

## **VIII. MANUFACTURING COSTS**

### **1. Introduction**

1.1. In the manufacturing sector the two main ways of meeting the profit crisis are to increase output and reduce waste, whether of time, material, or money. Effective use of equipment, streamlining of work methods, standardisation of product, and careful production control all contribute to profit improvement through cost reduction.

1.2. The means or practical methods of obtaining a better product at the lowest possible cost, and the principles involved are considered here.

1.3. We all admit that, to survive in a competitive market, a business enterprise must realise a profit on the sale of its products or services, and to enjoy profitable business a manufacturing firm must satisfy its customers on five counts; customers must be satisfied with the quality, quantity, price, time of delivery, and service. Each of these points must always be borne in mind when trying to control or reduce costs. For it is of no use to reduce your selling price if your service is found poor, or if the quality of your product is not up to par. It won't help you either to look for low manufacturing costs at the expense of late deliveries. Sooner or later, you are bound to have trouble and lose your outlets, even if your prices are the lowest; and we all know what it means to any business to lose its customers.

1.4. Keeping these principles in mind, let us assume that there are two main ways to control or reduce costs in the plant. First, by increasing output with the equipment and labor force available, and second, by reducing costs or waste; whether it be waste of time, of material, or of money.

1.5. There are many requirements a manufacturing firm must meet to obtain maximum output from existing equipment and the working force it employs.

## **2. Getting Most from Equipment**

2.1. First, a good layout of equipment is necessary if the various operations of a manufacturing process are to follow one another in a logical and continuous manner. Thus, bottlenecks and unnecessary handling-always costly items are avoided.

2.2. Adequate equipment is required to obtain maximum productivity, and a product of good quality. But beware of expenditures for additional equipment or improvements to existing equipment that do not pay for themselves through the savings they effect. Otherwise these purchases or improvements are merely additional expense, and, therefore, an increased cost. When considering the purchase of new equipment, you should not stop at making sure you can afford the capital outlay, but you should analyse the charges for depreciation, interest on money to be spent, installation and any other expenses involved, to see if the anticipated savings will take care of these extra expenses and still leave an appreciable benefit.

2.3. Another point that one should not lose sight of, is the capacity of the equipment that you are buying. This capacity should be in line with your needs. For instance, it is an unnecessary expense to buy a machine which can produce 10,000 units daily when your plant capacity requires only 2,000 units, if less expensive equipment may be procured.

## **3. Work Simplification & Product Standardisation**

3.1. Streamlining of methods and standardisation of product, wherever possible, are also very useful ways to increase productivity, and thus reduce costs.

3.2 Simplifying work methods requires careful study of each operation in order to find shorter or more advantageous ways to reach the same goal. To achieve this end, one has to be patient, willing to work unrelentingly, and be well acquainted with modern methods and techniques. A progressive manufacturing enterprise must devote particular and sustained care to finding ways to improve its product and its manufacturing methods.

3.3. The task of simplifying work methods does not end with just putting them into practice; there must be a follow up. Establishing new methods and putting them into practice often requires more than one person, and, of necessity, the cooperation of the foreman and the workers concerned. This is not always an easy task, as you will have to change the old habits and modify deeply-rooted routines. Tact and patience are required to change the manner of working of an employee who has been doing the same operation for years, and more so if the employee is competent.

3.4. It has been mentioned already that standardising a product would assist in reducing costs. It is obvious that if some machines have to be adjusted several times a day, considerable time is lost. Moreover, an operator who has to change work many times a day will not be in a position to produce what may be expected of him, and will not be able to acquire the ability and rapidity of another who does the same operation all day long. This standardisation must be sought with the cooperation of the sales department, and should not be to the detriment of that department. While you may make many products, it is often possible, and also advantageous, from a cost viewpoint, to determine the basic operations applying to each of these products. This will help balance your production lines with a view to obtaining maximum output.

3.5. In many cases, production control or planning will be most useful in balancing production, and thus increasing the yield.

3.6. The principle guiding production control may be explained as follows: A factory with its equipment and workers is capable of producing a maximum quantity of products in a given period, provided the required materials are available at the proper time and place to manufacture without stops or delays. Moreover, this maximum quantity of products that we want to make cannot exceed the maximum capacity of machines and workers in each of the operations where the products must undergo a transformation. In other words, the maximum capacity of a factory is equal to the maximum capacity of the weakest spot in the plant. Admittedly, this is a rather vague definition, but let us use an example to illustrate it.

3.7. Let us suppose that a pastry plant normally bakes 3,000 cakes daily. It is close to the Christmas season and the same plant has to make fruit cakes which require longer baking than ordinary pastries. It seems evident that, if the ovens cannot bake more than 3,000 pieces of ordinary pastry daily, it would not be advisable to prepare 3,000 fruit cakes in a day. There will be a bottleneck at the ovens, a loss of time, and probably a loss of materials. The production controller must take into account the capacity of the ovens, and not put into production more cakes than the ovens can bake. But, to obtain a maximum yield, he nevertheless must balance the orders he is putting into process in such a way as to allow each department or operation to produce a quantity of products as close as possible to the maximum capacity of the plant.

#### **4. Production Control in Action**

4.1. Here is how this system operates in a footwear factory. Each day a list or schedule of orders which are intended to put into process is to be prepared. The person responsible for the operation of the system-the production controller, or the production manager - must make sure that they have in hand all the required raw materials

and machines, so that the orders are not stopped en route because a piece of material is missing. He must also make sure that all the orders do not call for the same patterns, because all leather cutters cannot work on one or two sets of patterns at the same time. The production controller must also check the required lasts and sizes to make sure that enough lasts are available in the desired sizes to make lasting possible at the determined time. Also, he must be sure that the shoes which he is putting into process will not cause any bottleneck at certain operations or machines because these styles may take more time to make, or require special work where the plant capacity has a limited number of machinery or workers. This applies particularly to the stitching department where operations are often irregular and more liable to create frequent bottlenecks if no trouble is taken to study and balance the daily schedule according to the capacity of machines or operations. This equilibrium or balance is reached in the following manner.

4.2. On the cost sheet which is prepared for each model they make, they prepare an estimate of the cost of each operation in Rupees. This cost serves as a basis or measure to determine the production capacity of each of the machines and operations in the stitching room. For example, they know that a sewing machine operator can earn Rs. 9.00 per day, and consequently the capacity of each sewing machine in that department is Rs. 9.00 worth of work rather than X pairs. The capacity in pairs is easily obtained by dividing Rs. 9.00 by the estimated cost of the work per pair according to the model.

4.3. Thus, if they have two machines of a given type, and the operation on each pair of those on these machines cost 5 paise, the production controller knows that he cannot put into process on any given day more than 360 pairs of that model. He must find other orders for shoes which do not have to go through these two machines to complete the maximum quantity required to fill in the daily production schedule.

4.4. This work necessitates a good knowledge of the working conditions of a plant as well as a vast technical knowledge of the product. It may appear complicated, but the best results can be obtained by the company. This scheduling or planning of operations will enable them to balance the production, and to increase yield by about 20% without an appreciable increase in personnel or equipment.

4.5. The scheduling or planning of operations allow them to make full use of their manpower and equipment.

4.6 Let us now consider the reduction of costs or waste.

## **5. Controlling Waste**

5.1. Materials are often the largest single item in the cost of a product. They account for as much as 60% to 80 % of the manufacturing cost in some businesses,

and are equal to overhead and labour costs in others: No plant can turn out its products without the right materials at the right place at the right time. In any manufacturing concern, two items consistently appear at the top of the list of competitive advantages or disadvantages: they are direct labour and materials. Materials are often easier to lose control of or neglect than people, and lack of control of raw materials can quickly lead to critical working capital problems, particularly in smaller concerns. Though there is seldom a 'materials control department' in a small company, the function of materials control should be carried on, to some extent at least, by someone in authority.

5.2. To prevent ruinous overstocking of items or equally ruinous serious shortages, it should be the responsibility of someone to make sales analyses or forecasts as a basis for the purchase of materials. From this, we see that a material control programme affects many departments and requires integrated planning and organisation, which are the first phases in any programme. Other phases are the establishment of procedures and records to control proper use of material, and prevent waste.

5.3. Interest in the subject of waste control appears to fluctuate with the state of a company's prosperity. When business is good and profits are realised, the attitude towards waste control may be indifferent, but when business is dull, management begins to tighten control on all forms of waste. However, the transition from wastefulness to thriftiness is not always easy to accomplish. Once an attitude of laxity is allowed to prevail, it is difficult to re-establish control of wasteful practices. Nevertheless, as realisation of a profit is dependent upon the effective use of the five 'M's'-men, machines, money, materials, and methods-waste must be reduced to a practical minimum in any efficient factory. The term 'practical minimum' is used intentionally, as it would not be evidence of good management to attempt to control waste 100%. The imposition of too many rules and regulations, too many procedures and restrictions, all of which may cost more to operate and enforce than the savings they are intended to effect, would not be wise, efficient, or prudent. Both extremes must be avoided. But, remember, Rupees saved are Rupees earned.

5.4. Moreover, every member of a business organisation, from the General Manager to the worker has a responsibility for waste control, which, generally speaking is in ratio to the importance of the position he holds.

5.5. The first step in waste control in any industry is to find out what the situation is. A complete survey will tell the extent of wasteful practices down the line. Having ascertained the weak spots and determined the causes, the next step is to review the systems, procedures, and methods with a view to plugging the leaks and tightening the controls.

5.6. No matter how well-devised a waste control plan might be, its effectiveness will depend upon selling it to those charged with specific responsibilities, and persistent

and consistent follow through. Their interest and cooperation must be enlisted, and this is a challenge to the leadership ability of any controller. It may be borne in mind that effective control of waste might well spell the difference between profit and loss.

5.7. The most important items in the control of production costs have been outlined so far. There are many others, and each one reinforces the others. They take into account that eliminating losses and waste is just as important as increasing output. A happy medium must be established if the customer is to receive a good product at a good price, the employees are to be paid fair wages, and the shareholders are to draw their dividends. This is a high goal to attain, but should be the objective of any business enterprise.

5.8. The years of easy profits are coming to end. Competition is keener than ever before, wages and manufacturing costs have increased manifold, and are stilton the way up. This all adds up to the point that if tight control of production costs was important to the success of a manufacturing firm in the past, today it has become a necessity. Having discussed here how material waste reduction improves the profitability of the industrial unit, let us discuss the importance of material utilisation in a country like ours.

## **6. Material Utilisation**

6.1. The importance of proper utilisation of materials, especially in a country like ours, where there are serious shortages, need hardly be overemphasized. In India, material costs in many industries account for 60 to 80 per cent of the total manufacturing cost. Materials, therefore, constitute a major item of importance in our industries as far as utilisation of resources is concerned. The greater the utilisation of materials, the lesser the scrap, the lower the cost, and the greater the return to the industry.

## **7. Types of Materials Used in Industry**

7.1. Different types of materials are used in industry. They are:

1. Solids,
2. Liquids, and
3. Gases.

7.1.1. (a) Among solid materials we have ferrous and non-ferrous metals in many forms like rolled sections, rods, and sheet stock.

7.1.2. (b) Liquid materials are oils, lubricants, thin and thick liquids; liquids which evaporate when exposed to atmosphere; e.g. acids; liquids which

get deteriorated due to shortage, exposure to sunlight; and- finally, liquids which are inflammable.

7.1.3. (c) Among gases, we gave Carbon Dioxide, Oxygen, and Hydrogen which have industrial uses.

7.2. The materials used in the industry may be direct or indirect. Direct materials are those which go directly into the finished product, e.g. stainless steel sheet in a plate or a vessel, yarn in textiles, cloth in readymade garments, and paint in painting. Indirect materials are those which do not go directly into the product, but which aid its production; e.g. lubricants, cutting oils, cotton waste, emery paper, sulphuric acid in electroplating, and oxygen-acetylene gas in welding.

7.3. *Example:* In a factory manufacturing automobiles or bicycles, some parts are machined on special equipment. During machining the equipment requires lubricating oil, cutting oil, etc. These materials, though not forming a part of the finished product, are yet required for producing the desired finished product, and so they are called indirect materials.

## **8. Economic Use of Raw-Material Is-Waste Reduction**

8.1. *Solids:* Proper utilisation of materials can be achieved through two ways:

- (a) Reducing waste by use of right quantities, and
- (b) Reducing waste by selecting the right manufacturing process.

8.1.1. **Right Quantities of Materials:** Waste occurs when more materials than required are used in making a part or a product. For instance, a tailor may, through careless cutting, use  $2\frac{3}{4}$  meters of cloth for making a bush shirt, whereas with care and experience he may require only  $2\frac{1}{4}$  meters. This may look very simple, but such instances are common in some industries, and when it comes to scarce materials, even small wastes may cause considerable losses. Such wastes may be deliberate (due to carelessness of workers, inefficiency of management, etc.), or may be due to ignorance. For instance, in a factory manufacturing steel almirahs, it was found that the management which was keen on reducing materials waste was actually frittering away scarce M.S. Sheets by improper selection of sizes and by thoughtless cutting of sheets for various components, (Front, back, top, bottom, sides, ribs, racks of almirahs). By a rearrangement of the selection of sizes and cutting, the management was able to affect a 38 per cent saving in the use of M.S. Sheets.

8.1.2. **Selecting the rightly manufacturing process:** Waste of materials may also occur due to wrong manufacturing processes. Suppose we require a bush, this can be machined from a solid bar or can be made from a tubular section. In the first

Process, the bar will have to be machined, and the material removed to the required bore size. A lot of material is wasted in this process during machining operation. Instead, if a tubular piece is taken, and then machined, probably bulk to bulk, the quantity of material required will be 1: 6, or even 1: 8, as the case may be.

Similarly, there are instances where a part can be machined from a solid bar stock or forged roughly to a shape and then machined. By forging the part, raw material wastage will be practically insignificant, whereas with a bar or a stock size material not only is there wastage, but also difficulty in machining. Thus by selecting a right manufacturing process, you can achieve better materials utilisation.

## **9. Raw Material Wastage in Foundries**

9.1. Coming to the wastage of raw materials in foundry, the runners and risers provided sometimes form part of the raw materials consumed in molten condition. If the size of pouring is not properly designed, there is every likelihood of more metal being used for such purpose. This means that the molten metal is wasted, instead of being used for direct purpose, thus increasing the cost of melting as well as the cost of production. Proper care should be taken in the manufacture of castings; if there are too many rejects there is loss of material, loss of labour, and increase in the cost of production.

## **10. Wastage of Standard Materials**

10.1. Standard parts like bolts, nuts, screws, and required in assemblies should also be utilised carefully. There are instances where if we require, say a bolt of 1 ½ cms. Length, and if the same is not available, immediately a longer bolt is taken, trimmed to the required length, and used. This is also a case of improper utilisation of raw materials. Such wasteful practices are common in some industries, but they should be avoided. Where large quantities of bolts are used, it is necessary that bolts of proper lengths length should be held in ready stock and made available for assembly. Sometimes, if for a certain assembly a specific length of bolt may be required for some other purpose, but have been misused in a particular instance. This constitutes avoidable waste and improper utilisation of materials.

### **10.2. Wastage of Sheet stocks**

10.2.1. It should be remembered, that in preparing blanks or cutting out shapes for different parts maximum economy should be used; otherwise there will be wastage of raw material.

*10.2.2. For example:* A specification might call for 16-gauge material, but since it is not available you may use 12-gauge material. This may be acceptable to the customer, but the fact is that more material has been consumed by way of volume. At the same time the manufacture of another part requiring 12-gauge sheet may be held up for want of this particular raw material. This is another point which should be borne in mind in material utilisation.

### *10.3. Wastage of Liquid Materials*

10.3.1. The wastage of liquid materials can be minimised by proper controls. Many of you might have observed that when spray painting is done in open space, a lot of paint is wasted due to atmospheric conditions, and only a part of it is utilised on the product. If care is taken to see that the gun is directed correctly on to the product, and that there are no external sources spreading the paint, you will obtain a better use of your paint. In some machines where coolants are provided for cooling the tools, the coolants are not properly collected and are wasted.

### *10.4. Wastage of Gases*

10.4.1. In gas welding, both oxygen and acetylene are used, and they are tapped from a cylinder. It is likely that the gases may be escaping through the valves if proper care is not taken to tighten up all the covers, etc. There is also a tendency on the part of the welding operators to allow the burner to burn continuously just to avoid the setting of the burner glow each time they start welding. Though the sparking of the gas takes a few seconds, it is always preferable to do so rather than allow the gas to burn which is a source of wastage.

10.4.2. From the above examples, it is clear that in all materials - solid, liquid or gas - whether direct or indirect, proper care should be taken to minimise all waste and to maximise utilisation. Only by this process can the cost of production be kept to a minimum.

10.4.3. Apart from the above, wastage of materials may occur due to other factors as well.

### *10.5. Wastage due to use of costly materials*

*10.5.1. For Example:* In packing cases, sometimes timber of fairly high value is used instead, it is possible to use cheap timber with thinner cross sections. Similarly cardboard can be used in packing, instead of costly packing materials.

### *10.6. Wastage due to selection of uneconomic size of materials*

10.6.1. The suppliers supply raw materials in given stock lengths. It would be necessary to calculate how economically the stock lengths should be cut to ensure

Maximum utilisation. A particular raw material may be required for many individual parts.

*10.6.2. For Example:* A 1 cm. diameter bar of steel may be required for making different lengths of bolts or pins, etc. It may be that at one time we may make one particular size of bolts, and take up other sizes/items as and when necessary; but, while the pieces are cut from the bar stock, care should be taken to see that, after allowing the required minimum waste for cutting, the bar is cut economically so that even the pieces left out can be utilised for other sizes/items which may be taken up for production at a later stage.

#### *10.7. Wastage due to change of design*

10.7.1. For inventory control, stock of raw materials should be based on certain set rules. If any design change is contemplated, the raw materials available should not be a burden on the factory, but, as far as possible, should be utilised. If this is not taken care of at the stage of planning a new design, a lot of material may have to be scrapped due to design change. So, it is necessary that whenever a design change is contemplated proper care should be taken to check up the raw materials in stock, and see how far they could be utilised in the new design; if this is not possible, the introduction of new design may have to be delayed until the existing materials are used up.

#### *10.8. Wastage due to improper storing and other causes*

10.8.1. The proper storage of materials is another important factor in material utilisation. If materials are stored without proper treatment for corrosion, etc., they are bound to deteriorate, and their utility lost.

*10.8.2. For Example:* In places near the sea-shore where the climate is humid, there is always the possibility of corrosion setting up if steel is exposed to atmosphere. So, it is very essential that such materials are properly treated to prevent corrosion.

10.8.3. Some materials like timber get deteriorated due to corrosion by insects.

If you are stocking such materials, care should be taken to see that they are not affected by insects or other atmospheric conditions.

10.8.4. Certain material, like rubber, also deteriorates if they are exposed to varying atmospheric conditions, like too much heat or cold. It is, therefore, necessary that such materials are stored in buildings with proper temperature controls.

10.8.5. Certain liquids like spirit and thinners evaporate in certain temperatures. This should be watched, and steps taken to keep them in proper temperatures.

10.8.6. It is thus obvious that the greater the care you take in the storage of materials, the better is the utilisation. Any scrap or non-utilisation or deterioration of the

Material will be reflected in the cost of production as these costs will have to be recovered from the total production of the factory.

## **11. Material Wastage and Costs**

11.1. As already stated, since the material costs in our country account for nearly 60 % of the total cost of production, there is a great necessity for keeping the cost of this item to the minimum. The greater the utilisation, the nearer we come to the actual cost of raw material. Otherwise the cost of all the materials misused during the production process or otherwise will have to be borne by the product which will increase the cost of production. By utilising solid bars, instead of hollow bars, the cost of raw material is proportionately increased. By turning extra material instead of forging, the cost of raw material is increased, since the volume of material used is more in the former case. The manufacturing cost of a casting increases if during the melting process more molten metal than necessary is used in runners and risers. Similarly, in arranging the blanks to be cut from a given stock size, if you reduce the scrap, the cost will be less. In the case of gas welding, if the gas is burnt out without being utilised, the cost of the gas will increase the cost of the product as well. These examples are enough to show how proper utilisation of materials will bring down the cost of production. The relationship between the cost of material the costal production is in the form of a straight line curve: the higher the cost of material, the higher the cost of production~ and vice versa.