

OPTIMIZE AS/RS WITH ADVANCED WAREHOUSE EXECUTION SOFTWARE

How Data Science Techniques Are Enhancing System Performance
and Enabling Fulfillment Strategy Configurability

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ABSTRACT

Today, many distribution and fulfillment (D&F) operations are adopting automated storage and retrieval systems (AS/RS) to address a variety of e-commerce and omnichannel retail market challenges. As the labor shortage continues to grow, wages rise and service levels become more demanding, AS/RS are helping site managers to reduce their reliance on manual labor and transition to more automated processes.

With its flexible, scalable construction and smart use of available vertical space, an AS/RS is often a logical investment for operations seeking to maximize the utilization of existing facilities and avoid expansion costs. In the race to meet escalating order fulfillment requirements — with higher throughput rates, more SKUs and shorter cycle times — AS/RS delivers much needed fulfillment bandwidth and accuracy.

Although AS/RS impacts are immediate, many operations often encounter limits in achieving continual process improvements. This is often because most AS/RS solutions lack the tools to effectively manage system complexities or maximize its benefits for peak effectiveness.

For example, a typical AS/RS solution requires the precise orchestration of hundreds of shuttles and/or storage and retrieval (S/R) machines across numerous aisles and vertical lifts. In this interdependent system, every function, action or decision — to retrieve and replenish inventory or deliver a tote to a specific goods-to-person (GTP) station — can impact other parts of the system and create a variety of unintended consequences, including:

- Imbalanced workloads
- Unnecessary bottlenecks and congestion
- Low system utilization and/or efficiencies
- Missed customer service level agreements (SLAs)

And if a specific set of SKUs is stored only in one location, then that aisle or level can quickly become a bottleneck as multiple S/R units converge to retrieve items for various orders. This congestion could potentially reduce AS/RS operating speeds and throttle overall throughput rates.

This paper will explore how AS/RS and GTP technologies, coupled with advanced warehouse execution system (WES) software, can precisely orchestrate S/R activities to increase system utilization, responsiveness and throughput rates.

INTELLIGENT WES SOFTWARE DRIVES AS/RS OPTIMIZATION

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The key to effective AS/RS automation lies within a system's ability to continually process live data and make the most optimal storage, retrieval and GTP station routing decisions. The latest generation of WES software is leveraging advanced analytics and data science techniques – such as machine-learning (ML) algorithms and artificial intelligence (AI) – to make intelligent AS/RS decisions that support an operation's throughput and system responsiveness goals.



Momentum WES software from Honeywell Intelligrated is engineered to address modern fulfillment complexities, deliver performance improvements, and coordinate activities among all automated systems and resources within the four walls of a distribution center (DC). By leveraging advanced ML algorithms and AI techniques in a powerful data science engine called Decision Intelligence, Momentum WES provides the dynamic real-time decision-making capabilities that give D&F operators a robust toolset for maximizing the effectiveness of AS/RS and GTP station processes.

ENSURE ITEM AVAILABILITY

Storing a particular SKU in one location of the AS/RS creates the potential for system bottlenecks, fulfillment delays and even order cancellations. Typically, these problems arise when a storage aisle or vertical level becomes inaccessible due to a shuttle, S/R machine fault or unplanned maintenance.

WES software mitigates the possibility of bottlenecks by intelligently placing SKU containers in multiple storage locations. This strategy creates inventory redundancy that helps to eliminate single points of failure, reduce the potential for bottlenecks, and allow multiple points of access for identical SKUs.

INCREASE STORAGE DENSITY

The practice of using uniform storage bin profiles for product cartons of different sizes can result in poor space utilization, which could ultimately reduce total system storage density. ML algorithms in modern WES software are now capable of maximizing AS/RS storage density by evaluating the profiles of available storage locations against incoming carton sizes to make the most optimum allocation decisions.

But making these inventory allocation decisions requires accounting for a variety of unknown variables, including:

- Various box sizes that will be introduced into inventory over the coming days and weeks
- Inventory locations that will be available based on demand for specific items
- The precise sequence and timing of when new inventory will arrive

Given the SKU profiles, container sizes and available storage locations, advanced data analytics can weigh the probabilities of locations becoming available against the potential sizes of unknown, incoming inventory profiles. By evaluating all these factors, WES software can make more accurate inventory planning assessments and determine the best possible storage location based on a container's dimensions — all of which ensures maximum AS/RS storage space utilization and the least amount of wasted storage space.

OPTIMIZING INVENTORY RETRIEVAL AND/OR THROUGHPUT RATES

One of the most important objectives of any AS/RS is to improve inventory retrieval, which in turn should lead to increased system throughput rates. But retrieval efficacy is intrinsically tied to storage density strategies, often requiring operators to strike a balance between these two factors:

- **Pick cleans** — refers to the practice of emptying all inventory from one location to make room for new inventory
- **Throughput speed** — focuses on the goal of maximizing throughput, regardless of its impacts on inventory

In modern WES software, advanced ML algorithms can be configured to accomplish either objective, which would impact the way inventory is retrieved to meet demand. Essentially, end users decide which factor takes precedence, and then leave it to the algorithm to achieve the most optimized balance between them.

Consider a typical D&F scenario where an operation receives a large order of multiple SKUs with break-pack quantities. The software needs to decide how to fulfill the order, selecting from varying levels of inventory allocated in multiple storage locations and different inventory levels per individual totes. The order could be filled fastest by pulling from fewer totes containing residual inventory or it could make room for new inventory by selecting from a larger number of totes that result in pick cleans.

In the Momentum WES software, Decision Intelligence provides the flexibility and configurability to achieve an operation's particular objective — whether that means favoring speed over pick cleans, pick cleans over speed, or some balance of the two. And in instances when an S/R machine is faulted, the software automatically responds by planning inventory retrieval from other available locations.

ALLOCATE AND RELEASE ORDERS MORE EFFICIENTLY

When an AS/RS receives orders from a host system, the most common method to generate fulfillment allocation tasks is first in, first out (FIFO). But with dynamic and ever-changing order priorities, this method does not always guarantee the most effective order allocation strategy. Instead of evaluating incoming orders myopically on a per-order basis, WES software can process all incoming orders and determine how to allocate them most efficiently.

This holistic approach allows the WES software to dynamically consider *SKU affinity*, or the practice of retrieving enough inventory of common SKUs at one time to fulfill multiple orders. The same concept also applies to releasing orders to individual GTP stations in accordance with various order priorities.

To achieve this, advanced ML algorithms — such as those in Momentum WES with Decision Intelligence — can be configured to determine the priority of all incoming orders, allocate them in the system, and then release them accordingly to available GTP stations.

For orders with SKU affinity, donor totes are sent to a single GTP station, instead of dispersing them inefficiently across multiple stations. The data science engine also factors in the capacity of any given GTP station to determine the best options for completing an order. Benefits of this methodology include:

- Tracking the current amount of work at a GTP station and how much work is en route to automatically make the best capacity management decisions
- Preventing over-congestion or under-utilization of resources among all available GTP stations
- Creating the most optimal pacing of workloads for each GTP station operator
- Shortening the order cycle time

SMART INVENTORY REPLENISHMENT OPTIMIZATION

Many AS/RS solutions with GTP capabilities also utilize decanting stations to replenish items back into storage. For the most effective GTP station order consolidation, totes are typically divided into multiple compartments and filled with SKUs of various sizes. But this adds complexity to replenishment processes.

Modern WES software can calculate the volume, dimensions and maximum weight of totes and their compartments for various SKU profiles to determine the optimal quantities of items to be replenished. In Momentum WES, an intuitive interface guides the operator through this process. To facilitate efficient replenishment, Momentum WES instructs operators to pull items from donor totes and divide them accordingly into different totes, compartments and storage locations.

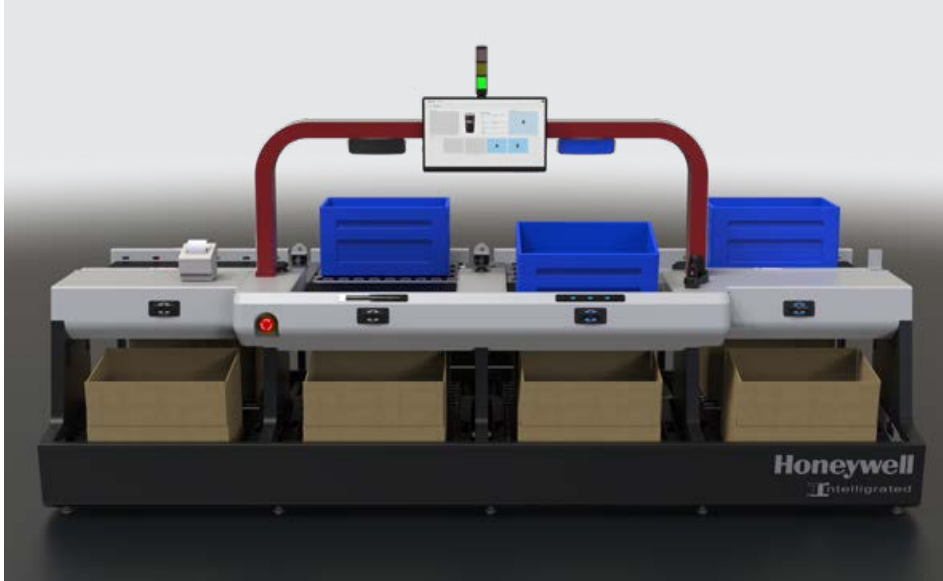
CONCLUSION

| Partner With an Expert to Optimize AS/RS

AS/RS solutions with integrated GTP stations have become essential tools for companies seeking to maximize their existing DC footprints and address growing labor challenges. But properly operating and managing these powerful automation tools require the assistance of advanced warehouse automation and execution software.

Momentum WES from Honeywell Intelligrated is designed with Decision Intelligence to optimize the performance of AS/RS shuttles, GTP and decant stations in complex e-fulfillment operations. We can configure ML algorithms to meet your specific optimization goals — whether that's higher throughput custom inventory rules or utilization preferences.

With the Momentum software suite, you can access all your warehouse automation software within one platform, simplifying operations while utilizing only the functionality needed to achieve your operational goals. Contact our experts to learn more about optimizing your AS/RS and GTP stations with Momentum WES.



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