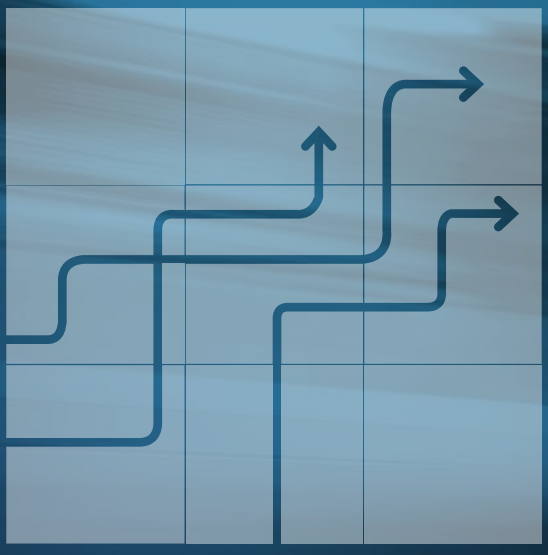
WHITE PAPER

Secrets of the Smart Warehouse

Ten ways to think smarter about distribution center design.



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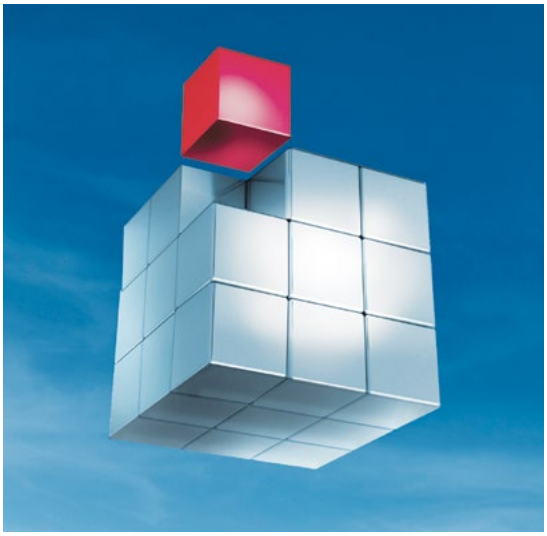
Introduction

The Rubik's Cube offers 43 quintillion possible arrangements of its pieces in search of a solution. Another type of 3-D mechanical puzzle is the distribution center (DC) "cube" or "box." While its permutations do not extend to the nth power, they are nevertheless considerable, as the combination of architecture, mechanical systems, controls and software lead to decision-making conundrums squared and cubed.

Whether addressing the Rubik's Cube riddle or the DC puzzle, the use of mathematical algorithms is key to finding a correct solution. With the latter, however, it requires more than the consistent application of complex calculations. Unlike the Rubik's Cube, the DC is dynamic, with the need to adapt to changing market opportunities, competitive pressures, product mix, technology and other variables, especially those unforeseen. Data-driven analysis and metrics alone are insufficient. They must be tempered with experience in the day-to-day operation of a distribution center and its all too surprising vagaries.



Is there an optimum DC design? Perhaps there is in the theoretical. However, many experts in this field would argue convincingly that the optimum solution is a distribution system fully meeting current operational requirements while offering flexibility and scalability to quickly and relatively inexpensively exploit market opportunities and adapt to customer demands. In other words, a "smart warehouse."

This paper will review four functional areas: situation assessment; planning and design; workflow considerations; and health, safety and environment (HSE) issues – which are key to smart warehouse design and operation.

Situation Assessment

Balancing Analytics With the Anecdotal

Computer power has unquestionably had a profound effect on all aspects of human life. In the business arena, an entire school of management thought arose relying exclusively on statistical modeling for decision-making processes. Known as the "Whiz Kids," this generation of executives created some of the most spectacular calamities in American business history. Their mistake was obvious: the application of one-dimensional static models in a dynamic environment will ultimately lead to failure.

Certainly, an exhaustive collection of warehouse fulfillment data along with objective analyses is an essential first step in comprehensively evaluating current warehouse systems and performance. As one needs clay to make bricks, so must one have data to establish benchmarks and metrics. These are critical in projecting future operational requirements as well as for assessing current fulfillment capabilities.

Collecting and analyzing data, important as they are, form only a part of the assessment puzzle. Gathering input from all stakeholders from every level of the organization puts flesh on the bare bones of statistical data. To obtain a more complete picture of a system's efficiency – from inventory, order accuracy and operational metrics to the efficiency of automated material handling systems and related software – seek the objective counsel of supply chain experts who can make informed observations about the operation of your distribution system, and talk with the people who live with it and use it every day.

Balancing computer-driven statistical data with human experience will expose the disparities between the numbers and observed realities, thus ensuring that a truer, real-world picture is captured during the assessment phase. Algorithms alone will not solve your distribution center puzzle.

Planning and Design

Design for the Future While Building for Today

Common wisdom advises not to buy more house than you need. Good advice, unless you are a growing family with designs of fielding your own hockey team in the not too distant future. This same caveat applies to the design and construction of your distribution "house." Build only what you need today but with an eye toward future growth.

It is tempting to overbuild a warehouse system in terms of both capacity and capability. Managers are by nature optimistic that growth goals will be exceeded sooner rather than later. But overcommitting precious capital to a future state not yet achievable is a questionable business decision. A more pragmatic approach that minimizes initial investments while hedging against an uncertain future of growth may be a wiser course of action – and one that frees up capital for other opportunities.

The answer is to design a DC that is both flexible and scalable to cost effectively accommodate future growth and advances in technology. It requires foresight and forward thinking to successfully converge equipment, software, people and processes in an expanded "house." This can be achieved largely by modular design. For example, one company had a five-year growth plan to expand from 10,000 SKUs to 30,000 SKUs. But instead of planning to handle 30,000 SKUs from the outset, their facility was cleverly designed to expand for incremental growth through the use of flexible components, like a multi-tiered, walk-back pick module that could be expanded to accommodate additional SKUs over time. This type of thinking helps avoid over investment and capital costs, yet considers optimum material flow for current operations while laying the groundwork for successful future expansion. Equally important is that the DC design included the plans to enable implementation of incremental capacity expansion without disturbing ongoing fulfillment operations.

Take Exceptions Off-Line

"Special orders don't upset us." Really? Well, they should, because if you've designed a system to handle every possible ordering request, then you've almost certainly over-designed it. And this means added costs and complexities. Exceptions are just that: exceptional. Seasonal workflows to include customized gift-wrap stations, extraordinary expediting, highly specialized or sensitive customer requests or accommodations, etc., are best and most cost effectively addressed off-line. Your distribution system is at maximum efficiency when it is fully applied to its primary mission: mainline material flow.

A Warehouse Control System (WCS) – The Real Brains of the Operation

Manager frustration with expensive upgrade paths for warehouse management system (WMS), the lack of communication between system, and the inability to generate real-time views of DC performance have led to the development of powerful warehouse control system (WCS) middleware. A real-time, bidirectional interface capable of connecting all warehouse systems, WCS software operates as a service bus, providing connection and information routing capabilities that link disparate software and automation systems so they perform as a single unit. Using easily configured adapters or agents, WCS software permits new islands of automation to be quickly and simply deployed and fully integrated when needed.

Placing WCS software at the center of the system architecture creates a single point of integration for all systems. Removing the WMS from the middle of the system's architecture eliminates the need for multiple, complex integrations and custom hard-coding when the WMS is upgraded to a newer version.

For these reasons, choosing and implementing a WCS is as important as the material handling automation system itself. WCS software delivers tangible economic and efficiency benefits, including:

- Reduction in WMS modifications and customization
- Enhanced, real-time reporting and metrics capabilities
- Real-time communication between disparate systems
- Long-term scalability of operational systems

Let It Flow: De-Bottlenecking

The bane of all process systems – from chemical and pharmaceutical manufacture to order fulfillment – is the bottleneck. Processors spend considerable effort to avoid them in system design and even more time and money when they inevitably occur in the real world. When designing a new automation system, it's important to realize that the maximum throughput is only as great as the most constrained point in the system. Identify the most constrained point and plan in advance ways to improve throughput. This will likely require planning ways to reduce overall congestion, such as placing "early-out" locations to expedite material flow direct to packing. The ultimate goal is to make use of dynamic routing alternatives to work around congested processing areas, improve throughput and reduce the order's time in the system. Similarly, when upgrading existing material handling systems, take a close look at the underperforming components in your material handling system; focus on ways to improve material flows and remove current and potential bottlenecks.

Workflow Considerations

Catching the Wave

Experienced surfers have developed a sixth sense when it comes to anticipating the rhythm of the waves. In a similar way, warehouse managers can use data to predict order "waves." Also known as wave picking, it is an application of short interval scheduling to assign the workload into intervals (i.e., waves). This enables management to coordinate the several parallel and sequential activities needed to complete the task. The wave data includes the workload by function (e.g., case picking, repack picking, pallet movement, pick position replenishment, etc.). This provides management with the information to calculate staff requirements and assign staff by function, with the expectation that the work in each function and within each wave can be started and completed at about the same time.

In other words, the way product is released to the floor plays an important part in the successful distribution system operation. Are all picking stations working at equal capacity? Are replenishment activities happening in parallel to support product availability? And, are recirculation plans in place to allow congested zones to catch up? Because even with the most thorough waving system, there will inevitably be out-of-balance situations where recirculation loops will need to be in place. These are all questions that automation system data or simulator run-through data can be used to answer. Use these results to achieve ideal wave picking scenarios by grouping orders in such a way that tasks are most effectively distributed to the warehouse floor. Rely on this data to understand pick zone capacity and release orders to match. Finally, build in bypass capability where needed, and re-route or recirculate materials until capacity becomes available again.

Inventory Allocations: When Procrastination Is a Good Thing

All our lives we're taught to be on time or, better yet, to be early in keeping appointments or handing in assignments. Generally good advice, except when it comes to inventory allocation decisions with automated order fulfillment systems. In this case, a little tardiness can be a good thing. Inventory replenishment/transfer allocation decisions should be made as late as possible based upon a real-time view of order requirements and inventory levels.

One of the quickest ways to frustrate customers is to not have inventory on hand to fulfill their orders. What's worse is having inventory on hand but not using it for rush orders because of hard allocations to other orders already in the queue. Unfortunately, this can happen with many inventory allocation processes where inventory is blocked from being picked prematurely. Delaying allocation provides the time needed to balance the most current order data with total inventory levels throughout the system (both picking and bulk locations). This information will enable the operator to better avoid the most commonly perplexing problem – the inability to fulfill orders because inventory in pick locations has been blocked for orders that have not been released for picking.

Similarly, with automated material handling systems, postponing the decision-making until the last-possible second provides advantages. For example, consider an automated put-to-store system in which product is inducted to a conveyor system and is diverted to the appropriate sort zone. The decision to divert each case is typically made at the point of induction. However, by delaying the decision, a robust WCS can consider the workload balance across each sort zone in its decision-making process, thereby improving the overall performance of the system and the employees who perform the put-to-store tasks.

Continuously Revisit Slotting

Slotting would be a simple matter in a static fulfillment model. But products change and demand fluctuates – constantly. Continuous vigilance and decisive responses are imperative for operation efficiency and customer satisfaction.

Warehouse operations managers should continuously evaluate slotting strategies to ensure alignment with changing business models. Slotting is subject to change due to differing product life cycles, new SKU introductions and their subsequent impact on replenishment frequencies. Periodic, careful review of inventory slotting, replenishment frequency and other relevant reports will reveal if items are slotted most effectively. With this data, you can determine replenishment frequency and have a clearer view of days on hand inventory allocations. It will also help to contain the footprint of the slotting area as obsolete items are pruned to make room for new, high-demand products.

The ultimate goal is to create balance between replenishment and picking efficiency by having the correct inventory available on hand and slotted correctly. And by retaining the smallest practical footprint, the distance travelled by personnel can be minimized to achieve fulfillment efficiencies.

Human Factors

The Human Element

“People are our most important asset.” Do we really believe that, or is it only a gauzy platitude? Do we take health, safety and environment workforce issues seriously, or merely pay lip service to them?

Keeping human factors top-of-mind when designing a DC is critical to the development and retention of a conscientious, invigorated workforce. Does the facility have sufficient lighting and ventilation with ergonomic equipment and flooring materials, comfortable overhead conveyor clearances, etc.? How clean is it? Are we in compliance with all industry and governmental safety standards? Are goods slotted to optimize picking workflows and minimize the pickers’ travel distance? Are handling weights and girths within the capability of the staff? All aspects of the working environment should be evaluated in terms of the health and safety of the employees. They really are the most important asset in maximizing the return on investment of the fulfillment system.

And finally, don’t underestimate the importance of cross-training employees in warehouse operations. Like the facility and material handling equipment, the workforce should be flexible and scalable to adapt to changing conditions and seasonal demands. The payback will be a more energized workforce, better prepared to implement change and accommodate material flow fluctuations.

Location Really Does Matter

DC location has become a science unto itself. Optimal single or multiple facility locations based on latitude/longitude for each demand point, as well as weight factors such as pound miles, total number of shipments, cost of living index, labor costs, etc., are well understood and statistically verifiable. But perhaps the most important if not most overlooked factor is the human element in the equation.

Is the prospective location capable of providing a workforce with the requisite skills to consistently accomplish the facility’s mission? Is there a sufficient pool of people to accommodate expansion and expected attrition, even if other DC operations are established in the same vicinity? Equally important, is local managerial talent available?
Is the area vibrant enough to attract key transplant employees and their families?

Summary

When confronting the many issues related to DC design and operation, the algorithms alone are insufficient in determining an optimal solution. Like the Rubik's Cube – where a seemingly infinite combination of decisions can lead to solving the puzzle – DC planning and design requires a strategic approach and careful consideration from multiple angles. To be sure, flexibility and scalability must be integral to DC design in order to achieve the perfect balance between initial investment and future expandability. And without an objective blueprint for design, operators can fall into the trap of designing around the promise of a material handling equipment brand rather than blending the ideal equipment, WMS, WCS and associated technologies according to the specific demands of each company's unique distribution model.

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Why FORTE

Single-Source Accountability

Whether we're helping you develop a strategic plan, design and build a distribution facility or optimize a distribution operation through performance metrics and analytics, FORTE provides a true single point of contact responsible for the complete performance of your distribution network. No finger pointing. No fragmentation of responsibility. No multiple suppliers for technical support. You have performance goals, and it's our job to make sure they're met on an ongoing basis.

Total Objectivity

We don't manufacture equipment. We don't develop WMS software. We don't have commercial arrangements with any suppliers for expected volumes of business. We're simply interested in delivering the most efficient distribution solutions at the lowest total cost. Our client-side service approach means our only allegiance is to our customers. So with every engagement, you know we'll choose the most appropriate level and blend of technologies integrated into an effective operational system.

Expertise

Our team is deeply rooted in the hands-on implementation of DC design and warehouse automation. FORTE's engineers and technicians integrate today's best practices in supply chain management and DC operations while developing next-generation technologies. As a result, our solutions employ the best combination of practical advice, data-driven analysis and technology-enabled systems. With FORTE, you get:

- More accountability than a consultant
- More experience than a systems integrator
- More objectivity than a manufacturer