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WHITE PAPER

Adopting automation in the digital age

A point of view on how organizations will realize the potential of automation to deliver speed, scale, and efficiency within the constraints of their existing distribution networks, and how the software industry will evolve to provide greater value in semi-automated environments.

The Digital Supply Chain Transformation is happening faster than the physical supply chain can react, requiring hybrid solutions in semi-automated environments where humans and robots work side by side. New incentives to modernize operational capabilities should be added that capture efficiencies not achieved previously, while laying the foundation of a digitized supply chain, continuously re-evaluating plans and evolving for optimal performance.

Automation has long been looked upon as a solution to operational challenges, but trends in the marketplace portend an unprecedented rate of adoption taking hold in the coming decade. E-Commerce is driving service expectations to levels that may not be achieved without the use of high speed picking alternatives to manual operations. The aging generations in mature economies and challenges securing a loyal millennial workforce for repetitive tasks are creating increased disruption to staffing, forcing employers to look to automation to offset risk of labor shortages. Continued innovation has reduced costs of entry for automated capabilities, delivering improved business case justification for automation of many forms.

Author biography

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With such a strong justification, operations leaders across the globe are seeking ways to capture the potential that automation offers. Large scale transformation of distribution networks is capital intensive, however, and rarely warranted given the pace of change – however rapid – and market uncertainties. Therefore, we are forced to look within existing environments to identify opportunities to introduce automation into existing facilities, combining automated equipment with manual operations, which requires the added complexity of orchestrating work across semi-automated operations. This scenario introduces the question of how to create an optimal environment allowing warehouse management systems (WMS) to orchestrate work across manual and automated areas to ensure efficient operations and maintain quality and service levels.

Today's automation systems landscape

In automated environments, WMS often work alongside warehouse control systems (WCS) that manage the routing of containers as they traverse the material handling equipment, and warehouse execution systems (WES) which often have basic task management capabilities but not the level of control or optimization of a WMS. Below are a few general groupings of automation that typically leverage these entities in different ways.

- Conveyors and sortation equipment receive destination / routing information from the WMS and leverage the WCS to divert containers to the appropriate location.
- Pick execution equipment, including picktolight, carousels, or A-frames will receive pick instructions from the WMS and rely on the WCS to control the MHE. At times, these devices will manage task distribution and user interfaces for the performance of picks, though often, the WMS will manage the tasks through prioritization, and provide a common user experience (using consistent equipment where appropriate) for work performed in the pick modules and in bulk storage which feeds it (this work would include putaways, cycle counting, and picks where appropriate). Often, a WES has been sufficient for high volume outbound operations in retail, but with increasing emphasis on service levels, the advanced functionality of a WMS specific to inventory accuracy, pick module replenishment, cross-docking, and exception handling, the WMS brings a strong justification for a two pronged approach.
- Automated guided vehicles (AGVs) and automated storage and retrieval systems (ASRS) are well established, though adoption is increasing as more forklift providers offer driverless units. These units can take direction from a WMS (typical when involved in semi-automated environments) or WES (often used in ASRS racking systems where materials are commingled or when the vehicles can follow multiple routes to alleviate congestion). In either scenario, a WMS is often utilized to manage inventory allocation to customer and order.
- Palletizers use visual determination for pallet building capabilities, but most in use require some level of consistency in product dimensions at the layer level. Advanced pallet building and robotic arm picking capabilities are increasing in use, and also require some consistency in dimensions, but improvements in digital sensing will soon be changing the game here.

Retrofitting today's supply chain with automation

Automation adoption will continue to accelerate in response to advanced service level expectations and e-commerce, with a focus on scale and speed, whereas a continued migration of margin focused businesses will drive adoption of driverless vehicles and high density storage modules, especially in cold storage or mega-cities with high volume real estate. The introduction of automation into the existing facilities will bring challenges, such as:

- Traditional footprints, system capabilities, and business processes will be challenged when faced with the introduction of conveyance, sortation, and pick execution equipment. A natural inclination to delineate businesses, and potentially create channel-specific operations, can result in artificially inflated inventory levels and/or reduced service levels in increasingly sensitive environments to failures in this area. Multi-channel capabilities can be achieved, often driving operational leaders to adopt pick execution capabilities to distribute work without recognizing the backlash to overall service levels of having disparate capabilities with traditional WMS controlled processes. The results, if not thought through, can have repercussions on inventory accuracy, exception management, and operational efficiency.
- The introduction of driverless vehicles (AGV or ASRS) offer strong advantages in terms of scale and cost, ROI projections in union environments can often deliver break even points less than a year after go live, even in new projects. However, legacy storage equipment and material flow can introduce limitations. The environments best

prepared for the introduction of driverless forklifts are those managing full pallets in bulk locations (where dimensions are predictable and stack requirements are well documented), or those where racking capacity is capable of managing fixed locations that can be tracked in the WMS (if locations can be dedicated to a specific lot), or in the WCS (where multiple pallet locations can be managed by the WCS but the WMS can manage storage/allocation in concert with non-automated areas). In more complex operations, the WCS can take a more active role in determining work and allocation, but this often drives customization and redundancy with WMS functions specific to the needs of the business.

- More robust, piece level management in advanced pick modules controlled by ASRS such as goods-to-person automation, offer advanced capabilities for high volume distributors and e-tailers. Often, this will require tote storage of product to standardize the storage capabilities, though concessions for non-conveyables must be considered. Integrating pick and pack operations with traditional areas of the same operation also force decisions on how to integrate inventory management with shipping capabilities, adding complexity to projects as WMS and WCS providers offer similar capabilities.

Disruptive technologies

Perhaps the most exciting technologies driving next generation warehouse automation will be by-products of innovation occurring in other areas. Some technologies to consider include driverless cars, drones, image recognition technologies, the Internet of Things, and Machine Learning.

- **Driverless cars** –Technologies employed by driverless vehicles have long been employed by automation providers in order to promote safety. Sensors causing vehicles to slow or respond are standard in AGVs today. However, advancements in route optimization, like Google Maps, suggest a future state of continuous optimization in warehouse automation. Advances are likely in WMS that will provide a basic level of route optimization to better direct automated and non-automated vehicles, whereas WCS providers take this a step further with algorithms in three dimensions that optimize travel through storage grids that allow multiple points of entry/exit, but only for fully automated environments.
- **Drones** – A variety of uses for drones have been explored in warehousing - as well as in transportation. The most attractive uses of drones in warehousing today focus on inventory verification (e.g. cycle counting), or asset verification (e.g. yard audits). Stability and control mechanisms are the primary concern with drones at this point, though image recognition technology will alleviate most of that concern in the yard and eventually in the warehouse.
- **Image recognition technology** – Intelligent recognition of photo and video feed is available today, though many of the use cases that will leverage this technology in supply chain are still developing. There is an anticipation that shelf monitoring in stores (as a component of a broader Internet of Things evolution) will drive this evolution, with barcode recognition allowing drone based cycle counting, pallet selection in multi-slot locations, and even robotic arm picking in commingled totes. Investment in this area will likely come across the board from peripheral providers (in addition to augmented reality) as well as from WCS providers who will fully integrate the solution with their robotics.
- **The Internet of Things** – Widespread recognition of product location in a facility will become more pervasive as Bluetooth location technology, image recognition, and advanced robotics continue to mature. The use of IoT in a warehouse will change the way that inventory management, task management, and vehicle routing are understood.
- **Machine Learning** – Finally, advanced analytics and machine learning will continue to evolve, leveraging ever more information available from IoT in order to continuously drive optimization through stock location assignments and vehicle routing recommendations. The roadmap for machine learning will embrace both internal and external factors including weather, forecasts, marketing promotions, and port and road traffic congestion.

Digitalization and next generation capabilities

Many of the challenges currently complicating the adoption of automation suggest areas of focus for the next generation of capabilities that will be brought to market. The WMS market will focus largely on those areas that optimize semi-automated facilities (i.e. where the improvements can increase efficiency of manual, automated, or combined operations), whereas the WES/WCS market will focus on increased efficiencies or speed to market advancements that improve the justification of the automation equipment's adoption.

- **Dynamic Task Management** – System optimization today largely depends on committing plans for inventory and tasks based on what is known at the time the system is generating those tasks. However, real time optimization can, and should, consider a broader set of variables. This will allow the system to determine the optimal pick or storage locations, inventory, and travel path, at the time the work will be performed, considering engineered expected times, shelf life requirements, and appointment times. Parlaying the advancements in individual assignments, interleaved task algorithms will deliver optimal work assignments for multi-task instructions, re-calculating sets of individual optimizations into a single, comprehensive one. In automation, this could even be considered while work is in progress as congestion is encountered or as tasks are added or updated, triggering a re-evaluation of potential tasks for a re-optimized solution.
- **Load building** – Transportation optimization tools already perform basic truck and pallet building, some with advanced capabilities around stacking and weight distribution requirements. Increased attention to iterative optimization and asset utilization will continue to drive these capabilities, converging with automated picking capabilities to bring a comprehensive automated picking and loading solution to the marketplace also capable of driving the same results from manual operations.
- **Traffic management** - Currently, XYZ coordinates and equipment speed are considered in best of breed applications when identifying storage locations and dock door recommendations, but step by step information related to travel sequence and directions is needed to better guide driverless vehicles, and these capabilities will likely evolve in WMS. This capability will drive efficiency in manual operations as well, with systemic understanding of congestion avoidance options delivering recommendations to the drivers (or robots) in real time. These additional considerations will also be valuable to machine learning, where insights can be evaluated for facility design improvements, business process changes, or re-warehousing.

Conclusion

The benefits expected from advances in the market to promote automation adoption will not be realized solely through automation. Manual and semi-automated operations also have much to gain. Dynamic task management offers tremendous opportunities in large facilities to increase workforce efficiency, regardless of automation levels. Image recognition technologies will improve pick efficiencies and accuracy, improving service levels to customers at the same time. Traffic management introduces opportunities to drive efficiency and avenues to motivate the workforce through gamification. But, perhaps the greatest promise is inherent in the shift to a real-time optimization paradigm, where systems can recognize and correct inefficiency through machine learning, or even anticipate environmental changes affecting buying habits or material flows, and react to address potential risks of disruption in our increasingly digitized world.

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