Think “inside the box”!
Use your distribution center as a secret weapon

Do you regard your distribution center as a “box” that collects inventory or as a potential strategic weapon in your supply chain arsenal?

Distribution centers often make the difference between a merely adequate supply chain and one that gives your company a business edge.

Benchmarking drives performance
To the outsider, receiving, storing, picking, packing and shipping may appear to be straightforward and mundane tasks. Logistics professionals, however, know that doing them well, saving their company money, and providing excellent service to customers require rigorous attention to detail and continuously looking for ways to improve the operation. Exploring new approaches, benchmarking what other companies are doing, evaluating trends, identifying best practices, and incorporating them into your operation enables you to leverage your distribution center in a way that optimizes your supply chain’s performance.

Metrics of areas of focus should include labor efficiency, picking productivity, storage density, order turnaround time, inventory accuracy and overall building throughput capacity. This paper outlines some trends and best practices targeted to addressing these and other common challenges companies face in their distribution centers.

The “ideal warehouse” drives the unit cost of fulfillment as low as possible
The outbound side of a distribution operation focuses on order fulfillment and shipments to customers. Customer orders can encompass a wide range of goods and configurations that have a major impact on picking methods and labor content. Up to half of a traditional facility’s labor is dedicated to picking orders, and that percentage is even greater in centers focusing on e-commerce.

The ideal warehouse design includes a mix of various storage and picking technologies, as well as material handling equipment to reduce operating costs and drive the cost of unit fulfillment as low as possible.
Automated cross-docks
At the low end of the labor content spectrum are highly automated cross-docking facilities. They contain extensive integrated conveyor systems that enable a dock-to-dock flow without human intervention, connecting receiving docks and shipping docks with “sortation” in between. In these systems, labeled cartons are automatically scanned and diverted from inbound trailers to outbound trailers. Typically such cross-dock distribution centers link merchandise suppliers with retailers’ stores.

More manual operations have higher operating costs but can handle wide variations in activity and product mixes. They are a less risky approach when there is high need for flexibility or when the business planning horizon is only a few years into the future.

Designing an efficient picking system
Proper product slotting can reduce handling and travel distances as items are placed in storage areas and picking areas according to popularity or velocity.

The ideal approach to designing an efficient picking system is to minimize the distance a picker has to travel to get to the product, which can consume up to 50 to 70 percent of his/her work day.

In placing items for maximum efficiency, consider that:

- Full pallet picks are performed with lift trucks, either from racks or floor storage locations. In extremely high volume situations, such as beverage warehousing, lift trucks can be configured to handle multiple pallets simultaneously.

- Case picking can be performed from traditional reserve storage locations or forward pick areas. Pickers’ travel distances are less in a forward pick line, while replenishment labor is eliminated by picking from reserve. Factors that impact the decision include cubic volume per pick (aka pick/replenishment ratio) and the number of active “case pick” SKUs. In many instances the optimal solution involves fixed forward pick positions for the most frequently picked SKUs, with dynamic locations for the other items—only that day’s SKUs and quantity are replenished; these locations are picked clean by day’s end.

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Automatic labeling
Often a “print and apply” labeling system is used to automatically label the cartons with the ship-to address—again, without human intervention. The suppliers of goods to the retailer package store orders into cases, apply a unique tracking label to the case, and then ship to the cross-dock distribution center. This cycle is repeated on a large scale as trailer loads from multiple suppliers are unloaded, sorted and reloading onto store specific trailers.

Vary pallet loads
Traditional distribution centers inventory product in pallet load form and serve as stocking buffers to cover production lead times, optimize transportation costs and account for demand fluctuations. These facilities employ a variety of technologies to enable full pallet, full case, and piece (broken case) picking. There is typically a mix of all three types in a particular facility, although the amount of each can vary.

The speed of balancing mechanization vs. the flexibility of labor
In today’s just-in-time environment, most picking is at either the case level (such as grocery store fulfillment) or the piece pick level (e-commerce fulfillment). A key-tradeoff is the balance between mechanization—with its associated capital costs—to save labor vs. flexibility and accompanying variable costs required to deal with uncertainty. Highly mechanized operations have defined limits on speed, types of goods handled and selectivity, and are designed to minimize labor.

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Picking labor time management

![Picking labor time management diagram](image_url)
Optimize piece picking

Piece picking is the most labor intensive type of picking, and several strategies and technologies have been developed to reduce the labor content. Each approach has strengths and weaknesses and a “sweet spot” where the optimization of space, capital, and labor efficiencies are realized. The best solutions include a mix of approaches tailored to each order type:

- **Picking carts** are simple devices that allow a group of small orders to be “batch” picked when a single product/SKU may be needed for several of the orders within a group. This approach can also be combined with light strips, radio frequency or voice operator interfaces to speed location recognition and picking accuracy.

- **“Put” systems** are an extension of the cart batching strategy, using equipment for racking, shelving, carousels, automated storage and retrieval systems (AS/RS or sorters) to vastly increase the batch size. A variety of sorter types handle units and can distribute product to hundreds of orders simultaneously. These include Bombay (which uses gravity to drop), tilt tray (product slides into collection chutes) and cross belt (product is powered diverted to the side).

- **“Goods to operator” technologies** literally transport product from a storage buffer to an operator work station, eliminating operator travel entirely. They can support picking individual orders or a batch picking or put system. These handling systems include horizontal or vertical carousels, small load automated storage and retrieval machines (mini-load AS/RS), and automated guided vehicle robots.

Storage density is key

Product storage is typically the largest user of space in a facility. Once again, you need to consider the trade-off between storage density and product accessibility. Product can be stored directly on the floor or in elevated racking locations. Floor storage is limited to the stackability of the product, usually about 12 to 15 feet to the top of the load. A variety of racking types can store product to higher elevations. Current fire protection guidelines allow rack storage to approximately 35 feet without in-rack sprinklers in buildings with state of the art fire protection systems.

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<th>Pallets Per Item</th>
<th>Floor Storage</th>
<th>Drive-in Racks</th>
<th>Double Deep Racks</th>
<th>Single Deep Racks</th>
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The correct application of storage technology is driven by how many pallets of an item are typically on hand. Another key factor is how fast the product ships, as smaller storage lanes are emptied faster—freeing up the locations for new product.
Determining ideal column spacing

A facility with optimal column spacing typically can be sized approximately 4 to 5 percent smaller than a building whose column space does not match the operation’s requirements. This space reduction can translate into a savings of $100,000 to $250,000 per year. But determining the optimal column spacing can be tricky. Either way, your conditions will be less than perfect for some of the time.

The best solution is to find a column spacing that works for multiple scenarios. High throughput/aisle picking operations work best with a column spacing divisible by 20 feet. Very narrow aisle (VNA) warehousing works best with a column spacing divisible by 15 feet, and reach trucks are optimized with a column spacing divisible by 18 feet. Column spacing of 60 feet meets most organizations’ needs. High throughput and VNA fit this configuration perfectly, and can be relatively easily switched back and forth. Reach trucks also work well in 60-foot columns, with efficiency only about 1 percent less than optimal.

For buildings with single side or cross-loading, these recommendations apply to the direction parallel to the dock door wall(s). The other direction is less critical, although it is often beneficial for the first bay to be as big as possible for minimum impedance to dock operations. In many new buildings, this first bay is usually designed from 60 to 90 feet wide. Keep in mind that if you locate offices over the docks—a best practice for cube utilization and effective management oversight of operations—the column spacing will need to be tighter.

Storage density varies and affects lift truck options. The lift truck has to be able to operate in the aisle as configured (typically a 6- to 12-foot range), have sufficient lift to access the product, and have adequate load handling capacity to carry the weight of the products since this capability diminishes as storage elevation increases. Traditional counter-balanced lifts require 12-foot aisles and are powered by either electricity, propane—which is falling out of favor due to emissions and noise—or the newer hydrogen cell technology. The most common type is electric and, depending on usage, is either done with conventional or rapid charging. Conventional charging on multishift operations is often supported by multiple batteries per vehicle and battery switching equipment.

Selective racking, such as single-deep arrangements, can be the tallest—over 100 feet in automated systems—but because of lower density, they require more aisles. Double deep configurations can use vehicles with a reach capability, or they can be drive-in or have pushback pallet rails. The drive-in and pushback options can be used for configurations more than two pallets deep when appropriate. Pushback racking’s limit is approximately five deep, and drive-in or drive through racking can be 10 deep or more.

The ideal storage technology minimizes aisle space while maximizing storage density and allowing the necessary product selectivity. That being the case, a 300-SKU warehouse may look significantly different than one storing 10,000 SKUs or more. The chart above depicts various storage and vehicle combinations and their relative impact on space usage.
Increasingly, decisions to improve distribution center performance are driven not by facility or material handling equipment, but by IT advances. One recent trend is the movement to massive enterprise resource planning (ERP) systems such as SAP and Oracle that run the entire company. ERPs typically replace dozens of systems that formerly supported specific areas of the company such as finance, controlling, customer service, warehouse, production, planning, allocation, retail operations and transportation.

Although this trend is a best practice from a corporate governance perspective, it’s often not optimal for the warehouse. Over the last ten years ERP systems’ warehouse management functionality has improved greatly, but for most users still does not reach the level of industry leading warehouse management system (WMS) packages. Many companies using ERPs “bolt on” a WMS to it, but that strategy can run counter to rationale behind implementing ERP: full integration and a minimal number of systems to support.

If your organization is using the ERPs WMS, there are several steps you can take to improve warehouse performance within the ERP model. First, make sure to fully leverage the warehouse control system capabilities of conveyers, sorters and other automation within the facility. Often these systems do not utilize their full capabilities when interfaced with a WMS with redundant features; but, when interfaced to an ERP, these features could be valuable in helping to control the operation.

New bearing and motor technologies have made conveyor systems quieter, more accurate and reliable, easier to program, more energy efficient and better at handling delicate products. Automated guided vehicles have advanced to where they can actually perform all of the functions of an operator-driven lift truck, including loading the trailers. AS/RS technology has been configured for pallet, case and piece handling. Warehouses that make extensive use of these technologies can operate with minimal labor staffing—the ideal of the “lights out” distribution center is within reach.

**Maximize information technology to achieve more with less**

Advances in computing power, software development and electrical controls have significantly improved the cost effectiveness of material handling automation equipment and software systems. Warehouse management systems are now being built with standardized communications modules that can easily interface with equipment. Equipment control systems have been developed with flexible, configurable designs that reduce their implementation costs and increase their effectiveness.

**These changes have made the use of automated equipment more affordable and practical at a time when labor cost increases and availability increasingly affect operating expenses.**

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**Master planning for the future**

After outgrowing its existing space for the past 25 years, a wholesale beverage distributor procured a much larger facility nearby and, with expert advisory help, developed a long-range master plan that projected future operating and storage needs, incorporating various growth and acquisition scenarios. The company then made a significant capital investment in optimized storage racking, high-speed conveyor sortation/transportation and an integrated software management solution for inventory management, warehouse slotting, receiving through shipment processing, vehicle task interleaving, conveyor system control, and label/voice picking technologies.

The conveyor control system reduced energy usage, provided advanced maintenance diagnostics, and linked vision systems employed for product flow management and product security, resulting in:

- **Fulfillment capacity was doubled at startup, and added infrastructure was put in place for additional capacity increases**
- **Automated process improved productivity and worker safety**
- **Reduced product damage and shrinkage**
- **Increased order accuracy and product traceability**
- **Ability to pursue substantial business growth opportunities**
- **Overall technology investment had a 3—4 year payback**
Distribution centers should be regarded not just as operational necessities but as competitive “secret weapons” that can improve customer service and profitability.

The keys to unleashing your full potential “within the box” are:

- Storage and picking technologies, as well as material handling equipment, have evolved rapidly—more affordable and practical today.
- Facility layout and design configuration is both an art and a science.
- Storage density is key—picking travel time is a huge productivity killer.
- Optimal column spacing can reduce your footprint by 5 percent.
- Labor Management Systems have demonstrated increases in productivity as much as 15 percent.
- Embrace improved information technology to drive efficiency and effectiveness.

Key take-aways

Also, ERPs are designed to allow program enhancements to be written without disrupting the core ERP functionality or negatively impacting upgradability. This has been a historic problem with WMSs and is the reason some operations are using 5- to 10-year-old versions of WMS packages. Consider having programs or transactions developed to address areas where your ERP doesn’t fully support the distribution operation.

Regardless of the level of mechanization in a facility, your employees are the most critical resource to ensure that your operation runs at peak efficiency. Labor Management Systems (LMS) are being increasingly used to schedule, direct, measure, incentivize and monitor distribution center workers. Results vary, but it’s not unusual to see a 15 percent productivity gain after implementing an LMS and potentially 10 percent more with an added incentives program. Many top tier WMSs have an optional LMS component. In addition, there are a number of specialized LMS packages that some companies prefer to the WMS solution, or for use where WMS is not an option.

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