



White Paper

Profitable Distribution System Design – Part I

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Basic Design Principles

In today's competitive world of distribution and logistics, there is mounting pressure for industry professionals to accomplish more with less, to increase order accuracy and employee productivity, and to do so within a shrinking work window with fewer employees.

Simply implementing expensive systems doesn't guarantee success. Success is based on system performance in terms of return on investment (ROI). In this whitepaper, we discuss the principles of good distribution system design and best practices of high performing distribution centers (DCs), including data analysis and review of logistics and selection of appropriate storage media to meet operational needs.

Basic Design Principles

Begin with the End in Mind: What does your system ultimately need to accomplish? Define the system goals up-front and focus the design effort to meet those goals. Is your goal same day shipping, 99.9% accuracy, 20% reduced labor content, or something else? Set objectives and be prepared to take measurements to evaluate progress.

Identify and Measure Key Business Drivers: Key business drivers include, but are not limited to, current and projected sales, SKU growth, inventory levels and turns, and order processing time. . A distribution system designed for a business forecasting flat sales growth will look very different than one for an operation planning 20% per year compounded growth.

Set Operational Objectives: Once your business drivers are assessed, set the operational objectives or (quantitative metrics that define system needs and performance objectives). Common measurements include: system throughput (orders and lines processed in a specific time frame); labor productivity to accomplish the order/line volume expectations; and quality (order and inventory accuracy).

Devise an Evaluation Methodology: Once operational objectives have been established, it's time to collect relevant data to measure progress. Information pertinent to order and SKU dynamics needs to be analyzed and process alternatives evaluated to identify optimal solution(s) for your operation.

For example, a typical catalog operation, which averages 1-2 lines per order and requires same day shipping, lends itself to a pick-pack operation, where the order filler picks directly into the shipping container. A manufacturer or major retailer consistently processing orders with a larger number of line items and quantities per line may find a multi-zone pick and consolidation operation more practical.

Data Analysis...The Devil is in the Data

Data-driven designs typically out-perform other operations, by requiring less capital, and resulting in better ROI. During data analysis, remember that averages are useful, but can be very dangerous. If your business is seasonal and/or experiences cyclical trends (daily/weekly/monthly), planning to averages will most likely yield a design that works very well except at the times you need it to perform the most.

The type of data that you need to evaluate includes the following:

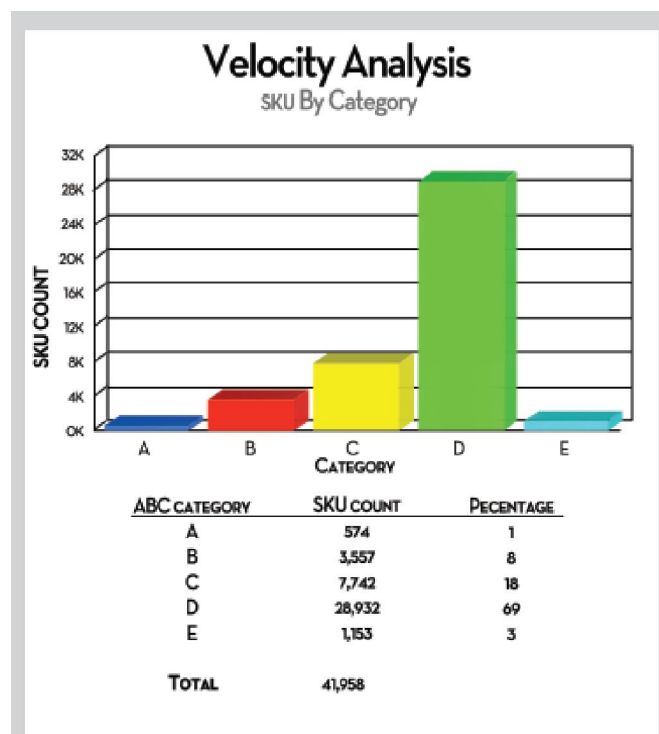
Order Profiling: Analyze daily order and associated line activity for a twelve-month period. This will capture seasonal/cyclical trends as well as unusual spikes. Prepare a stratification of orders by line count to identify order size patterns. For example, if most orders may have a low line count, like 1-3 lines, while a minority could have 75+ lines. Clearly, an alternative operating approach could be used for order profiles on either end of the spectrum.

It is also helpful to compute the variance of the daily and cyclical trends by calculating the standard deviation (Std Dev) of the variables. Generally speaking, one Std Dev will account for approximately 84% of the observed activity (this takes into account the entire left side of a bell shaped distribution curve). Two Std Devs cover nearly 97% and 3 Std Dev, 99% of all the observed activities. Designing with 1-2 Std Devs in mind will usually yield a system that functions well through non-peak and peak times, and require additional resources only during the highest spikes.

Pareto analysis (80-20 principle) is helpful for understanding correlations between the percent of lines and SKUs, which leads to the next data analysis step.

SKU Velocity: This analysis divides SKUs into categories "A" through "E", based on "hit-rate" (the number of times a SKU appears on an order). "A" SKUs represent the fastest moving products, while "D" SKUs represent the slowest. Tabulate the lines/units processed by category, to measure the percent of volume each group represents.

"E" SKUs are those that have on-hand inventory, but no activity in the twelve-month period analyzed. These SKUs typically represent dead inventory and should be closely scrutinized as to how they should be stored, if kept at all.



Calculating inventory in terms of “days on hand” (typically an average calculation), will help identify any significant opportunities, to shrink obsolete inventory. Managing inventory by category will result in reduced space and storage needs, while increasing inventory turns and freeing up vital business capital.

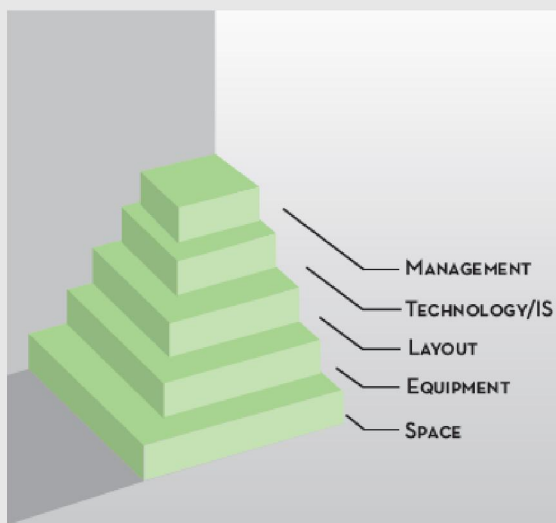
Cross Profiling: A cross profile analysis, where the correlation between the SKU velocity categories and the percent of completed orders is analyzed, can help minimize the investment in automation, while maximizing system throughput and productivity. Orders that have SKUs in multiple categories might be started in a “Warehouse within a Warehouse” (WWAW), then routed and/or consolidated with picks from other areas in the DC.

If one SKU category comprises over 80% of the total orders processed, this might be an indication that there are many 1-2 line item orders being processed from this group. In this case, a WAWW concept, where mechanization and/or automation is used in an area/zone where this SKU group is stored, picked and delivered to the shipping area, may be useful.

Review Logistics

Make a List, Check it Twice

Time and time again, operational challenges and hence, improvement opportunities, can be categorized into five main areas of distribution operations, as summarized in the following diagram:



Space: In the majority of DCs, storage media should occupy no more than 25-30% of the available building footprint. Many variables affect the amount of space needed for a specific facility-- from on-hand inventory levels and value-add operations to product storage concepts and utilization of available cubic space.

Layout: Space and equipment should be properly configured to optimize results. Consider inventory flow from receiving through shipping to identify and streamline product movement and potential bottlenecks. Take an existing layout of your DC and overlay arrows depicting all product movements. Excessive crossed lines and reversing movements indicate wasted material handling and labor costs. Be sure to provide adequate aisles and ample room for the receiving and shipping functions.

Information Systems: Significant advancements in Warehouse Management Systems (WMS), Warehouse Control Systems (WCS) and various technologies such as Pick-To-Light (PTL), Bar codes, Radio Frequency (RF), Voice, and RFID, are creating opportunities to rethink basic operational processes to increase accuracy and productivity within the DC. Solutions that were not practical or affordable 10-15 years ago are much more cost-effective today.

Management: Even the best-designed system will not perform to expected levels if managed poorly. Evaluate your team's skill set and current management involvement to keep the process optimized.

Equipment: Many operations suffer from a lack of, or misapplication of, storage media, mechanization (e.g.; conveyor) and/or other automation. Data collection and analysis is paramount for selecting and implementing the most appropriate equipment and automation for your operations.

Storage Media – One Size Does Not Fit All

A common mistake is the generic selection and allocation of storage media in the DC (SKUs are stored in the same storage media, for example; all bins or all pallet rack, regardless of their physical characteristics, velocity or order completion correlation .

By implementing a WAWW zone, one client was able to achieve significant savings of labor and time and channel automation to key areas of the DC. This operation had over 30,000 conveyable SKUs stored in bin shelving. Non-conveyable items were stored in pallet rack. Upon analyzing the data, Fortna discovered that 6-7% of the SKUs comprised the "A" category of fast moving items, which accounted for 60-65% of all orders. After implementation, the new WAWW zone consisted of bins, carton flow, pallet flow and decked rack, to accommodate the various SKU characteristics and storage quantities. Orders now begin in the WAWW, and many travel directly to the manifest stations. Other orders are routed to the subsequent zones for completion, and are then conveyed to the manifest area.

When evaluating your operations, consider the most common storage media types and their respective application, while taking into account SKU characteristics, velocity, cube requirement and picking/stocking considerations.

Storage Media	Application
Bin Shelving	ideal for small cube, conveyable product and easily facilitates broken case picking; intermittent shelves can be adjusted independently as needed to accommodate varying product package configurations; bins can be placed in a mezzanine configuration to take advantage of the building cube.
Wire Deck/Shelf Rack	used for conveyable product, which, due to physical characteristics or pick location quantity, is not suitable for bin shelving; useful for non-conveyable product that is received and stored in less than a pallet quantity
Carton Flow Rack	used primarily for fast moving SKUs which are stored in less than pallet load quantities at the primary pick location; Replenishing product from the back while picking orders from the front of the racks allows stocking and picking functions to simultaneously occur and facilitates First In First Out (FIFO) inventory rotation; can be used for both broken case and full case picking
Pallet Flow Rack	used to house fast moving SKUs that have multiple pallets stored at the primary pick position; can be used for either full case or broken case picking, as well as for conveyable and non-conveyable product
Carousels	machine driven, part-to-picker system used to store small cube SKUs with medium velocity; also effectively used for inventory requiring high levels of security or limited access by warehouse personnel
Pallet Rack	used for storage of pallet load quantities at both primary pick locations and reserve overstock positions
Drive-In/Drive-Thru Rack	provides high-density storage for SKUs having multiple pallet quantities on hand; typically used for reserve inventory storage; full pallet quantities can be retrieved for order processing and in some instances, full case picking from the floor levels; does not effectively support FIFO inventory cycling
Pushback Rack	used to store reserve pallets for SKUs having multiple pallets on hand, but fewer than that required to justify higher density storage concepts like drive-in rack or floor stacking; Higher storage density is achieved without the use of specialized forklift equipment

We have highlighted a few cost effective areas for improving the performance of your distribution operation and hopefully given you some items to consider in light of your current distribution system. Fortna offers a process and solutions for companies seeking to improve distribution system performance. If you would like help evaluating your DC operations or implementing some of the ideas presented here, contact us for more information.

Due Process

The process of designing high-performance operations is highlighted in the illustration below



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