Chapter 12
Materials Handling

To manufacture any product, it is necessary either that materials move from one step of the manufacturing process to another or that operators move to the materials. The most common practice, of course, is to move the move the materials. This movement of materials from one processing area to another and from department to department necessitates the use of much personnel and equipment and the handling of treatment tonnages of materials.

Consideration for the handling of work-in-processes materials, as well as raw material and finished goods, has always been a part of the production systems design process. Basic cost accounting evaluation of the cost of manufacturing products reveals that when materials handling costs are separated from other costs, they can be seen to be significant.

Recently, the materials handling function has been undergoing significant changes in concept and implementation. Management has been changing its view of materials handling as the routine transfer of materials from place to place and is beginning to think of it as part of a total materials flow system. This change in thinking has come about largely as a result of new automatic handling and storage equipment and systems that are integrated closely with automatic processing and sophisticated management information and control systems.

Definition of Materials Handling

In a broad sense, materials handling includes all movement of materials, in a manufacturing situation. It has been defined by the Materials Handling Division, American Society of Mechanical Engineers, as follows: “Materials handling is the art and science involving the moving, packing, and storing of substances in any form.” This is an all inclusive definition and can include fluids and semi-fluids, as well as discrete items. For the sake of simplicity, we shall limit our discussion in this chapter to the movement of discrete items, such as gears, tires, castings, and boxes. Similarly, we shall consider only the movement of materials within the plant or storage areas. Movement of materials between plants—particularly when common carriers are used— is generally considered a problem in traffic and is frequently handled by a separate traffic department.

Objectives of Materials Handling

The simplest solution to the materials handling problem—“No movement, no cost” is hardly practicable for a complete manufacturing process. It is basically sound approach when one is attempting to improve a complete production cycle and when the number of handling can be reduced. It is also a good solution in the making of heavy industrial equipment.
In the latter situation it is often more feasible to bring the tools and workers to the product than to transport the product to the machine or work area.

In addition to the objective of reducing the overall costs of materials handling by reducing the number of handling involved, the following may be considered as objectives of the engineer in his or her approach to this problem.

Lower the unit materials handling costs. It is obvious that if the overall materials handling costs are reduced the unit costs will be reduced. This approach requires the costs of handling be allocated to or identified with the units of product, or its component parts that moved.

Reduce the manufacturing cycle time: The total time required to make a product from the receipt of raw materials to the finished goods can be reduced through effective materials handling.

Contribute toward a better control of the flow of goods: A principle way in which good materials handling practice can effect savings is by making the control of goods easier-particularly in continuous manufacturing, where all operations are “tied together” by the materials handling plan.

Provide for improved working conditions and greater safety in the movement of materials many of the provisions of the occupational Safety and Health Act require adherence to safe handling practices. These must be followed. In addition, it is evident that the safe handling of materials will be reflected in a better industrial accident record.

Provide for fewer rejects: Care in the handling of the product will contribute to a better quality level of the goods produced. Products damaged by inefficient handling are all too often a major cost to manufacturer.

Achieve decreased storage requirement: Better movement and storage of materials should increase the utilization of storage space.

Gain Higher productivity at lower manufacturing cost: Any materials handling system, if it is worth its investments, is design to improve productivity. This improvement should be achieved by moving materials in the fastest, most efficient and economical way possible.

Principles of Material Handling

A good materials handling engineer will generally have several years of experience that can be brought to bear on the solution of materials handling problems or the design of materials handling systems.
For many years, discussions of principles of materials handling have been published by many experts in the field. The following list has been adapted from two of these sources:

1. Eliminate wasteful methods by
   a. Reducing to a minimum the number of handleings of materials.
   b. Eliminating unnecessary mixing and subsequent sorting.
   c. Using mechanical aids to eliminate the use of hand labor in movement of materials.
   d. Avoiding the unnecessary transfer of materials from floor to workplace or from container to container.
   e. Increasing the speed of handling.
   f. Utilizing containers and unit loads.
   g. Utilizing gravity as a moving force wherever practicable.
   h. Introducing automatically into the materials handling plan.

2. In laying out the plant:
   a. Plan a system for materials flow and combine handling with processing wherever possible.
   b. Provide for continuous or appropriate intermittent flow of materials.
   c. Provide for the optimal flow of materials between operations and with a minimum of retrograde movement.
   d. Plant the layout of the work-station area for a minimum of handling of the product.
   e. Maximize the quantity and size of weight handled.
   f. Coordinate the overall materials handling throughout the entire plant.
   g. Provide for safe handling and safe equipment and integrate with the management information and control system.
   h. Plan for adequate receiving, storage and shipping facilities.
   i. Make optimum use of building cubage.
   j. Design adequate aisle and access areas.

3. In the selection and application of materials handling equipment:
   a. Plan activities and analyze equipment needs before considering the purchase of new equipment.
   b. Ensure that the existing equipment is being used effectively.
   c. Use the simplest equipment that is adaptable to the problem: avoid the use of complicated mechanisms and controls.
   d. Adopt standard equipment if possible; ensure that the purchase of special equipment is economically justified.
   e. Select equipment that is flexible in its application.
f. Select equipment that will minimize the ratio of mobile equipment deadweights to pay loads.
g. Determine comparative costs of equipment before purchasing.
h. Recognize the need for different equipment for different jobs.
i. Recognize the need to provide suitable building conditions for the equipment.
k. Give consideration to the maintenance of the equipment.
l. Replace obsolete methods and equipment with more efficient ones.

Analysis of Materials Handling Problems

In chapter 10 we discussed a systematic approach to the solution of methods problems. The same procedure will work equally well in solving materials handling problems. It requires establishing an objective, collecting as much factual data as possible, analyzing the data, applying known principles, and formulating a solution. In collecting the data careful attention should be give to the effect of handling on the product, the present method, and cost factors.

Hughes Aircraft described an example of the use of simulation to study a materials handling problem. They describe an effort to combine six storeroom into a single, automated facility. The simulation analysis enables the materials handling and process engineers to identify key interrelationships and dependencies that had to be considered in the new design.

General Types of Materials Handling Equipment

Tompkins and White divide materials handling equipment into five classifications. They give the following list but note that numerous variations can exist within each category:

1. Conveyors
2. Monorails, hoists, and cranes
3. Industrial trucks
4. Containers and supports
5. Auxiliary and other equipment

Factors Affecting the selection of Materials Handling Equipment

The selection of materials handling equipment requires the attaining of proper balance between the production problem, the capabilities of the equipment available, and the human element involved. The ultimate aim is to arrive at the lowest cost per unit of material handled.

Equipment factors to be taken into consideration may well include the following:
Adaptability: the load carrying and movement characteristics of the equipment should fit the materials handling problem.

Flexibility: Where possible the equipment should have flexibility to handle more than one material, referring either to class or size.

Load capacity: Equipment selected should have great enough load-carrying characteristics to do the job effectively, yet should not be too large and result in excessive operating costs.

Power: Enough power should be available to do the job.

Speed: Rapidity of movement of material, within the limits of the production process or plant safety, should be considered.

Space requirements: The space required to install or operate materials handling equipment is an important factor in its selection.

Supervision required: As applied to equipment selection, this refers to the degree of automaticity designed into the equipment.

Ease of maintenance: Equipment selected should be easily maintained at reasonable cost.

Environment: Equipment selected must conform to any environment regulations.

Cost: The consideration of the cost of the equipment is an obvious factor in its selection.

Accounting for Materials Handling Costs

The cost of materials handling arises from two sources: the cost of owning and maintaining equipment and the cost of operating the system. General cost-accounting practice classifies the cost of handling materials as an indirect cost or overhead. This classification is based on the position that the movement of the materials does not contribute to their physical change or add value to them as a product or as a component part thereof.

In some manufacturing situations, such as a carbon black plant where the material is constantly moving during the production process, this contention of the cost accountants might be challenged. However, the problem of classification of unit handling costs of most situations is more of an academic than a practical nature.

Relation of Materials Handling to Flow of Material and Plant Layout

The pattern of flow of materials in a plant definitely affect the materials handling costs. The production process should be so planned and the machines and benches so
arranged that the handlings of materials are reduced to a minimum with as little backtracking of goods as possible. The type of manufacturing is a major factor in this respect.

In the layout of a plant for continuous manufacture the pattern of flow is planned will in advance; because of balanced machine and assembly lines, it lends itself to a well-planned flow of component parts, subassemblies, and assemblies. This makes it possible to plant the handling of materials in advance, procure and install the best equipment for the job, and design for a minimum materials handling cost. However, one installed, the plan lacks flexibility—usually it cannot be changed without major expense.

Storage

Material in storage is generally thought to be stationary or idle. But the use of conveyors as storage devices is quite popular. These conveyors may be overhead and constantly moving, yet utilizing ceiling—space storage. Such an installation is pictured in figure 12-10. Other storage installations may be like the skate conveyors shown in figure 12-11b. In one Midwestern furniture plant the complete floor of the finish drying room is covered by a large slat conveyor that moves very slowly: pieces placed on this “floor” at one side of the room are dry when they reach the other side.

Packaging

Whether packaging is or is not a phase of materials handling is to some degree an academic question. The unit load is in itself a “package”. Generally speaking, however, the term packaging is used to cover the preparation of the final product for shipment, particularly if the product is a consumer good.

From the viewpoint of a material handling problem, packaging of the incoming materials as well as of the outgoing product directly affect materials handling methods and equipment—and the resultant materials handling costs. The designing of the package of a product, although usually identified as a separate activity or function, is closely interrelated with materials handling, methods of production, and marketing. Attractively packaged good on the shelves and counters of the store, as well as the identification of large shipments on trucks and railroad cars, are effective advertising and sales promotion.

Organization For Effective Materials Handling

Good materials handling practice is the responsibility of all members of the manufacturing team, from the top management down to the trucker working in the aisle of the plant. Very few other elements of manufacturing activity must be so carefully considered by each function in the manufacturing organization. Optimum effectiveness of materials handling procedures can only be attained if each individual recognizes and plays his part. Education and training in materials handling are prerequisite to minimum materials handling costs.
Responsibilities assigned such a staff group may well include:

1. Determining all new methods for the handling of new materials or products and selecting the equipment to be utilized.
2. Conducting research in materials handling methods and equipment.
3. Conducting education and training for all manufacturing personnel in good material handling practices.
4. Establishing controls of current materials handling costs by analysis of costs and comparison to budgets of either unit or total materials handling costs.
5. Initiating and conducting a continuing materials handling cost-reduction or cost improvement program.
6. Determining measurements for effectiveness of materials handling that can become the yardsticks for progress in this activity.
7. Developing and conducting a preventive maintenance program for all materials handling equipment.