ME 392

SESSION 1-3: MATERIAL HANDLING

MATERIAL HANDLING

- The primary function of material handling is to move material. It goes through three stages of development: conventional, contemporary, and progressive or system oriented.
- Conventional material handling is primarily the movement of material from one point to another point within the confines of a facility.
- *The* contemporary stage deals with more concern for the overall material flow.

- In the more progressive interpretation, analysts visualize every material handling and physical distribution activity as part of one all-encompassing system, which includes:
- The movement of materials from all sources of supply.
- All intra-plant handling
- The distribution of finished goods to all customers.
- This all inclusive point of view is called the system approach, with the goal of conceptualizing a solution or at least an approach, to the total handling problem in terms of a theoretical ideal system. The interrelationships in material flow are shown in figure 3.1.

Introduction

- **This segment discusses the management of *material movement* in an organization.**
- **Material movement occurs any time a product or part thereof moves or is transported from one place to another.**
- **Material movement usually accounts** for somewhere between 5 % and 90 % of total factory cost, with a probable average of 25 %.
- Since little or no work is done on a part or product as it moves, movement in that sense is nonproductive; yet, on the average, a factory spends 25 % of its costs on this movement.

Material Movement Cycle.

- **Material Handling is the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal.**
- Material movement occurs throughout the entire product manufacturing cycle and both before and after it.
- Raw materials are usually moved from the natural state to some type of primary operation before finally being moved to the manufacturing plant.
- After production, the product is moved or distributed to the various users.

Material Handling

- After the product has completed its useful life, it is either discarded or scrapped. For discarding, one more movement occurs before the material is disposed; but in the case of scrappage, movement occurs back to the primary operation for reclamation, thus completing what might be called a material movement cycle.
- Although material handling is handling any material, any place, and any time, we will limit our discussion here to within-plant movement and leave distribution (outside-plant movement)

1-3.2 Objectives of Material Handling

- The overall aim in carrying out the activities outlined in table 3.1 is to reduce production costs.
  This can be subdivided into more specific goals such as:
- Increased capacity
- Improved working conditions
- Improved customer service
- Increased equipment and space utilization
- Reduced costs.

1-3.3 Material Handling Equation

- The material handling equation is a very useful in visualizing the many aspects of a handling problem.

- Figure 3.2 shows that there are six major handling questions to be answered in searching for solution to a material handling problem.

Material Handling Equation

- They begin with the question, "Why this at all?" - which calls for a serious look at the problem to be sure that the problem has really been identified properly, and does in fact exist.
- Then the analysis proceeds to the question of "What?" - with a concern for the material or item to be moved.
- Next, the analyst considers the questions of "Where?" and "When?" - which identify and specify the move to be made.
- And lastly, he considers the "How?" and the "Who" - which pertain to method.
- One of the major difficulties in the solutions to many material handling problems in the past is that the analyst in his haste to find a hardware type answer to the problem, has jumped from the "What?" to the "How?".

Material Handling Equation

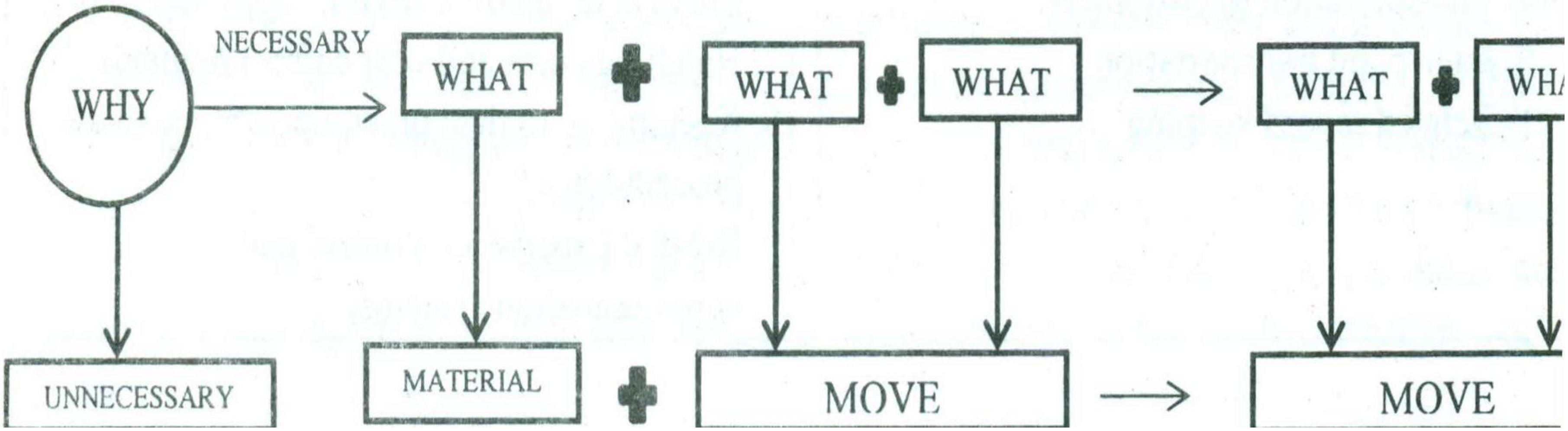


Figure 3.2: Material Handling Equation and Factors to Consider in a Material Handling Analysis

Equipment Concepts

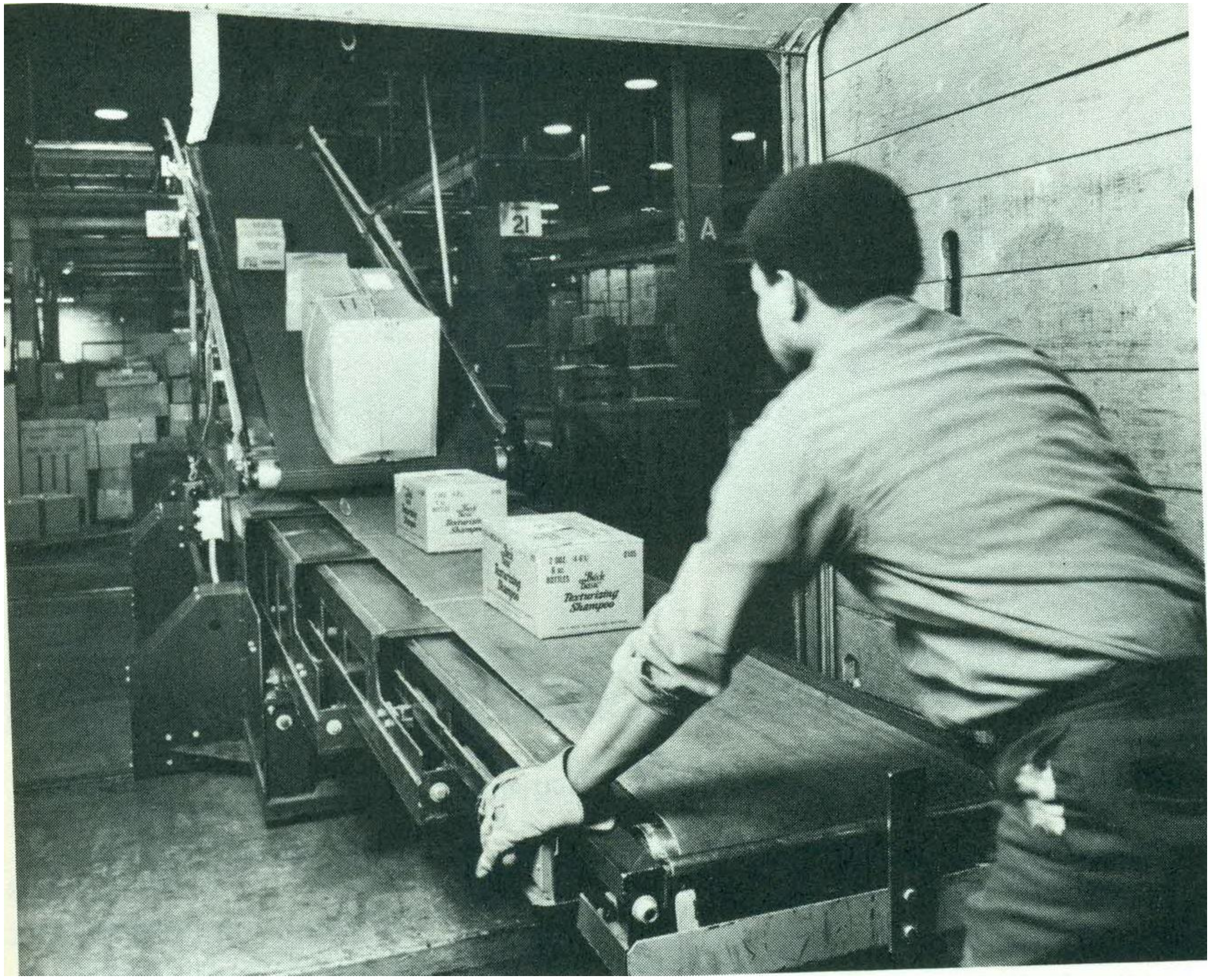
- The first problem encountered in material handling is the almost impossible task of understanding what types of equipment are available and what are the strengths and weaknesses of each.
- There are available more than 50 different types and varieties of material handling equipment, with each material handling system usually requiring several different types.
- This coupled with the rapidly changing technology makes it very difficult to keep up to date in material handling.

MATERIAL HANDLING EQUIPMENT

- Some of the basic types of material handling equipment are listed below.
- *(1) Conveyors:*

  Gravity or powered devices used for conveying material from one fixed point to another fixed point (although portable conveyors may be moved from time to time).
- They are particularly useful for moving homogeneous materials over a route that does not vary and when the material is supplied at a relatively constant rate.
- An example of an extendible belt conveyor useful for loading and unloading trucks.

Extendible belt conveyor.



Industrial Trucks

- *(2) Industrial Trucks:* Vehicles (either manual or powered) used for transporting material over varying paths where usually the load is intermittent.
- They are especially useful when the nature of the load and the path prohibit the use of conveyors or other mass production oriented devices.
- Job shops, for example, find industrial trucks particularly useful.
- A picture of a powered high-lift electric fork truck is shown.

High-lift electric fork truck.

Cranes and Hoists

- *(3) Cranes and Hoists:* Overhead lifting devices used for moving loads in a fixed area.
- They are particularly useful for moving intermittent loads when the size or shape varies between loads.
- They, of course, require some ceiling clearance and adequate support from the roof or building columns.
- a picture of a coil lifter suspended from an overhead crane.

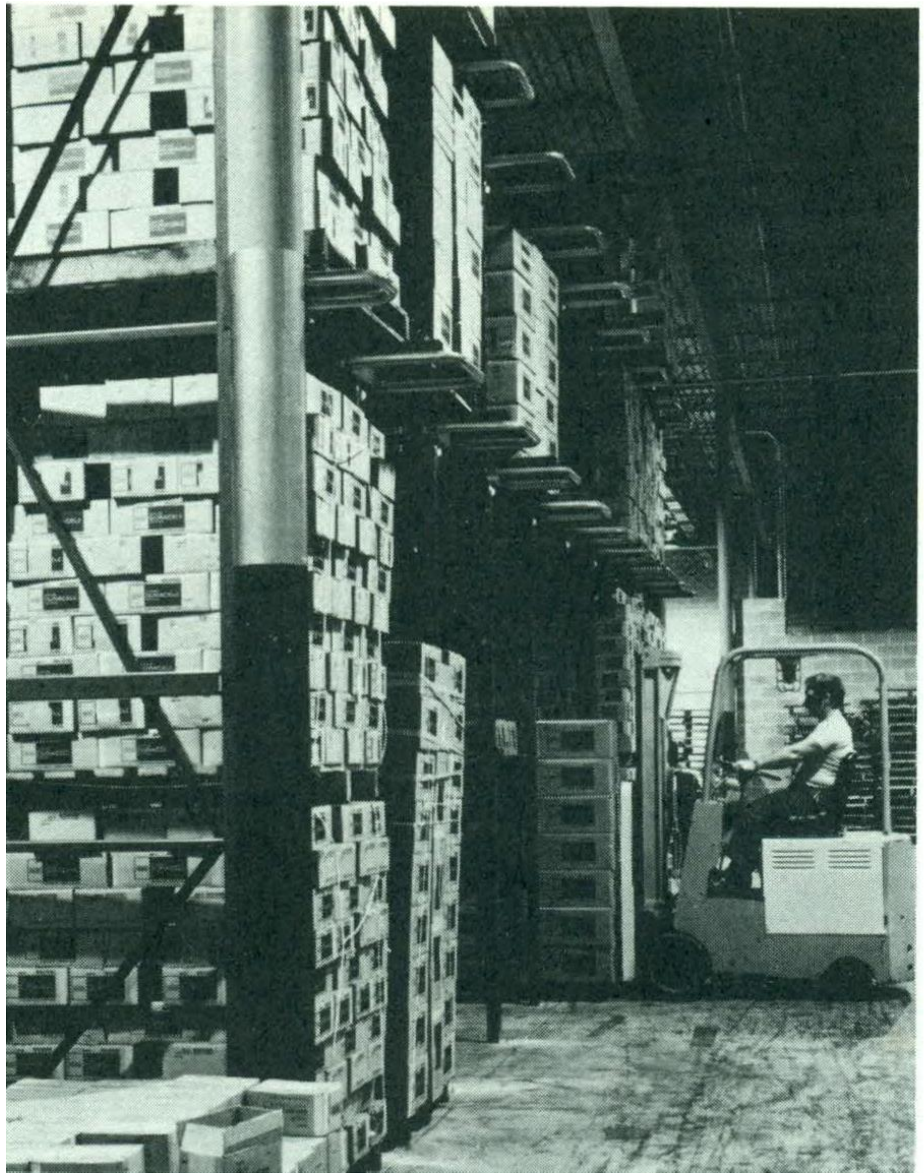
Hydraulic Scissor Lift

Containers and Racks

- *(4) Containers and Racks:*

  Devices used to store and handle bulk materials.
- Containers are used to unitize quantities of material for storage or use.
- Racks are storage devices for better use of space (higher utilization of the cube). Figure 14.5 shows a sample storage rack application and Figure 14.6 is a picture of a plywood container being stacked for storage purposes

A sample storage rack application



Plywood containers being stacked

Elevators and Lifts

- *(5) Elevators and Lifts:*
  Devices used to vertically raise or lower material.
- Although fork trucks, conveyors, cranes, and hoists also lift, these devices lift by applying force from underneath and are fixed in location.
- A picture of an hydraulic scissor lift is shown.
- The industrial engineer must have a working knowledge of each of these
  basic types of material handling equipment. With this knowledge, he is able
  to make decisions on the equipment needed and can proceed to do detailed
  economic analysis.
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Principles of Material Handling

- Given that you now understand the basic types of material handling equipment, you must still design systems that effectively and efficiently utilize
  the equipment.
- Over the years certain principles of material handling that lead to efficient and effective systems have been observed and recorded in list form for use by those involved in material handling systems design.
- *(1) Planning Principle:* AII material handling systems should be planned, not evolved.
- *(2) Systems Principle:* The planning of the system should include as much as possible of the material movement cycle. For example, a vendor could ship material in a container that can be used through- out your production process and perhaps even used as the container for shipment to a customer.
- *(3) Material Flow Principle:* Facilities layout and process engineering should assure that materials flow smoothly.

Principles of Material Handling

- *(4) Simplification Principle:* Apply the concepts of work simplification to material handling systems design. For example, the principles of motion economy should be obeyed.
- *(5) Gravity Principle:* Gravity should be used to move material when- ever practical. Gravity feed bins and roller conveyors are examples.
  (6) Space Utilization Principle: Make optimum use of space. High racks for use with narrow aisle stacking trucks make good total "cube" usage.
- *(7) Unit Size Principle:* **In** general, the larger the accumulated load handled, the better. The use of pallets to handle large quantities of properly stacked cartons is an example. Unitization should occur as soon as possible and as long as possible in the cycle and stacking patterns should be developed for more effective unitization.

Principles of Material Handling

- *(8) Mechanization and Automation Principle:* Always consider mechanization and automation in the design of the handling system. They may be impractical but they should be considered. Powered conveyors are an example of mechanization and automatic pallet stackers is an example of automation.
- *(9) Equipment Selection Principle:* Be careful to consider all aspects of the material to be handled, the move to be made and the methods to be utilized, in selecting equipment. The purchase of fork trucks with a great deal of flexibility for use throughout the plant is an example.
- *(10) Standardization Principle:* Standardize material handling methods and equipment. The adoption of a system of pallet stacking patterns and the use of standard sized pallets are examples.
- *(11) Adaptability Principle:* Design methods and equipment so they can perform a variety of tasks. Variable speed conveyors are examples.

Principles of Material Handling

- *(12) Dead Weight Principle:* Reduce the ratio of equipment or dead weight to payload. The use of plastic, aluminum, or other light-weight pallets is an example.
- *(13) Utilization Principle:* Effectively utilize both manpower and equipment. The use of walkie talkies by fork truck drivers for rapid assignment to new jobs is an example.
- *(14) Maintenance Principle:* Plan for preventive as well as emergency maintenance on material handling equipment. The use of a preventive maintenance program and the adequate stocking of replacement parts are examples.
- *(15) Obsolescence Principle:* Make economic evaluations periodically to check on replacement of material handling equipment by identical models or newer types. Scheduled replacement policy based on sound engineering economy is an example.

Principles of Material Handling

- *(16) Control Principle:* Use material handling equipment to aid production control, inventory control, quality control, etc. The use of conveyors for assembly lines to insure a constant rate is an example.
  (17) Capacity Principle: Use handling equipment to aid in fully utilizing production capacity. The use of outdoor storage whenever possible and the design of conveyor speeds for optimum feeding of parts are examples.
- (18) *Performance Principle:* Measure and monitor the performance of your material handling system. For example, the calculation of a cost per move and the constant monitoring of this should be done.
  (19) Safety Principle: Design methods and equipment for operator safety. The use of "cages" around and especially over the head of a fork truck operator is an example.

Principles of Material Handling

- These 19 principles are vitally important to anyone involved in material handling systems design and each principle should be considered in every design endeavour.
- They are, however, qualitative in nature. Almost all industrial engineers prefer to deal with quantitative techniques.
- Infact, many quantitative techniques are applicable in the design of material handling systems, but this is outside the scope of this course.

1·3.5 The Unit Load Concept

- The Unit Size Principle in material handling implies that, the larger the load handled, the lower the cost per unit handled.
- A unit load may be defined as a number of items, or bulk material so arranged or restrained that the mass can be picked up and moved as a single object, too large for manual handling, and upon being released will retain its initial arrangement for subsequent movement.
- It is implied that any single object too large for manual handling is a unit load.
- Even though it has many advantages, the unit load also has some disadvantages, such as;
  - Cost of unitizing and de-unitizing
  - Equipment and space requirements
  - Tare weight of unitizing medium
  - Problem of returning empty pallets or containers
  - Transfer equipment often no available on both ends of the move

Unit Load Concept

- Basic ways to move a **unit load**
- Movement of unit loads is normally accomplished in one of the following ways;
  - A lifting device under the mass
  - Inserting a lifting element into the body of the load
  - Squeezing the load between two lifting surfaces
  - Suspending the load
- This leads to the various types of unit loads and related devices;
  - On a platform
  - On a sheet
  - On a rack
  - In a container
  - Self-contained

Unit Load Concept

- Devices such as pallets of skids that may be used to handle unit loads should be selected on the basis of factors as;
  - Purpose for which the unit load is intended
  - Characteristics of item handled
  - Handling system capabilities and limitations
  - Carrier characteristics
  - Physical facilities - vendor, plant, customer
  - Disposition of pallet, etc.
  - Common practice in the industry
  - Pallet characteristics
  - Building characteristics

Unit Load Concept

- Unit load **planning and** design
- In carrying out the design of the unit load, it should be evaluated against such criteria as:
- Minimum tare weight
- Low cost
- Mechanical strength
- Disposable (or expendable)
- Universal in application
- Optimu 1 size
- Low maintenance