Chapter 20. Warehousing Systems

20.1. Warehousing Systems Introduction

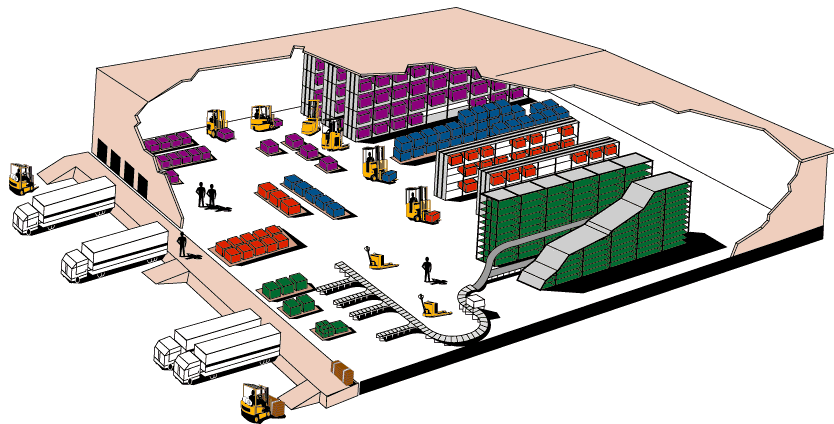*Figure 20.1. Warehousing Example*

Figure 20.2. Warehousing System Illustration

Warehousing and Inventory Justification

Economies of Scale

Response Time Constraints

Required Aging Processes

Amplified by Uncertainty

Tradeoff with Transportation Costs and Schedules

Tradeoff with Production or Purchasing Costs and Schedules

One of the main functions of a warehouse that furfills customers orders is the transformation of the large, relatively few, and homogeneous with respect to products input or arrival quantities to the many, small, heterogeneous with respect to products output quantities. The larger input quantities are caused by the desier to exploit trnasporation economies of scale, especially over larger distances. The small and frequent output quantities are caused by the furfillment of customers orders that ever more diverse, smaller, and have a shorter response time.

Warehousing Functions

Receiving

Storage - Holding

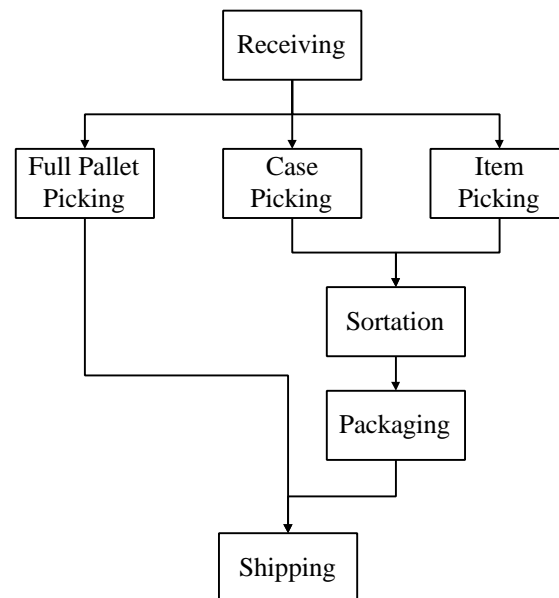Order Picking - Retrieval

Consolidation - Sorting

Shipping

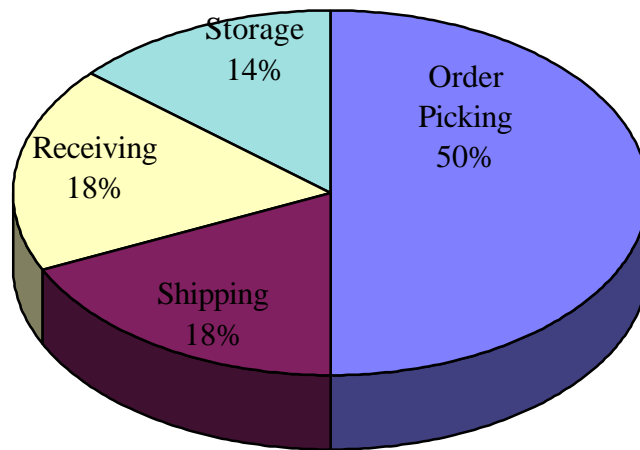*Figure 20.3. Warehousing Functional Process Diagram*

Figure 20.4. Warehousing Cost Breakout

Order picking is a prime component of labor and its associated costs in the warehouse. Two main layouts for warehouses are common. The first layout executes the order picking operations directly from the storage locations for a product. When the number of picks for that product become larger, this mode of operations becomes increasingly more expensive because the large storage area causes large travel distances for the order picker. A second layout executes the orderpicking operations mostly from a concentrated forward picking area, while keeping the bulk of the inventory for a product in a larger reserve storage area. When the inventory is low in the forward picking area, it is replenished from the reserve storage area. The costs associated with this extra material handling move must be traded off with the savings of picking the products from the smaller forward picking area.
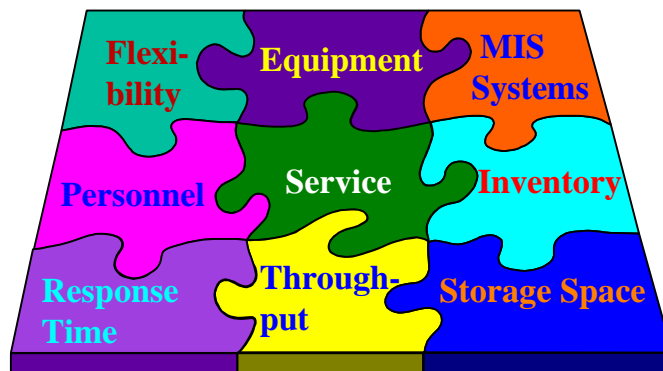

Figure 20.5. Warehousing Interrelated Factors and Costs

Direct Shipping = No Handling

Cross Docking = No Storage

Unit Load Storage = No Picking, Sorting, or Packaging

Supply Chain Determines Inventory

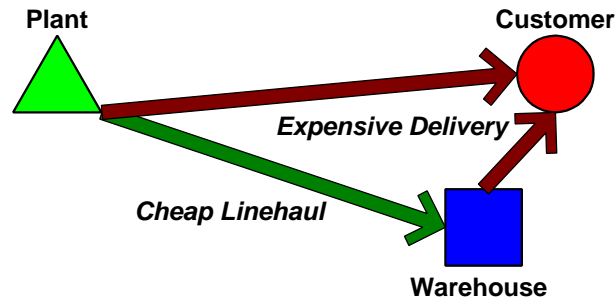Unit Load Duration-Of-Stay Determines Warehouse Location

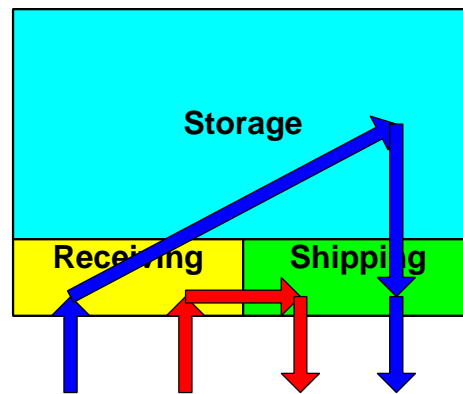*Figure 20.6. Warehousing versus Direct Shipping Tradeoff*

Figure 20.7. Warehousing Crossdocking Schematic

Temperature	Ambient	Refrigerated	Frozen
Chemical	Regular	Flammable	Hazardous
Value	Regular	High	
Storage Mode	Unit Load	Case	Piece
Access Frequency	High	Medium	Low
Equipment & Location			

Figure 20.8. Systematic Product and Warehousing Segmentation
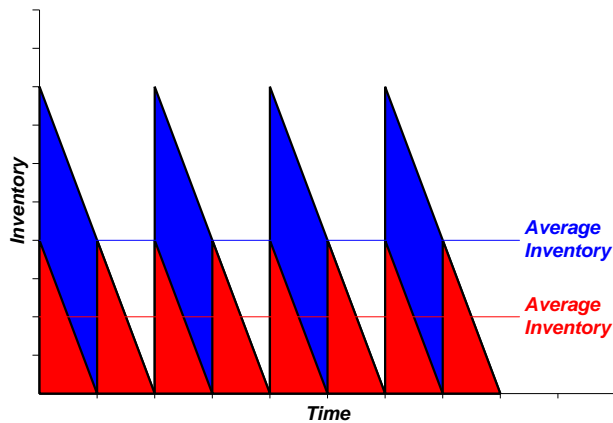
Warehousing and Inventory

Figure 20.9. Impact of Replenishment Frequency on Cycle Inventory

Computation of the safety inventory in function of the average lead time, lead time variation, and demand variation.

$$SI = k \cdot \sqrt{LT \cdot Var_D + D^2 \cdot Var_{LT}} \tag{20.1}$$

$$CV_D = \frac{\sqrt{Var_D}}{D}$$
$$Var_D = \left(CV_D \cdot D\right)^2 \tag{20.2}$$

$$SI = k \cdot \sqrt{LT \cdot CV_D^2 + Var_{LT}} \cdot D \tag{20.3}$$

Conclusions

Tradeoff Transportation for Inventory and Handling

Tradeoff Information Systems for Inventory and Handling

Tradeoff Transactions for Inventory and Handling

Figure 20.10. Recent Trends in Warehousing

Warehousing is an Integral Component in the Supply Chain

Product and Warehouse Segmentation

Products are not Uniform, Use Duration-Of-Stay of Individual Loads

Simple Statistical Analysis Yields Large Savings