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## ANALYSIS: THE METHOD OF DISTRIBUTION DESIGN

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The rising costs of raw material, labor, and energy have impacted modern organizations in many ways, one of which has been to force most companies to improve the efficiency of their distribution operations in order to meet customer demands while reducing the impact of cost increases throughout the supply chain. Increased competition is squeezing inefficient operations out of business. Customers are demanding prompt, reliable, and accurate service. New equipment and technology applicable to warehouse operations continues to evolve. As a result, designing and operating a warehouse or distribution center has become much more complicated. The role of analysis in the process of distribution design is taking an increasingly crucial role in developing the most efficient and economical operation. All aspects of the business and operations must be precisely analyzed and the results properly interpreted. This article will describe the basic analytical processes involved in designing facility operations for a typical warehouse or distribution center.

The process of distribution design begins with certain fundamental questions:

- What is the mission of the warehouse – which products need to be stored, what order volume needs to be handled, etc.?
- What storage and handling equipment will be used?
- How is material received and stored?
- How should orders be picked, packed, and shipped?
- How many truck docks will be required?
- What procedures should control the operations?

- What level of staffing is required for each part of the operation?
- How much total space will be required?
- What should the layout look like?

To answer these questions, a large amount of information needs to be collected and interpreted. This interpretation and the conclusions that result are the keys to the role of analysis in distribution design.

Some of the typical data profiles that need to be collected and analyzed are as follows:

### 1. Product Characteristics

Product characteristics refer to the size and shape of the product being stored and shipped in the distribution center. These characteristics are used to determine the types of storage methods and modules suitable for different products. For example, palletized loads with good stackability can be stored on the floor or in pallet rack sections. Pallet loads with poor stackability, however, are not as suitable for floor storage since the available building clear height will not be fully utilized. Long loads such as steel bars and tubes are appropriate for storage in cantilever racks. Small items are best stored in bins, rack shelves, totes, storage cabinets, or similar equipment. Product characteristics also influence the type of handling equipment to be used. While a variety of different lift truck options can be used for pallet loads, long loads may require side loaders or bridge cranes. Small products can often be handled manually.

Classifying the entire product line into proper categories and establishing the size, shape and special storage

or handling characteristics is the first step in distribution design analysis.

### 2. Inventory Profile

The second step is to establish an inventory profile for each product group. This profile will include average and peak levels of inventory for each item in the product group. These inventories should be expressed in units of storage such as number of pallets, bins, or other defined units of measure. The amount of loads to be stored by SKU can then be profiled. These item lot sizes will have an impact on which storage modules are most efficient. For example, items with single pallet lots are best stored in single deep pallet racks, while items with lots of 10 pallets or more may be more suitable for bulk floor, push back racks, drive-in racks, or other deep storage. The inventory levels will influence the space requirements for each type of module and the total overall storage space required.

### 3. Movement Analysis

In most companies, the 80/20 Pareto rule applies to the movement of material -- 20% of the SKUs typically account for 80% of the movement. Developing a periodic movement profile for each item will allow for the classification of all SKUs into categories based on movement (for example, fast, medium, and slow movers). When analyzed properly, this categorization will be the basis for the determination of which equipment should be used as a forward pick module and which items should be slotted in which locations. Faster movers are typically slotted into flow racks, pallet flow, or automated pick modules, medium movers can be slotted in carousels or shelving, while the slowest movers may not have forward pick positions

or be located in picking locations furthest from the conveyor line or pick path.

#### 4. Order Characteristics

The most labor-intensive activities of any distribution operation are the order picking, checking, and packing activities. The efficiency of these operations depends highly on the physical layout of the pick/pack lines and workstations as well as the methods employed to pick and pack orders. These layouts and methods are dependent upon the characteristics of the orders received for shipping. There are often many variables in the order characteristics. The number of orders to be shipped per day can vary from day to day or period to period. An order may consist of a single line item or multiple line items. Units per line item may vary from one to many.

The historical orders for a sufficient time period, such as a year, need to be collected and carefully analyzed in order to develop accurate profiles. These profiles will indicate whether the orders should be picked as single orders, in batches, by zones, or in some combination of these methods. The amount of space, equipment, and staff required will also result from a detailed analysis of the order and movement characteristics. For instance, the methods required and space needed to segregate batches or merge zone picks must be determined. In addition, the required accumulation into the packing stations as well as the complexity of the packing operations will be greatly influenced by the order profiles.

#### 5. Receiving and Shipping Characteristics

Receiving and shipping characteristics must be analyzed for efficient dock area design and a determination of the number of dock doors and staging space required. The profiles to be developed will include truck arrival and departure patterns, the number of inbound and outbound shipments, composition of loads in terms of cartons and pallets, and shipment documentation requirements.

#### 6. Returns Analysis

Although not directly related to the design process, an analysis of the issues resulting in returns - wrong items, damages, late shipments, etc. - can provide valuable clues to help determine the causes of these errors and provide corrective action in the overall design process.

#### 7. Information Analysis

No operation can function efficiently without the proper flow of information, instructions, and documents among the company's staff and its functions. This exchange of information can be as simple as word of mouth communication or as sophisticated as communication between workers and the warehouse management system via portable RF devices. The efficiency of most of the physical operations is closely related to the manner in which the information is provided to the workers, the information they must feed back, and the documents they have to handle. A simple example of the importance of information is when

picking documents have items arranged in the same sequence in which they are located in the pick line, the picker can perform his task quicker and more efficiently than if he or she has to search for items in a longer travel path than necessary.

One way to perform an analysis on this part of operations is to develop an information flow chart for each warehouse function. This chart should include the sequence in which information and documents flow, what information is being recorded and by whom, and how this information is distributed. This chart can then be examined to identify redundancies, steps that could be eliminated, forms that could be eliminated, missing information, and information that can be systems-based rather than manual. This analysis needs to be performed with the physical operations in mind so that their efficiency is not sacrificed to improve information handling and visa versa.

These processes of analysis are not all encompassing for distribution design. Additional processes may be required, depending on operation, and the specific steps of analysis will vary. But designing a warehouse or distribution operation is not simply an arbitrary arrangement of racks, bins and operational areas. An efficient and effective distribution design requires an intelligent understanding of the business and operating needs, achieved through a thorough analysis of distribution products, orders, inventories, movement, returns, and information.