Introduction to Logistics.

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Logistics.

Logistics is the art and science of management, engineering, and technical activities concerned with customer requirements, product design, maintaining and supplying resource to support objectives, plans, and operations.

(SOLE-The International Society of Logistics)
Elements of Logistics.

[Part 1: System Management]

Definitions.

System engineering (SE) is an application of scientific and engineering efforts to transform an operation need into a system through top-down iterative process analysis, allocation, synthesis, design, test and evaluation.

Logistics engineering is one element of this process.
System Life Cycle.

The interrelationship of the Life-cycle Phases.

Life-Cycle Cost (LCC)

Life cycle costs is to sum all costs associated with a system/product/service during its lifetime from concept development, to phase-out.

LCC of a system is broken down such as the categories.

1. Design and Development.
2. Production & Construction Cost.
3. Operation and Maintenance Cost.
Opportunity for Cost-Effectiveness.

System Engineering Process.

[Part 2 : System Design & Development]


1. Needs Analysis.
   - Functions to be performed

2. System Requirement.
   - Feasibility Analysis.
   - Operational Requirement.
   - Maintenance Concept.
   - Technical Performance Measure (TPM)
   - System Specification

3. Function Analysis & Requirement Allocation.
   - Lower-level Specifications


5. System Test and Evaluation.
   - Design Validation

6. Construction & Production
   System Utilization
   System Retirement
Reliability.

Reliability with respect to systems and equipment is defined as the probability that a system will perform its intended function for a specified interval under stated conditions.

Three elements of reliability.

1. A probability of an item functioning as intended.
2. An operational interval defined in time units or cycles.
3. A definition of the item's operating environment.
Maintainability.

Maintainability is the measure of the ability of a system to be restored to a specified level of operational readiness within defined internals with the use of prescribed personnel, facility, and equipment resources. Two elements of maintainability.

Corrective maintenance. The unscheduled actions, initiated as a result of failure, that are necessary to restore a system to its required level of performance.

Preventive maintenance. The scheduled actions necessary to retain a system at a specified level of performance.
Availability.

Maintainability and reliability determine the availability of systems and equipment.

A measure of the degree to which an item is in the operable and committable state at the start of a mission, when the mission is called for at an unknown (random) time.

Availability is thus defined as the probability that an item will be available when required or as the proportion of total time that an item is available for use.
Supportability.

Supportability means to the degree to which a system can be effectively supported, both in terms of the built-in design characteristics of the overall maintenance and support infrastructure.

It relates to levels of maintenance such as:

- Organizational Level.
- Intermediate Level.
- Depot Level.
Typical Figures of Merit.

\[
CE = \frac{\text{System Effectiveness}}{\text{Life Cycle Cost}}
\]

\[
CE = \frac{\text{Reliability}}{\text{Life Cycle Cost}}
\]

\[
CE = \frac{\text{Availability}}{\text{Life Cycle Cost}}
\]

\[
CE = \frac{\text{Supportability}}{\text{Life Cycle Cost}}
\]
Analysis Methods and Tools.

1. Life-Cycle Cost Analysis (LCCA).
2. Failure Mode, Effects and Criticality Analysis (FMECA).
3. Fault-Tree Analysis (FTA).
5. Reliability Centered Maintenance (RCM).
Scheduling of Design Review.

- System Design Review.
- Equipment/Software Design Review.
- Critical Design Review.
Competitive Advantages.

- Price.
- Quality.
- Delivery Speed.
- Delivery Reliability.
- Flexibility.
- Product Design.
- After Sales Customer Support.
Make-to-Stock.

A manufacturing process strategy where finished product is continually held in plant or warehouse inventory to fulfill expected incoming orders or releases based on a forecast.
Assemble-to-Order.

<table>
<thead>
<tr>
<th>Design</th>
<th>Procurement</th>
<th>Manufacture</th>
<th>Inventory</th>
<th>Assemble</th>
<th>Ship</th>
</tr>
</thead>
</table>

A production environment where a good or service can be assembled finally after receipt of a customer's order.
Make-to-Order.

A manufacturing process strategy where the trigger to begin manufacture of a product is an actual customer order or release, rather than a market forecast.
Engineer-to-Order.

A process in which the manufacturing organization must first prepare (engineer) significant product or process documentation before manufacture may begin.
Product Layout (Flow Shop).

- A limited range of similar products is produced.
- Workstations are dedicated to specific operation.
- Demand must be sufficient to justify setting up the process.
- It is capital-intensive.
- Little buildup of work-in-process inventory.
- Short throughput and manufacturing lead times.
- Generally lower unit cost.
Manufacturing Process.

[Part 3 : Acquisition & production Support]

Process Layout (Job Shop).

- Lots or batches are produced intermittently.
- General-purpose machinery is used.
- Departments are based on similar types of skills and equipment.
- Work moves only to those stations required and skips the rest.
- Product or volume can be changed relatively easily.
- Production and inventory control are complex and expensive.
- Work-in-process inventory levels are high.
- Lead times are longer.
Cellular Manufacturing.

- A cell is a manufacturing unit consisting of a number of workstations plus the material transport mechanism and storage buffers that interconnect the cells.
- This manufacturing process produces families of parts within a single line or cell of machines operated by machines who work only within the line or cell.
Demand Forecasting.

A forecast can be determined by mathematical means using historical data, it can be created subjectively by using estimates from informal sources, or it can represent a combination of both techniques.
Make or Buy Analysis : Some Considerations.

<table>
<thead>
<tr>
<th>Making</th>
<th>Buying</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cost considerations&lt;br&gt;  (less expensive to make the part).</td>
<td>- Supplier's research and specialized know-how.</td>
</tr>
<tr>
<td>- Desire to integrate plant operations.</td>
<td>- Cost considerations&lt;br&gt;  (less expensive to buy the part).</td>
</tr>
<tr>
<td>- Productive use of excess plant capacity to help absorb fixed overhead.</td>
<td>- Small-volume requirements.</td>
</tr>
<tr>
<td>- Need to exert direct control over production and/or quality.</td>
<td>- Limited production facilities.</td>
</tr>
<tr>
<td>- Design secrecy required.</td>
<td>- Desire to maintain a stable work force&lt;br&gt;  (in periods of rising sales).</td>
</tr>
<tr>
<td>- Unreliable suppliers.</td>
<td>- Desire to maintain a multiple-source policy.</td>
</tr>
<tr>
<td>- Desire to maintain a stable work force&lt;br&gt;  (in periods of declining sales).</td>
<td>- Indirect managerial control considerations.</td>
</tr>
<tr>
<td></td>
<td>- Procurement and inventory considerations.</td>
</tr>
</tbody>
</table>
## Make or Buy Analysis

### Cost Avoidance Method

<table>
<thead>
<tr>
<th>1. Produce 10,000 units : Cost factors.</th>
<th>4. Total Avoided Cost.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>Raw material</td>
</tr>
<tr>
<td>Direct labor</td>
<td>Direct labor</td>
</tr>
<tr>
<td>Variable factory overhead</td>
<td>Variable factory overhead</td>
</tr>
<tr>
<td>Fixed factory overhead</td>
<td>Fixed factory overhead</td>
</tr>
<tr>
<td>Total cost to make</td>
<td>Total cost to make</td>
</tr>
<tr>
<td>$ 9,000</td>
<td>$ 9,000</td>
</tr>
<tr>
<td>$ 12,000</td>
<td>$ 12,000</td>
</tr>
<tr>
<td>$ 5,000</td>
<td>$ 4,000</td>
</tr>
<tr>
<td>$ 24,000</td>
<td>$ 18,000</td>
</tr>
<tr>
<td>$ 50,000</td>
<td>$ 43,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Purchase proposal</th>
<th>5. Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 4.50/unit</td>
<td>Cost not avoided</td>
</tr>
<tr>
<td></td>
<td>Plus cost to purchase</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total cost to purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ 52,000</td>
</tr>
</tbody>
</table>

### Factors to Consider:
- You only avoid 80% of the variable factory overhead cost.
- You only avoid 75% of the fixed factory overhead cost.
Total Cost Analysis Method

\[ TC_{\text{min}} = C_i D + \sqrt{2C_b C_h D \left(1 - \frac{D}{R}\right)} \]

Where

\( C_i \) = item cost.
\( C_b \) = ordering cost or line setup expenses.
\( C_h \) = holding rate per period.
\( D \) = demand during period.
\( R \) = replenishment rate.
## Make or Buy Analysis

### Total Cost Analysis Method: Example

<table>
<thead>
<tr>
<th></th>
<th>Make</th>
<th>Buy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item cost</td>
<td>$5.00</td>
<td>$6.00</td>
</tr>
<tr>
<td>Order or setup cost</td>
<td>$150.00</td>
<td>$10.00</td>
</tr>
<tr>
<td>Replenishment rate/day</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Holding rate per period (%)</td>
<td>0.005</td>
<td>0.005</td>
</tr>
<tr>
<td>Demand per period</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

Make = (5)(12) + \(\sqrt{\frac{2(150)(0.005)(12)(1 - \frac{12}{25})}{1}}\) = $63.06

Buy = (6)(12) + \(\sqrt{\frac{2(10)(0.005)(12)(1 - \frac{12}{\infty})}{1}}\) = $73.10
Fixed Price Contracts.

- Fixed price contracts are based on a price that will not differ from that agreed upon or understood to apply at the time of ordering.

- As contract terms lengthen or as complexity of development or performance increases, supplier risk rises in fixed price contracts.

Common fixed price contract types.

1. Firm Fixed Price.
2. Fixed Price with Adjustment/Escalation.
Cost Reimbursable Contracts.

- Cost reimbursable contracts guarantee the supplier a price sufficient to cover allowable costs plus whatever additional amount is negotiated.

- Because financial risk falls on the purchaser, the purchaser must carefully monitor such contracts.

Types of Cost Reimbursable Contracts.

1. Cost Plus a Fixed Fee.
2. Cost Plus Percentage of Cost.
3. Cost Plus an Incentive Fee.
5. Cost Sharing.
Manufacturing Planning System.

**INPUT**
- Business Plan.
- Financial Plan.
- Market Plan.
- Critical Resource.
- Production Plan.
- Forecast & Order.
- Status of Inventory.
- Bottleneck Center.
- MPS.
- Bill of Materials.
- Status of Inventory.
- Capacity of All.

**OUTPUT**
- Production (aggregate) Plan.
  - By Month or Quarter.
  - By Product Group Inventory/Backlog Level
- Detailed Plan for End item.
  - By Week.
  - By End item in a Product Group.
- Time-phased Production & Purchase Orders.
  - For Components.
  - For Raw Materials.

**Flowchart Diagram**
- **Sales & Operation Plan (S&OP)**
- **Master Production Schedule (MPS)**
- **Material Requirement Plan (MRP)**
- **Purchasing**
- **Production Activity Control (PAC)**
Sales & Operation Planning.

A strategic planning process that reconciles conflicting business objectives and plans future supply chain actions.

S&OP Planning usually involves various business functions such as sales, operations and finance to agree on a single plan/forecast that can be used to drive the entire business.
Master Production Schedule.

The master level or top level schedule used to set the production plan in a manufacturing facility.

Lot Size : 50
On Hand : 50
Lead Time : 2 Periods.

Demand Time Fence : 3
Planning Time Fence : 8

<table>
<thead>
<tr>
<th>Item : 78100</th>
<th>Description : Commercial Generator Unit.</th>
<th>Week (Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Forecast</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Orders</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Projected Available Balance 50</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>Available-to-Promise</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>MPS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Material Requirement Planning.

A set of techniques that uses bill of material data, inventory data and the master production schedule to calculate requirements for materials.

Time-phased MRP begins with the item listed on the MPS and determines

- The quantity all components and materials required to fabricated those items and
- The date that the components and material are required.
Material Requirement Planning.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Requirements</td>
<td>25</td>
<td>0</td>
<td>15</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Scheduled Receipts</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projected Available</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned Order Receipt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned Order Release</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Order Quantity: 50 units
On-hand Balance: 10
Safety Stock: 0
Allocated Qty: 0
Lead-Time: 1 weeks
Low Level Code: 0
Activities of Shop Floor Control.

1. Scheduling.
2. Lead Time Management and Expediting.
3. Input/Output Control.
4. Prioritization & Dispatching.
5. Bottleneck Management.
6. Total Productive Maintenance.
Aggregate Inventory Management.

Establishing the overall level (dollar value) of inventory desired and implementing controls to achieve this goal.

Activities.

- Types of Inventory.
  (Raw Material, Work-In-Process, Finished Goods, MRO)

- Definition of Inventory Function.
  (Lot size stock, Safety stock, Anticipated stock, Pipeline stock)

- Inventory Cost Analysis.
  (Ordering Costs vs. Inventory Carrying Costs)

- Inventory Management Performance Measures.
  (Customer Service Measures, Inventory Turns)

- ABC Classification.
Individual Inventory Management.

Inventory is not only managed at the aggregate level but also at the item level.

Management must establish decision rules about inventory items.

- Which individual inventory items are most important.
- How individual are to be controlled.
- How much to order at one time.
- When to place an order.
Decision to Order Quantity.

- Economic Order Quantity (EOQ).
- Periodic Review System.
- Lot For Lot (L4L).

Decision to Safety Stock.

- Customer Service Level.
- Demand Variability.
Definition of Quality.

Conformance to requirements or fitness for use.

Total Quality Management.

It is based on the participation of all members of an organization in improving processes, product, services, and the culture they work in.

The objective of TQM is to provide a quality product to customers at a lower price. TQM is both a philosophy and a set of guiding principles that lead to a continuously improving organization.
Continuous Improvement.

A never-ending effort to expose and eliminate root causes of problems; small-step improvement as opposed to big-step improvement.

Activities.

Pareto Analysis.  Brainstorming.
Cause & Effect Diagram. Mistaking Proofing.
Histogram.  Benchmarking.
Scatter Diagram. Design of Experiment.
Control Chart. Affinity Diagram.
Process Flow Chart. Tree Diagram.
Check Sheet. Process Decision Program Chart(PDPC)
Definition of JIT.

The elimination of all waste and continuous improvement of productivity. Waste means anything other than the minimum amount of equipment, parts, space, material, and workers' time absolutely necessary to add value to the product.

The long-term result of eliminating waste is a cost-efficient, quality-oriented, fast-response organization that is responsive to customer needs.

Elements of JIT.

Waste, Customer Focus, Employee Involvement, Continuous Improvement.
Kanban Production.

The pull system starts at the end of the line and pulls product from the preceding operation as needed. The preceding operation does not produce anything unless a signal is sent from the following operation to do so.
Logistics Management.

Logistics management is that part of the supply chain process that plans, implements and controls the efficient, effective flow and storage of goods, services and related information from the point-of-origin to the point-of-consumption in order to meet customer's requirements.
Elements of Logistics Management.

- **Management Actions**
  - Planning
  - Implementation
  - Control

- **Input into Logistics**
  - Natural Resources (land, facilities and equipment)
  - Human Resources
  - Financial Resources
  - Information Resources

- **Logistics Management**
  - Suppliers
    - Raw material
    - In-process
    - Finished goods

- **Output of Logistics**
  - Customers
    - Competitive Advantage (Marketing Orientation and Operational Efficiencies and Effectiveness)
    - Time and Place Utility
    - Efficient Movement to Customer
    - Proprietary Asset

- **Logistics Activities**
  - Customer Service
  - Demand Forecasting
  - Inventory Management
  - Logistics Communications
  - Materials Handling
  - Order Processing
  - Packaging
  - Parts and Service Support
  - Plant and Warehouse Site Selection
  - Procurement
  - Reverse Logistics
  - Traffic Logistics
  - Warehousing and Storage

Transportation.

Transportation is a very important part of the logistics system. A major focus in logistics is upon the physical movement or flow of goods or upon the network that moves the product.

This network is composed of transportation agencies that provide the service for the firm. The logistics manager is responsible for selecting the mode or modes of transportation used in moving the raw materials and finished goods or for developing private transportation as an alternative.
Storage.

A second area, which has a trade-off relationship with transportation, is storage. It involves two separate but closely related activities: Inventory management and warehousing.

A direct relationship exists between transportation and the level of inventory and number of warehouses required. For example, if firms use a relatively slow means of transport, they usually have to keep higher inventory levels and usually have more warehousing space for this inventory.
Packaging.

A third area of interest to logistics is industrial (exterior) packaging. The type of transportation selected affects packaging requirements both for moving the finished product to the market and for the inbound materials.

For example, rail or water transportation usually requires additional packaging expenditures because of the greater possibility of damage.
Material Handling.

A fourth area to be considered is materials handling, which is also of interest to other areas in the typical manufacturing organization.

Material handling is important to an efficient warehouse operation. Logistics managers are concerned with the movement of goods into a warehouse, the placement of goods in a warehouse, and the movement of goods from storage to order-picking areas and eventually to dock areas for transportation out of the warehouse.
Order Processing.

Order processing may require shorter delivery lead time, and the short delivery lead time may require a premium means of transportation. If order processing is considered part of the logistics, then the company might examine improvements, such as telephone calls and more computer equipment for processing, to reduce order processing time. This would allow the firm to use much cheaper transportation and still get the goods to the customer with required days.
Legal Forms of Transportation.

**Common Carriers.**
Carriers in this legal classification are available to all users at published rates. All tariffs are approved by the cognizant regulatory agencies.

**Contract Carriers.**
Carriers in this legal classification perform selected transportation function. Rate differentials for the same type of service are allowed; however, these rates must be published and made a matter of public record.
Legal Forms of Transportation (cont).

Exempt Carriers.
Transportation companies in this classification primarily move unprocessed products, such as agricultural products and fish. Exempt carriers are exempt from economic restrictions by regulatory bodies.

Private Carriers.
Carriers in this legal classification are operated by the producer or distributor of the cargo. A private carrier is not legally for hire by outside organizations.
Advantages of Individual Modes.

Rail.

- Mass movement of goods. - large capabilities.
- Low unit cost of movement.
- Dependable form of transport.
- Long-haul movements.
- Fairly extensive rail system network - coverage to major markets and suppliers.
- Numerous ancillary service - switching, in-transit privileges, storage, etc.
- Goods transfer to other carriers.
- Specialized equipment.
Advantages of Individual Modes (cont).

Highway.

- Flexibility - can go anywhere.
- Speed - 3 - 5 days delivery to any point in continental United States.
- Frequency - hourly and daily pickup and delivery service.
- Convenience - loading and unloading at the shipper's and receiver's places of business.
- Goods transfer to other carriers.
- Equipment diversity.
Advantages of Individual Modes (cont).

Water.

- Mass movement of bulk commodities - large capabilities.
- Very low unit cost.
- Movement of low-unit-value commodities, such as sand, gravel, or shell, which otherwise would have limited distribution.
- Long-haul movements.

Pipeline.

- Mass movement of liquid or gas products.
- Lowest unit cost of movement.
- Large capacity and volume of throughput.
- Most dependability of all the modes.
- Long-haul movements.
Intermodal Transportation.

**Truck-rail (Piggyback).** Truck-rail service may be trailer-on-flatcar (TOFC) or container-on-flatcar (COFC).

**Truck-water (Fishyback).** This combination involves intermodal truck and water service, sometimes referred to as "fishyback," which is accomplished by coordination of truck and water transport movements.

**Air-truck.** It provides feeder and delivery service between major airport hubs and remote communities deprived of adequate air freight service.

**Rail-water.** The "hydro-train" rail-water service.
Transportation Rates.

Class rates. The following factors are used in determining freight classification: (1) density, (2) stowability, (3) ease of handling goods, (4) liability - value per pound, fragility, theft risk, flammability, explosiveness, environmental impact, perishability.

Exception Rates. Exception rates, or exceptions to the classification, provide the shipper with rates lower than the published class rates.

Commodity Rates. Commodity rates apply when a large quantity of a product is shipped between two locations on a regular basis.

Contract Rates. Contract rates are those negotiated between a shipper and carrier.
F.O.B. Pricing.

1. Terms of Sale FOB Shipping Point, Freight Collect
   - Title passes to buyer
   - Seller pays freight charges
   - Buyer bears freight charges
   - Buyer owns goods in transit
   - Buyer files claims (if any)
   - Seller → Buyer
   - Freighter charges paid by buyer

2. Terms of Sale FOB Shipping Point, Freight Allowed
   - Title passes to buyer
   - Seller pays freight charges
   - Seller bears freight charges
   - Seller owns goods in transit
   - Seller files claims (if any)
   - Seller → Buyer
   - Freight charges paid by seller

3. Terms of Sale FOB Shipping Point, Freight Prepaid and Charged Back
   - Title passes to buyer
   - Seller pays freight charges
   - Seller bears freight charges
   - Buyer owns goods in transit
   - Buyer files claims (if any)
   - Seller → Buyer
   - Freight charges paid by seller, then collected from buyer by adding amount to invoice

4. Terms of Sale FOB Destination, Freight Collect
   - Title passes to buyer
   - Buyer pays freight charges
   - Buyer bears freight charges
   - Seller owns goods in transit
   - Seller files claims (if any)
   - Seller → Buyer
   - Freight charges paid by buyer

5. Terms of Sale FOB Destination, Freight Prepaid
   - Title passes to buyer
   - Seller pays freight charges
   - Seller bears freight charges
   - Seller owns goods in transit
   - Seller files claims (if any)
   - Seller → Buyer
   - Freight charges paid by seller

6. Terms of Sale FOB Destination, Freight Collect and Allowed
   - Title passes to buyer
   - Buyer pays freight charges
   - Buyer bears freight charges
   - Seller owns goods in transit
   - Seller files claims (if any)
   - Seller → Buyer
   - Freight charges paid by buyer, then charged to seller by deducting amount from invoice

Roles of Warehouses.

<table>
<thead>
<tr>
<th>Value-Adding Roles</th>
<th>Trade-Off Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Consolidation.</td>
<td>Transportation.</td>
</tr>
<tr>
<td>- Product mixing.</td>
<td>Order Filling.</td>
</tr>
<tr>
<td>- Service.</td>
<td>Lead Time, Stockouts.</td>
</tr>
<tr>
<td>- Contingency protection.</td>
<td>Stockouts.</td>
</tr>
<tr>
<td>- Smooth operation.</td>
<td>Production.</td>
</tr>
</tbody>
</table>
Roles of Warehouses (cont).

Roles of Warehouses (cont).

Trade-off Analysis.

Types of Warehouse.

Public Warehouses. Commercial facilities defined as public warehouses are broadly regulated by the UCC.

Private Warehouses. This legal destination describes commercial storage facilities that are either owned or leased by the user organizations solely for support of their own logistics requirements.

Special Legalities Regarding Consignment of Goods.

- Field Warehouse.
- Bonded Warehouse.
Material Handling Procedure.

Considerations for Storage.

- Random Location vs. Fixed Location.

- Cube Utilization vs. Accessibility.

- Central Location vs. Point-of-use Location.

- Others: Popularity, Unit Size, Compatibility, Complementarity.
Material Handling Systems.

Storage and order picking equipment includes racks, shelving, drawers, and operator controlled devices such as forklift trucks.

Transportation and sorting. The order picker can use a large selection of powered and non powered equipment for transporting and sorting items located in the racks, shelves, and drawers. Examples of apparatus of this type include forklift trucks, platform trucks, hand trucks, cranes, and carts. This equipment performs multiple functions in addition to transportation and sorting, such as order picking.

Shipping. Shipping of products to customers involves preparing items for shipment and loading them onto transportation carriers. Equipment such as pallets, palletizers, strapping machines, and stretch wrappers are important.
Material Handling Systems (cont).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- The counter balanced lift truck.</td>
<td>- The Storage Rack.</td>
<td>- Automated storage and retrieval systems (AS/RS)</td>
</tr>
<tr>
<td>- Tow tractors.</td>
<td>- Gravity flow storage racks.</td>
<td>- Carousels</td>
</tr>
<tr>
<td>- Pallet trucks or jacks.</td>
<td>- Bin Shelving Systems.</td>
<td>- Automatic Guided Vehicle System (AGVs)</td>
</tr>
<tr>
<td>- Reach trucks.</td>
<td>- Modular Storage.</td>
<td>- Robots</td>
</tr>
<tr>
<td>- Side loading lift trucks.</td>
<td>- The Shelving Mezzanine.</td>
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<tr>
<td>- Electric-powered rider straddle</td>
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<tr>
<td>trucks.</td>
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<tr>
<td>- Order picker Truck</td>
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</table>
Definition of SCM.

Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies.
Objective of SCM.

Value Chain.
A process consisting of a number of related steps, with each step adding a certain value to the total outcome.
Supply Chain Management.

[Part 4 : Distribution & Customer Support.]

Requirement for Effective SCM.

- Forecasting/planning systems.
- Automatic replenishment.
- Inventory management system.
- Streamlined distribution center processing.
- E-commerce.
- Shipping container marking.
- Automated point-of-sale data.
Quick Response.

The ability to respond rapidly to the customer with the proper product, quantity, price, and location at a minimal cost. This is important in retail, particularly in basic goods, seasonal goods, and fashion goods.

Principles for quick response.
- Rapid flow of information from manufacturing to point of sale.
- Effective planning tool warning of changes in demand and supply.
- The ability to synchronize requirements and capabilities.
- Focus on quality and integration.
Efficient Consumer Response (ECR)

A demand driven replenishment system designed to link all parties in the logistics channel to create a massive flow-through distribution network.

Replenishment is based upon consumer demand and point of sale information.
Efficient Consumer Response (ECR)