

Unit-3

Productivity and Ergonomics

Contents:-

- Productivity and Quality Control- Meaning, Definition, Importance,
- Measurement techniques, Quality control, Quality circles, TQM.
- Ergonomics: Definition, Importance, Bio-Mechanical factors, safety equipment and device.

Productivity (Meaning):

- Productivity is a relation between returns and the cost. When for the same production, cost decreases or for the same cost, production increases, there is said to be increase in productivity.
- Productivity can also be defined as the relationship between output of production and the input required to produce it.
- Productivity is an average measure of the efficiency of production. It can be expressed as the ratio of output to inputs used in the production process, i.e. output per unit of input.
- When all outputs and inputs are included in the productivity measure it is called as Total productivity.
- Productivity measures that use one or more inputs or factors, but not all factors, are called Partial productivity. A common example in economics is labour productivity, usually expressed as output per hour. At the company level, typical partial productivity measures are such things as worker hours, materials or energy per unit of production.

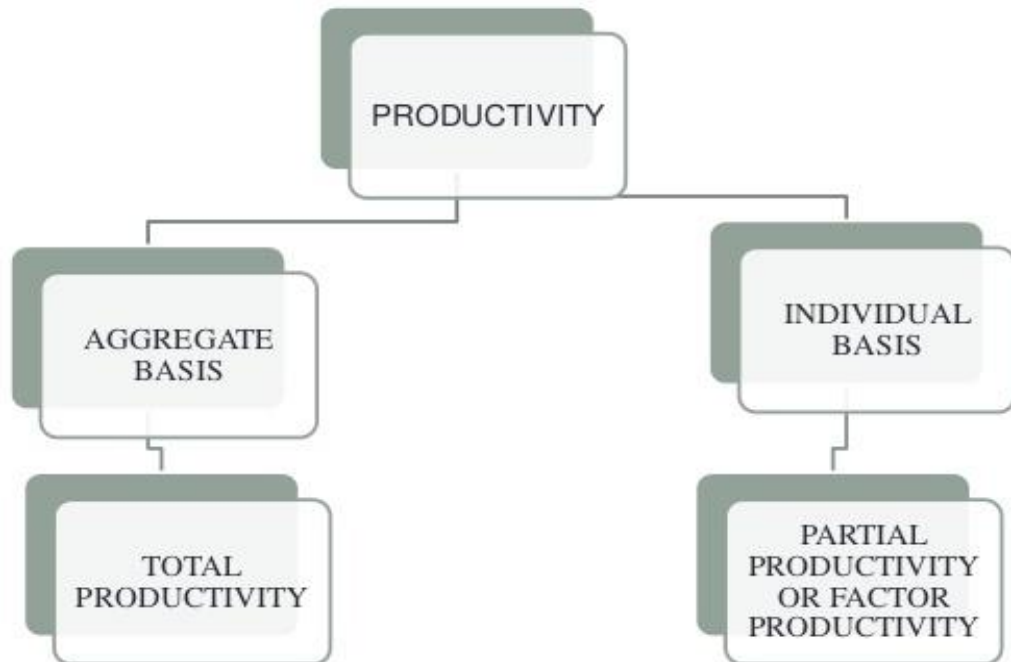
Importance of Productivity

- (a) To eliminate waste in all forms.
- (b) To reduce costs and make items cheaper.
- (c) To provide better standard of living to maximum number of people.
- (d) To improve working conditions and reduce fatigue.
- (e) To earn more revenue for the Government.

- (f) To help the worker in earning higher wages, incentives and bonus.
- (g) To obtain higher profits.
- (h) To reduce losses.
- (i) To enable the management to get more capital.
- (j) To enable the shareholders to get higher dividend and maximize their wealth.

+ Measurement techniques

Techniques for Measurement of Productivity:



Aggregate Basis

- On aggregate basis, output is compared with all inputs taken (added) together. This is called as Total Productivity.

Hence,

$$\text{Total Productivity Index} = \frac{\text{Total output}}{\text{Total input}}$$

- Where Total Output=Total production of goods and services and Total Input= Labor + Material + Capital + Energy.
- **This index measures the productivity of the entire organization with use of all resources. It is a way of evaluating efficiency of entire plant or firm.**

Example

10,000 Units Produced

Sold for \$10/unit

500 labor hours

Labor rate: \$9/hr

Cost of raw material: \$30,000

Overhead: \$15,500

Example : Total Productivity

$$TP = \frac{\text{Output}}{\text{Labor} + \text{Materials} + \text{Overhead}}$$

$$TP = \frac{(10,000 \text{ units}) * (\$10)}{(500) * (\$9) + (\$30,000) + (\$15,500)}$$

$$TP = 2.0$$

Individual Basis

- On individual basis, output is compared with any one of the input factor and this is called as Partial Productivity or Factor Productivity.
- Factor productivity or partial productivity indices are of following types:
 - I. **Labor productivity**
 - II. **Material productivity**
 - III. **Machine Productivity**
 - IV. **Capital productivity**

Labor Productivity

- Labor productivity is simply defined as the ratio of Total output to the Labour input i.e.

$$\text{Labor Productivity} = \frac{\text{TOTAL OUTPUT}}{\text{LABOUR INPUT}}$$

- Labor productivity depends upon how labors are utilized.
- Labor productivity can be higher or lower depending on factors like availability of work load, material, working tools, availability of power, work efficiency, level of motivation, level of training, level of working condition (comfortable or poor) etc.

Example

- **10,000 Units Produced**
- **Sold for \$10/unit**
- **500 labor hours**
- **Labor rate: \$9/hr**

What is the labor productivity?

Example: Labor Productivity

- $10,000 \text{ units} / 500\text{hrs} = 20 \text{ units/hr}$
- $(10,000 \text{ units} * \$10/\text{unit}) / 500\text{hrs} = \$200/\text{hr}$
- $10,000 \text{ units} / (500\text{hrs} * \$9/\text{hr}) = 2.2 \text{ unit}/\$$
- $(10,000 \text{ units} * \$10/\text{unit}) / (500\text{hrs} * \$9/\text{hr}) = 22.22$
- The last one is unit-less

Material productivity

- **Material productivity** = $\frac{\text{Total output}}{\text{Material input}}$ or
- **M.P** = $\frac{\text{Number of units produced}}{\text{Total material cost}}$
- Material productivity plays important role in cost of production.
- Material productivity depends upon how material is effectively utilized in its conversion into finished product.
- Material productivity can be increased by using skilled workers, adequate machine tools, good design of product etc.

Machine Productivity

- Production system converts raw material into finished product through mechanical or chemical process with the help of machines and equipment's.
- **Machine productivity** = $\frac{\text{Total output}}{\text{Machine input}}$ or
- **M.P** = $\frac{\text{Output in standard hours}}{\text{Actual machine hours}}$
- Machine productivity depends upon availability of raw material, power, skill of workers, machine layout etc.

Capital Productivity

- For any production set-up, facilities of machines, tools, land etc. are required which are assets of organization. Capital is needed for such assets.
- **Capital productivity** = $\frac{\text{Total output}}{\text{Capital input}}$ or
- **Capital productivity** = $\frac{\text{Total output}}{\text{Capital employed}}$
- Capital productivity depends on how effectively assets are utilized.

Quality control:-

MEANING:-

Quality Control is a systematic control of various factors that affect the quality of the product. The various factors include material, tools, machines, type of labour, working conditions, measuring instruments, etc.

Quality Control can be defined as the entire collection of activities which ensures that the operation will produce the optimum Quality products at minimum cost.

As per A.Y.Feigorbaum Total Quality Control is: **“An effective system for integrating the quality development, Quality maintenance and Quality improvement efforts of the various groups in an organization, so as to enable production and services at the most economical levels which allow full customer satisfaction”**

In the words of Alford and Beatly, **“Quality Control” may be broadly defined as that “Industrial management technique means of which products of uniform accepted quality are manufactured.”** Quality Control is concerned with making things right rather than discovering and rejecting those made wrong.

In short, we can say that quality control is a technique of management for achieving required standards of products.

OBJECTIVES OF QUALITY CONTROL

- To decide about the standard of quality of a product that is easily acceptable to the customer and at the same time this standard should be economical to maintain.
- To take different measures to improve the standard of quality of product.
- To take various steps to solve any kind of deviations in the quality of the product during manufacturing.

Total Quality Management (Meaning):

- The concept of TQM is of a very recent origin and developed after 1980. It deals with the product in its totality. It is a strategic total approach and comprehensive system of managing the entire organizational activities which result in the production of quality goods and services through constant innovation by doing the right things at the right time.
- TQM aims at a continual increase in consumers' satisfaction at continually lower cost. From this point of view, TQM is a continuous process of improvement for all employees and total organisation.
- TQM is a very wide concept which encompasses many aspects such as quality management, quality control, quality assurance, quality operations and continuous improvement, etc.
- In short, TQM means building, controlling and maintaining quality in everything and in every area. It needs collective efforts towards excellence.
- Quality circles, quality assurance, quality control, quality planning, are some of the important key elements of TQM,
- TQM is, in essence, a customer-oriented, quality focused management philosophy.

Quality Circles (Meaning):

- The concept of Quality Circles (QC) is a result of Japanese concern for Statistical Quality Control and the establishment of the Japanese Union Scientists and Engineers (JUSE) in 1949.
- A sub-committee of JUSE entrusted with the task of quality control encouraged workers to organise QC circles with their respective supervisors to study quality control. In the early sixties, it started a registration system to promote and co-ordinate the nation-wide institutions of QC circles. This was the beginning of a movement. Over the next 20 years, more than 1 lakh QC circles were registered with JUSE involving about 10 lakhs workers.
- According to one estimate, QC in Japan are reputed to solve three to four problems per year at an average cost saving to the company of about US \$ 15,000 per year (\$ 5,000 per problem) with approximately 1 million circles in operation. Japan as a nation is saving about \$ 5 billion per year.

Definitions of Quality Circles:

(a) 'QC is a small group of five to ten workers voluntarily performing quality control activities within the workshop to which they belong.'

— Ishikawa (1984)

(b) “QC are small groups of volunteers from the same work areas who meet regularly to identify, analyse and solve quality related problems in their area of responsibility.” — Munchus (1983)

Features or Characteristics of Quality Circle:

- (a) It is a group and not an individual effort.
- (b) The participating members are volunteers.
- (c) Their efforts are directed to improve quality within their shops or places of work.
- (d) They meet frequently, often at company cost.
- (e) They represent a cross-section of age, sex and positions in the organisation.
- (f) Their concern is to find ways and means to improve the quality of their output.

Ergonomics:

- The word ergonomics derived from the Greek words ‘Ergo’ which means ‘Work,’ and ‘Nomos’ means ‘Natural Laws’. Therefore, ergonomics means laws of work. The subject dealing with the human aspects of design for a given environmental conditions is known as ‘Ergonomic Design’.
- Ergonomics can also be defined as the study of relations between man and his environment, occupation, equipment and particularly the applications of anatomical, physiological, psychological knowledge to solve the problems arising between machine and machine interface.
- Ergonomics is the science of work which deals with the relationship between man and his working environment. It implies ‘Fitting’ the job to the worker.
- Ergonomics is the process of designing or arranging workplaces, products and system so that they fit the people who use them.
- Ergonomics is defined by ILO as the application of human biological sciences in conjunction with engineering sciences to the worker and his working environment so as to obtain maximum satisfaction for the worker which, at the same time, enhances productivity.
- Ergonomics is a multi-disciplinary science comprising subjects like anatomy, psychology, physiology, sociology, engineering, anthropology, physics and medicine.
- Ergonomics is the study of human abilities and characteristics which affect the design of equipment, systems and jobs.

- According to International Ergonomics Association Executive Council
“Ergonomics is the scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.”

Importance of Ergonomics

- (a) To improve human well-being and overall system performance by optimising the integration of man and machine.
- (b) To take care of the factors governing the physical and mental strain (fatigue), so as to obtain maximum satisfaction for the worker, which at the same time enhances productivity.
- (c) To attempt to minimize the risk of injury, illness, accidents and errors without compromising productivity.
- (d) To improve the design of machine at the initial design stage or later in the modification of an existing product.
- (e) To enhance the man-machine relationship.
- (f) To develop the most comfortable conditions for the worker as regarding lighting, climate, ventilation, and noise level.
- (g) To reduce the physical work load in hot environment.
- (h) To improve working postures and reduce the effort of certain movements.
- (i) To facilitate psycho-sensory functions in reading instrument displays.
- (j) To make the better use of spontaneous and stereotyped reflexes.
- (k) To make better use of spontaneous and stereotyped reflexes.
- (l) To avoid unnecessary information recall efforts and so on.