**OSCM –MODULE 5**

**Types of Inventories :**

Different authors have classified inventories into different categories. Accordingly

inventories are classified (1) By their condition during processing and (2) By Functions

**(1) By conditions during processing Inventories may be classified as :**

**Raw Materials** : These are Iron ore for steel, grain for flour, wood for furniture, raw

cotton yarn for cloth and materials used to make the components of the finished product.

**Components** : Parts of sub-assemblies ready to go into the final assembly of the product.

**Work in Progress** : Materials of components being worked on or waiting between

operations in the factory.

**Finished Product** : Finished items carried in inventory in a make of stock plant or

finished goods ready to ship to a customer against an order in a make to order plant.





**Principles of Inventory Management:**

• Adequate inventory has to be maintained to avoid stock out causing consequent

production held up and customer dissatisfaction

• Excessive investment in inventory items must be avoided as it increases carrying

cost resulting in loss of profit.

The scope of **inventory management** includes the following:

**• Inventory planning** based on sales forecast and production plans and also

include preparation of budget classification and codification of inventory items

etc.

• **Inventory execution** including setting inventory levels , fixing norms for safety

stock level, lead time analysis, calculation of inventory costs, inventory pricing

decisions etc.

**• Stores and Inventory control** : Physical control over inventories,

preservation of stores, minimisation of obsolescence and damage, disposal of

waste, inventory records, accounting and reporting system etc

1. **ROLE OF INFORMATION TECHNOLOGY IN INVENTORY MANAGEMENT,**

* It is no exaggeration to state that the use of IT systems to improve inventory management has contributed much of the cost savings achieved so far in most supply chains. Until the 1980s, inventory was generally managed using **rules of thumb** such as holding **three months** of demand in the warehouse. These levels were often (although not always) far from appropriate, resulting in too much of the wrong items and too little of the right ones. The errors were often very large when products had high demand variability or varying levels of criticality. A **second major** contributor to excess inventories was the fact that each location managed its inventories **independently**, ignoring inventories at other facilities. The end result was a **bloated inventory system** with relatively **poor service levels.**
* The first contribution of IT systems was to move inventory management from rules of thumb to setting inventories based on **historical demand** and **desired service levels**. IT systems allowed this analysis for potentially millions of SKUs and for the **inventory levels to be recalculated** as demand changed. As a result, it significantly lower inventories and improved service levels at the same time.
* Over time, IT inventory management systems have evolved to incorporate more sophisticated techniques for managing inventory. They include different types of demand distributions beyond the normal distribution to better model demand.
* One of the major improvements since the mid-1990s has been the incorporation of **multi echelon modeling** that allows the **analysis of inventories across the supply chain network** rather than at each separate location. Local analysis often leads to duplication of inventories because each location sets its inventory levels independently.
* Multi echelon analysis, in contrast, attempts to reduce total network inventories by **positioning inventories appropriately**. More advanced companies have linked their inventory systems to those of their suppliers and customers. This is important, as the amount of inventory you want to hold depends on how much your customer holds and how much your suppliers have or what they are producing. IT systems also allow inventory management applications to be linked to production planning so that inventory decisions are taken in conjunction with production decisions.
* With the growth in product variety, decrease in product life cycles, and rapid fluctuations in demand, it is almost impossible to manage inventories today without the use of IT systems. IT systems improve inventory management through their ability to act on a large number of products, to be frequently updated, and finally, to coordinate with other demand and supply planning systems both within the enterprise and across the supply chain.
* There is, however, plenty of room for improvement in inventory management systems. One area for improvement is the modeling of demand in different circumstances. The use of oversimplified demand distributions is often inaccurate and can even lead to inventory levels that are worse than the use of rules of thumb. As an example, consider stocking demand for spare parts in a production facility. The mean demand for a part might be quite low, but when it is needed, not only is it critical, but perhaps a specific set of other parts are also needed. Modeling the demand as normal and independent across parts is likely to give poor results.
* Another area for improvement in inventory management systems is the integration with other IT systems across the supply chain. Inventory buffers the variation of demand and supply within the supply chain. Thus, if inventory management systems do not communicate seamlessly with other planning and execution systems, inventory levels are unlikely to be optimal. In particular, it is important that inventory management systems communicate with demand planning systems to incorporate the impact of seasonality and promotions. The inability of inventory management systems to provide visibility and communicate effectively with other IT systems is often the biggest hurdle to their success. Given the importance of inventories, vendors of inventory management systems are the core supply chain management software providers.
* Thus, inventory management systems have played a central role in improving supply chain performance. The significance of IT is likely to grow in the future as more supply chain partners are beginning to set their inventory levels based on their partners' inventory and capabilities.

1. **TRANSPORTATION IN SUPPLY CHAIN.**

* Transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer.
* Transportation is an important supply chain driver because products are rarely produced and consumed in the same location.
* Transportation is a significant component of the costs incurred by most supply chains.
* The role of transportation is even more significant in global supply chains.
* Transportation network is a collection of nodes and links.
* Transportation originates and ends at nodes and travels on links.
* For most modes of transportation, infrastructure such as ports, roads, waterways, and airports is required both at the nodes and links.
* Most transportation infrastructure is owned and managed as a public good throughout the world. It is very important that infrastructure be managed in such a way that monies are available for maintenance and investment in further capacity as needed.

**MODES OF TRANSPORTATION AND THEIR PERFORMANCE HARACTERISTICS**

***Mode***

* Air (includes truck and air)
* Truck
* Rail
* Water
* Pipeline
* Multimodal

*Supply chains use a combination of the following modes of transportation:*

*• Air • Package carriers • Truck • Rail • Water • Pipeline • Intermodal*

**TRADE-OFFS IN TRANSPORTATION DESIGN**

* All transportation decisions made by shippers in a supply chain network must take into account their impact on inventory costs, facility and processing costs, the cost of coordinating operations, as well as the level of responsiveness provided to customers.

For example, Dell's use of package carriers to deliver PCs to customers increases transportation

cost but allows Dell to centralize its facilities and reduce inventory costs. If Dell wants to reduce its transportation costs, the company must either sacrifice responsiveness to customers or increase the number of facilities and resulting inventories to move closer to customers.

* The cost of coordinating operations is generally hard to quantify. Shippers should evaluate different transportation options in terms of various costs as well as revenues and then rank them according to coordination complexity. A manager can then make the appropriate transportation decision. Managers must consider the following tradeoffs when making transportation decisions:

• Transportation and inventory cost trade-off

• Transportation cost and customer responsiveness trade-off

**TRANSPORTATION AND INVENTORY COST TRADE-OFF**

The trade-off between transportation and inventory costs is significant when designing

a supply chain network. Two fundamental supply chain decisions involving this tradeoff

are

• Choice of transportation mode

• Inventory aggregation

**Choice of Transportation Mode**

Selecting a transportation mode is both a planning and an operational decision in a supply chain. The decision regarding carriers with which a company contracts is a planning decision, whereas the choice of transportation mode for a particular shipment is an operational decision. For both decisions, a shipper must balance transportation and inventory costs. The mode of transportation that results in the lowest transportation cost does not necessarily lower total costs for a supply chain.

**Inventory aggregation**

Transportation cost, however, generally increases when inventory is aggregated. If inventories are highly disaggregated, some aggregation can also lower transportation costs. Beyond a point, however, aggregation of inventories raises total transportation costs.

Consider a bookstore chain such as Borders. The inbound transportation cost to Borders is due to the replenishment of bookstores with new books. There is no outbound cost because customers transport their own books home. If Borders decides to close all its bookstores and sell only online, it will have to incur both inbound and outbound transportation costs. The inbound transportation cost to warehouses will be lower than to all bookstores. On the outbound side, however, transportation cost will increase significantly because the outbound shipment to each customer will be small and will require an expensive mode such as a package carrier. The total transportation cost will increase on aggregation because each book travels the same distance as when it was sold through a bookstore, except that a large fraction of the distance is on the outbound side using an expensive mode of transportation.

As the degree of inventory aggregation increases, total transportation cost goes up. Thus, all firms planning inventory aggregation must consider the trade-offs among transportation, inventory, and facility costs when making this decision.

Inventory aggregation is a good idea when inventory and facility costs form a large fraction of a supply chain's total costs. Inventory aggregation is useful for products with a large value-to-weight ratio and for products with high demand uncertainty.

For example, inventory aggregation is very valuable for new products in the PC industry, because PCs have a large value-to-weight ratio and demand for new products is uncertain. When products have a low value-to-weight ratio and customer orders are small, however, inventory aggregation may hurt a supply chain's performance because of high transportation costs. Compared to PCs, the value of inventory aggregation is smaller for best-selling books that have a lower value-to-weight ratio and more predictable demand.

**MAKING TRANSPORTATION DECISIONS IN PRACTICE**

1. ***Align transportation strategy with competitive strategy.*** Managers should ensure that a firm's transportation strategy supports its competitive strategy. They should design functional incentives that help achieve this goal. Historically, the transportation function within firms has been evaluated based on the extent to which it can lower transportation costs. Such a focus leads to decisions that lower transportation costs but hurt the level of responsiveness provided to customers and may raise the firm's total cost. If the dispatcher at a DC is evaluated based solely on the extent to which trucks are loaded, he or she is likely to delay shipments and hurt customer responsiveness to achieve a larger load. Firms should evaluate the transportation function based on a combination of transportation cost, inventory cost, and the level of responsiveness

achieved with customers.

2. ***Consider both in-house and outsourced transportation.*** Managers should consider an appropriate combination of company-owned and outsourced transportation to meet their needs. This decision should be based on a firm's ability to handle transportation profitably as well as the strategic importance of transportation to the success of the firm. In general, outsourcing is a better option when shipment sizes are small, whereas

owning the transportation fleet is better when shipment sizes are large and responsiveness is important. For example, Wal-Mart uses responsive transportation to reduce inventories in its supply chain. Given the importance of transportation to the success of its strategy, it owns its transportation fleet and manages it itself. This is made easier by the fact that it achieves good utilization from its transportation assets because most of

its shipments are large.

3. ***Use technology to improve transportation performance.*** Managers must use information technology to decrease costs and improve responsiveness in their transportation networks. Software helps managers do transportation planning, modal selection, and build delivery routes and schedules. Available technology allows carriers to identify the precise location of each vehicle as well as the shipments the vehicle carries. Satellite based

communication systems allow carriers to communicate with each vehicle in their fleet. These technologies help carriers lower costs and become more responsive to changes.

4. ***Design flexibility into the transportation network.*** When designing transportation networks, managers should take into account uncertainty in demand as well as availability of transportation. Ignoring uncertainty encourages a greater use of inexpensive and inflexible transportation modes that perform well when everything goes as planned. Such networks, however, perform very poorly when plans change. When managers account for uncertainty, they are more likely to include flexible, though more expensive, modes of transportation within their network. Although these modes may be more expensive for a particular shipment, including them in the transportation option.