longer constrained by local store inventories and are able to purchase a wider range of items from a larger number of manufacturers, often with different logistics and distribution requirements that have changed as well (such as size, packaging shape, or cold-chain storage requirements). This brings a new level of flexibility and agility requirements to the traditional warehouse model.

Supply Chain Shortages. The global supply chain has been stressed like never before, from shortages in semiconductors to the backlog of cargo ships waiting to dock at ports due to Covid restrictions. This has impacted both the availability of finished goods as well as the raw materials and components of internal parts, sparing no industry. Agriculture, medicine, consumer electronics, transportation and other industries all have been impacted and all tend to disrupt upstream. For example, the automotive industry, already on an accelerated shift towards smarter, more electronic vehicles, has resorted to slowed or shuttered production at some facilities due to component availability issues. In fact, even the availability of warehouse automation solutions has itself been impacted by supply chain shortages.

> ***"Companies are emerging and expanding from the pandemic and they're trusting technology more and more."***
>
> *— Supply Chain Automation Executive, Automation Solutions Provider*

Staffing Issues. Even before the current pandemic, warehouse operators have faced a series of long-term staffing challenges, from dealing with an aging workforce to attracting, training and retaining the right talent to address both ongoing and wildly variable seasonal requirements. But while most of these issues, including high levels of employee churn, could be solved by the addition of more staff, the pandemic (and the resulting "great resignation of 2021" have taken away that option – there simply aren't enough available candidates to meet operator's needs.

> ***"It's not about replacing workers, it's about not having enough workers, or (when we do) not enough consistency."***
> *— Supply Chain Automation Executive, Automation Solutions Provider*

The challenges facing warehouse and DC operators today are comprised of several diverse elements.

Worker Proximity. A safety issue, social distancing requirements have limited the number of employees that can physically work within a given facility as capacity numbers have been reduced (and often vary between regions or localities).

> ***"We focus automation on highly redundant tasks and let humans focus on higher level tasks."***
> *— Supply Chain Automation Executive, Automation Solutions Provider*

Labor Shortages. The great resignation and shifts in employee interests (as many changed jobs during the pandemic) has resulted in an acute shortage of employees across the distribution model (from warehouses to transportation, the impact has been severe). In many cases, employees have moved on to different, less labor-intensive, occupations. In others, there is simply a lack of potential employees located around existing warehouse operations (and not many are willing to relocate to existing operations in rural or remote locations).

> ***"The pandemic has been a game changer — we're seeing 100% turnover in some areas and finding qualified workers and keeping them safe is a challenge."***
> *— Executive, Automation Solutions Provider*

Employee Turnover. Employee retention has become a significant issue, resulting in increased training and onboarding costs as employers must train more employees than in the past just to keep up prior staffing levels.

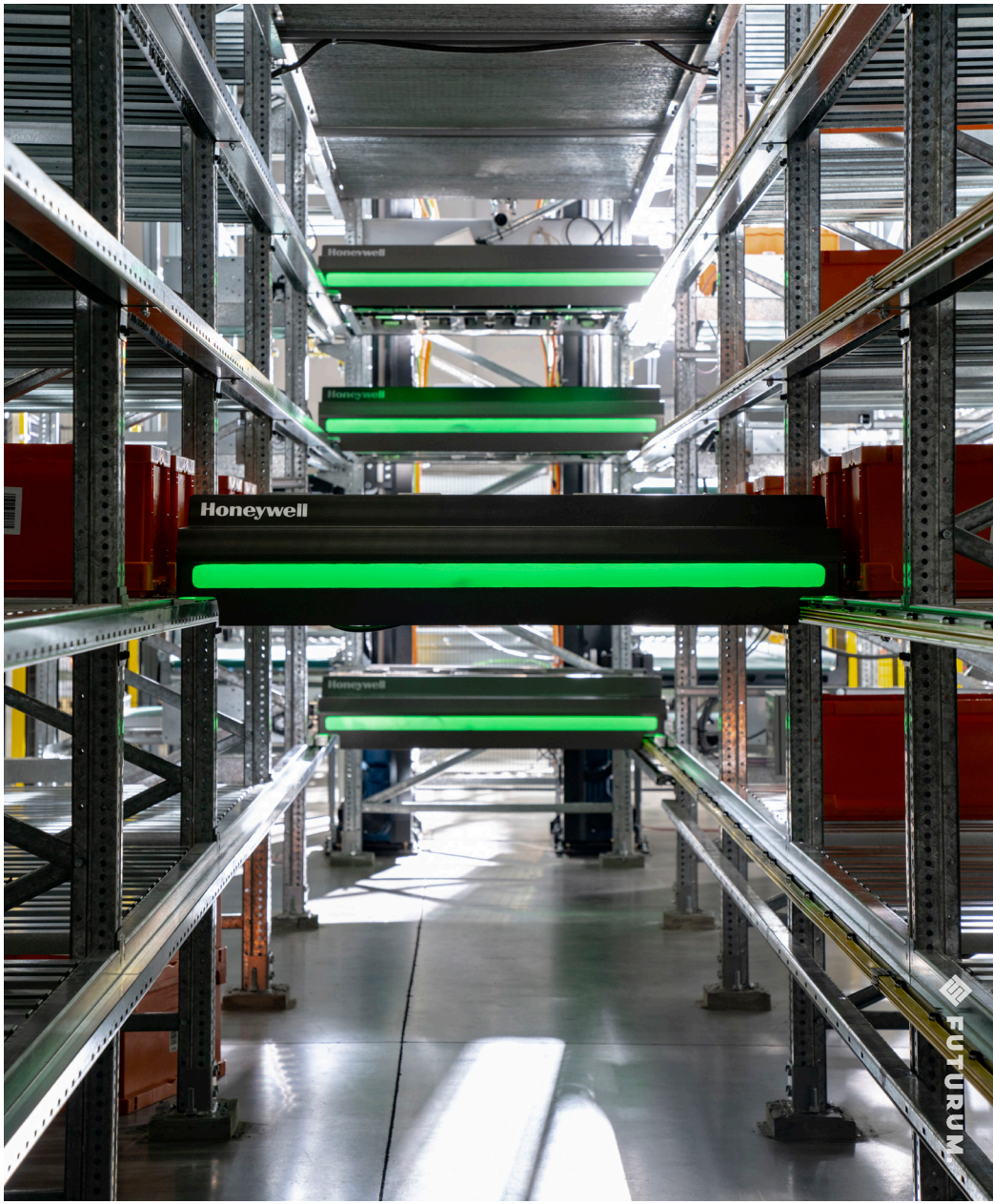
The Flattened Holiday Curve. As retailers have shifted to on-line consumer models, they've altered the traditional holiday or event-driven sales cycle. Consumers now start the seasonal sales process sooner, resulting in an extended, slightly flattened curve (which has resulted in a similar change to warehouse throughput and staffing requirements). And let's not forget the "any day can be a holiday" aspect of on-line shopping as retailers can easily reach a significantly larger and more diverse, digital customer base with targeted discounts and pricing (Amazon's Prime Day – and the similar efforts that followed by other retailers – being a prime example).

> ***"Even if we're expecting growth to slow, we're still having growing pains."***
> *— Executive, Automation Solutions Provider*

Next-day (Same-day) Delivery. The shift to next-day or even same-day delivery has dramatically impacted the geographical distribution of originating locations, modes of transportation, and end destinations. As a result, many warehouses and distribution centers located in rural areas adjacent to rail or interstate highways were no longer optimally located. To meet same-day shipping demands, many operators have transitioned from larger, remote facilities to smaller, more distributed facilities closer to the end customer (including very small micro-DCs that are often specialized and embedded within the last mile(s) of the customer in urban or suburban communities).

> ***"There is a shift, less rural and more urban or suburban where operators are more space-constrained and automation, micro-distribution and micro-fulfillment are needed."***
>
> *— Executive, Automation Solutions Provider*

It's important to note that disruption isn't a one-size-fits-all situation. Warehouse operators focusing on consumer goods distribution at the local level may be facing different challenges than global operators focused on shipping containers and port logistics, but the magnitude of disruption has been high across them all and all benefit from increased operational visibility, reduced downtime, improved efficiencies, and productivity.



THE WAREHOUSE REALITY

There are many different types of warehouses and DCs, each with slightly different purposes and operational requirements. Some are focused on storing and distributing finished goods, others focused on work-in-progress inventory as part of a distributed manufacturing process. Still, others function as massive, centralized distribution centers while others address that last mile micro-DC requirement.

> ***"There are few truly mature automation implementations yet — the need for advanced automation facilities is greater than what's been implemented."***
>
> *— Executive, Industrial Robotics Provider*

But even as the automation technologies and processes used across them all have steadily evolved and improved over the past decade, the market is far from mature, and many organizations are still in the early stages of their automation journey. Many are still looking to implement initial palletizer/depalletizer systems, while others are focused on their first picking, sortation, or conveyer systems. Yet others have already made those investments and are now focusing on autonomous mobile robots (AMRs) within extended warehouse facilities.

Regardless of where they are in their automation journey, there are several consistent approaches that warehouse and DC operators are following as they look to lay the foundation of future flexibility while overcoming the challenges of today:

Focusing on Reliability and Predictability. In the battle of operational efficiency, speed is not always preferable to predictability. While scalability, and the ability to increase capacity and throughput on demand is important for many organizations, the more pressing issue is often one of improved reliability and predictability of performance, e.g., how consistently an operation can be performed over time rather than how quickly it can be performed in short bursts. Achieving consistency of operations today is critical to overcoming the staffing-related challenges many operators will continue to face over the coming years. While machines are not as smart, or necessarily as fast as humans for individual or unique tasks, they are predictable and can operate 24x7x365 with minimal intervention.

> ***"Safety is an important metric — how many touches take place in a warehouse. If we can reduce the number of human/material touches we can reduce the risk of an accident."***
>
> *— Executive, Autonomous Mobile Robot (AMR) Provider*

Measuring the Right Return on Investment (ROI). Every investment in warehouse technology needs to provide a measurable benefit or return. And there are many approaches to determining the value of an automation system within a warehouse. They're often chosen to address a particular need or shortcoming, such as improved inventory count, picking accuracy, on-time performance, or system availability (operational uptime). From an ROI perspective, it's common to base a return on the equivalent human cost (and the measure of reduced cost/performance an automation system provides). But the real challenge organizations face today – particularly as many recognize they must invest now for the long-term future – is setting the right time frame expectations and understanding that today's investments are more about laying the foundation for future capacity and agility than they are about short-term gains or ROI.

> ***"ROI? Show me the money, but more forward-thinking and complex implementations are considering 3yr ROI cycles."***
>
> *— Executive, Autonomous Mobile Robot (AMR) Provider*

Optimizing the Human Element. In a tight labor market, optimizing the value of employees is critical to both performance and employee satisfaction (and retention). Manual labor and repetitive tasks are not efficient uses of the employee resources and often not sustainable or cost effective. Much like we see with automation in other areas, the value is not in replacing workers necessarily, but in augmenting their abilities and upskilling to address more creative or challenging issues.

> ***"You're paying somebody an hourly wage — walking is the least valuable thing you can pay them to do. They should be doing something better, more human."***
>
> *— Executive, Autonomous Mobile Robot (AMR) Provider*

Maintaining Flexibility in Implementation Planning. The massive increase in demand has driven many operators to aggressively test and implement automation solutions. But not many can afford the downtime incurred in a complete one-shot implementation. Even phased implementations can be a challenge, and risky, for organizations who must integrate old and new systems or maintain full operations during the process. One solution is to build new greenfield sites with over-capacity, then shift existing operations to the new facility (and upgrade or decommission existing sites). But this is not optimal for many who must find the right partners to manage the implementation process. Just like there is no one-size-fits-all approach to automation, there is no longer any best approach to implementing an automation solution – adaptability and flexibility are key.

> ***"A lot of automation tech has been developed for greenfield sites with no backwards compatibility, but who can afford to rip and replace existing infrastructure?"***
>
> *— Automation Lead, Retail & CPG Industry*



FUTURE-PROOFING AUTOMATION SOLUTIONS

Like many industries today, warehouse and DC operators have accelerated the adoption of digital technologies to address the extended disruptions of the past few years. For some it is a matter of survival and recovering previous throughput capabilities. While for others it offers a chance to use the disruptive period as an opportunity to reset and expand their operations for the future. But for all, it's important to leverage the unique opportunity they face today, from accelerated budgets and spending to a somewhat chaotic global market that presents an ideal time for many to implement or initiate larger, more comprehensive plans than they would have during a year of normal operations.

More forward-thinking organizations recognize the opportunity to not only accelerate existing plans but to rethink those plans to lay a stronger, more resilient, and agile foundation that can meet today's requirements while helping future-proof their investments and opportunities in the future (all the better to leverage the continued innovations and advancements yet to come).

Here are a few key approaches warehouse and DC operators are leveraging to implement for the future, today:

Focus on Worker Augmentation. While some may be looking towards the dark (employee-less) warehouse of the future, the goal of warehouse automation systems shouldn't necessarily be to just shift tasks from workers to automated systems as much as it is to scale capacity by augmenting human talent. This includes upskilling and refocusing employees towards higher-level, more challenging tasks.

> ***"We know we're going to end up with many more machines than people — maybe 4:1 — there's simply not enough labor available (today or tomorrow)."***
>
> *— Executive, Global Logistics & Warehouse Operator*

Anticipating a Decade Ahead. Automation can certainly help operators improve capacity, predictability and 24x7x365 availability today. But what about the future? Laying the foundation today for the requirements of the future requires a long-term approach from both a capacity perspective and ROI expectation. Consider it an investment and set expectations accordingly.

> ***"You need to anticipate your peak (3-4x normal) throughput requirements a decade from now. You're putting in a massive amount of fixed infrastructure today that must serve as a flexible foundation for the future."***
>
> *— Executive, Autonomous Mobile Robot (AMR) Provider*

Adopting a Data-centric Approach. Warehouse operations have traditionally been a manual process with limited collection of data as a performance or planning asset. But with automation, the ability to capture data on all actions and transactions across all processes exists. Coupled with asset tracking solutions (e.g., RFID/radio-frequency identification, wireless, etc.) and predictive analytics, warehouse operations can be mapped into digital twins for planning and optimization while predictive maintenance can be employed to ensure maximum availability of automated assets.

> ***"Warehouses can benefit from the data-centric approach of manufacturing to understand when — and how — to flex up and down to meet changing requirements."***
>
> *— Executive, Autonomous Mobile Robot (AMR) Provider*

Integrating Management Solutions. Warehouse operations should not exist in a silo, segmented from supply chain, distribution, or any other business system. Having a single source of record (truth) that spans an entire enterprise is critical to understanding business operations from first supplier to the last customer. The value of integrating smart AI systems with automation, supply chain, customer and ERP systems cannot be overlooked in the coming years.

> ***"Automation is not a magic wand — it doesn't make all your problems go away and it won't work magically by itself."***
> *— Executive, Global Logistics & Warehouse Operator*

Using Fast-Fail Proof-of-Concepts (POCs). Leveraging a fast-fail approach to POCs and being able to vet minimum viable solutions are key to continuous process improvement and achieving a faster time to value (ROI) from existing foundational investments in IT and automation technologies. A dedicated or cross-functional team tasked with identifying and evaluating automation systems must also be able to vet new process and workflows to move beyond automating the existing to automating the future.

> ***"We're constantly evaluating different types of automation technologies, even knowing 2 of 3 POCs won't work."***
> *— Executive, Global Logistics & Warehouse Operator*

Leveraging Integrator Experience. Automation technologies are evolving at a rapid rate, but no one solution fits all. And while greenfield implementations may be ideal, most operators are far enough along the automation journey to require the integration of new solutions with existing implementations. Forward thinking operators recognize the value of focusing on their business operations while partnering with established integration and technology partners that can leverage both business process and automation experience to identify, vet, and implement the right technologies and solutions.



RECOMMENDATIONS

The challenges faced by warehouse and DC operators today – particularly those driven by the pandemic and recent global events – are substantial, but not necessarily new. In fact, many of the challenges facing the industry today have been around for years but have now been exacerbated by recent events – even for those organizations that are more experienced or mature in their use of automation technologies. These include:

- Changes in consumer behavior (more digital, more online) and preferences (new or shifting product or brand interests) that have changed the mix/frequency of products that transit the warehouse and DC facilities,
- Supply chain disruptions that add an element of unpredictability to shipping volumes and the availability of in-warehouse technologies,
- Staffing issues such as high turnover, social distancing/ capacity limitations, and worker shortages that have constrained operator productivity,
- The flattened holiday curve and increased product returns that increase baseline operational requirements throughout the year (with fewer "peak" periods), and
- The requirement to deliver on brand/retailer promises for next-day delivery into areas where warehouse and DC operations typically have not been located.

Through this all, however, we see operators adapting to the new realities of the global economy and finding success through the deployment of automation technologies that fit within a long-term strategic framework, one that emphasizes:

- A focus on worker augmentation, not just task automation,
- Anticipating logistical and geographical requirements 5 to 10 years into the future, and working to ensure that current automation implementations serve as a foundation for long-term needs, and
- An integrated and data-centric approach to managing and monitoring operational activities and the use of smart, AI-based analytics and digital twin technologies to predict and model operations in the future.

With these in mind, we offer warehouse and DC operators the following three recommendations and points to consider as they navigate the challenges they face today and tomorrow as they mature along their automation journey:

(1) Focus on augmenting and securing, not replacing, the worker. While the concept of a dark warehouse exists on the horizon, the reality today is that the future of warehouse and DC operations for the foreseeable future is one where human workers and automation technologies are both needed and must co-exist. A few points to consider:

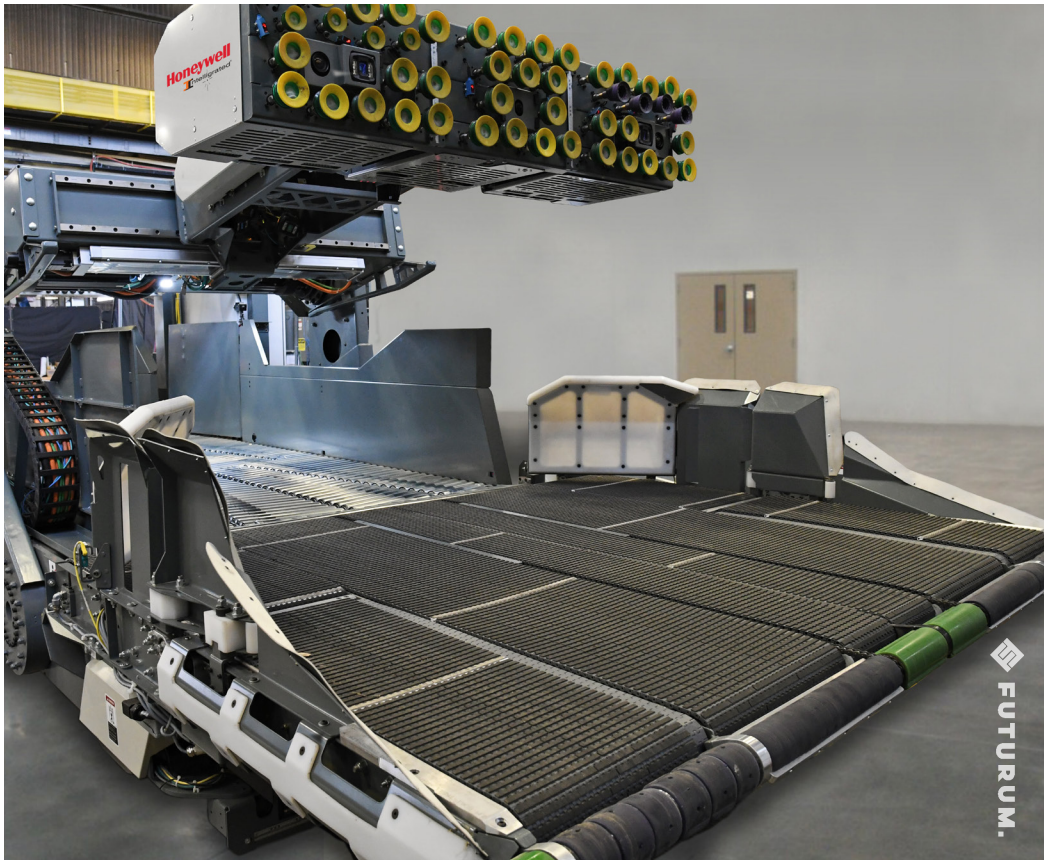
- Using automation to minimize worker/inventory touch points can improve both employee satisfaction (fewer manual touches) and safety (fewer touches = less risk).
- Automation should allow the human worker to focus on issues that are beyond the ability of automation technologies and leverage human skillsets (such as operational decisions, troubleshooting and oversight of automation tools).

(2) Constantly challenge assumptions and technologies. The value of automation should not be limited to just automating existing tasks or processes, it should be part of an overall strategy that addresses the issues of what tasks can be automated today while also asking what new tasks or processes might be possible tomorrow. Consider the following points:

- The capturing of operational data (inventory tracking, machine performance, IoT sensors, worker behavior and locations) can be used to both understand how operational requirements are changing and develop new models for operations in the future.
- The use of a fast-fail approach to testing new automation technologies and Proof-of-Concept implementations can be key to keeping up with advances in automation technologies and innovation through ongoing "what if" testing scenarios (automation technologies are evolving fast, and so too must operational processes and deployment decisions).

(3) Invest with a long-term focus for both technologies and partners. In a static or slow-growth market the application of automation technologies to address specific short-term needs may make sense. But the rapidly growing and evolving market of today requires a much longer focus and a more rigorous framework. Consider the following points:

- Investing for the future means reassessing expectations on ROI with a greater emphasis on near-term productivity improvements and foundational infrastructure and a longer-term time frame for financial returns.
- Automation technologies and best practices are evolving rapidly, even as global market conditions remain unpredictable. Leveraging the experiences of the right strategic partners for planning, integration, and operational management can ensure that warehouse and DC operators can focus on their core operations while being able to leverage the right automation tools in the right place and the right time without having to build that experience and capability in-house.



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