CHAPTER – II
CONCEPT OF PRODUCTIVITY

2.1 INTRODUCTION

The main objective of a business firm is to provide value satisfaction to the consumers at a profit. Business firms always attempt to maximize profit. But in order to maximize profit a business firm has to be efficient. Efficiency is measured by the capacity of a business firm to raise the productivity of existing resources so that cost per unit is reduced. Since cost and productivity are reciprocal of each other, a rise in productivity implies a fall in cost of production which ends in higher profit.

Productivity, as a common sense is the quantitative relation between what we produce and what we use as resources to produce them i.e., an arithmetic ratio between the amount produced (output) and the amount of resources used in course of production (input). It will be desirable to examine, in brief, the concept of productivity.

2.2 MEANING OF PRODUCTIVITY

The International Labour Organisation in its report summarises the concept of productivity as follows while some think of productivity as a measure of the economy as a whole. Others think of productivity in terms of individual industries or plants”. Some businessmen in their public relations speak as though the whole matter of productivity had to do with the degree of application of the workers to their jobs. At other times, the concept of productivity is used as though it is a measure of the degree of efficiency achieved in production.

The I.L.O. publication “Higher Productivity in Manufacturing Industries” has defined productivity as the ratio between output of wealth and the input of resources used in the process of production”.

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The Organization for European Economic Cooperation (OEEC) has defined the concept of productivity as follows. In its widest sense it may be said that productivity is the measurement of the economic soundness of the nations. The European Productivity Agency (EPA) has defined productivity as follows.

“Productivity is an attitude of mind. It is a mentality of a progress, of the constant improvement of that which exists. It is the certainty of being able to do better today than yesterday and continuously. It is the constant adaptation of economic and social life to changing conditions. It is the continual effort to apply new techniques and methods. It is the faith in human progress.

One thing common to all these concepts of productivity is the desire to portray some one’s ability to produce or the rate at which production is carried on”. Professor Mehta defines productivity as the “ratio of output to the corresponding labour”. He places the validity of this definition on its ‘popularity’.

Salter accepts the measure of labour productivity as output per man hour because it has a perfectly respectable ancestry July 15, 1987. Kendrick also opined that “productivity” used to denote the ratio of output to any or all associated inputs in real terms.

But today there appears to be a consensus of opinion that productivity is the ratio of output to input. Here it may be desirable to mention the difference between the productivity of enterprise as a whole or industrial productivity and the labour productivity.
Whereas the increase in the ‘productivity of the enterprise as a whole’ is a simple function of the factors like technological advancement, improved managerial or organizational skills better entrepreneurial ability, positive attitude of all concerned, good industrial relations and the like. The productivity of labour depends on the stimuli or incentives available to human effort.

The International Labour Organization productivity mission in India also pointed out that productivity does not mean mechanization. It means development of scientific attitude on the part of management and that of labour through the adoption of scientific principles and scientific techniques.

In the words of Riggs, “productivity is the quality or state of being productive. It is a concept that guides the management of production systems and measures its success. It is the quality that indicates how well labour, capital, materials, and energy are utilized.

Increasing productivity is a goal advocated by business organized labour and Government. A change in productivity of a system results from the combined effect of all the factors contributing to the system’s performance.
2.3 FLOW CHART FOR YARN MANUFACTURE

MIXING

BLOWROOM

CARDING

COMBER

DRAWING

SIMPLEX

SPINNING

CONE WINDING

DOUBLER WINDING

DOUBLING

PACKING

UTILITY

GENERATOR POWER HSD

DISTRIBUTION TO ALL PRODUCTION SERVICE COST CENTRE
MIXING:

Cotton of different varieties in different proportions, are hand opened and laid into different layers according to the quality of cotton and depending on the end use (Yarn quality requirement)

BLOW ROOM:

The cotton is well opened and cleaned to remove the foreign matter such as seed bits, leaf bits etc., and a thin uniform sheet of 40s width and rolled in lengths of above 10 meters, known as LAP.

CARDING:

The Laps received from Blow room is further opened and cleaned and a clean rope like material, known as Card Sliver is produced and stored in cans.

COMBER:

In Combing, Short fibres are extracted to be desired extend and thus cotton is upgraded to spin superfine counts with better yarn quality.

DRAWING:

The Card Slivers (6 to 8 Nos) are passed thro’ this machine, to make the fibres in the sliver in parallel and more even, in order to improve the quality of final years.

SIMPLEX:

The Drawing sliver is thinned and made to a Strand of required size, known as Rove and wound into bobbins of 1 to 1.5 kg weight. The thinning process of material is known as drafting.

RING SPINNING:

The Roving Bobbins received from simplex, is fed in Ring Spinning frames, where the material is further thinned down, twisted and yarn is formed which is wound on small cops of 50 to 60 grams.
CONE WINDING:

The yarn in small cops is wound into bigger packages known as cone of required weight (1.25kg) after cleaning the improves from Ring Spinning Yarn.

DOUBLE WINDING:

The yarn thread is wound parallel in a single cone on a doublers winding.

DOUBLING:

Necessary Twist is inserted on ring doubling machine to produce doubled yarn and transfer to cone winding.

PACKING:

The yarn is packed in pre-stitched polywoven bags, with 40 cones of 1.25 kgs to produce 50 kgs bags or according to market requirement, in order to dispatch to various market centres/depts. for sale.

2.4 EARLIER APPROACHES TO PRODUCTIVITY

Historically productivity measures related to the physical and technical aspects of the productive process. A formal organization was created to handle problems of specialization departmentation and technical co-ordination of jobs in an organization.

The Industrial Revolution brought significant changes in technical conditions of production. Before the advent of Industrial Revolution an individual made the complete product and there existed a simple and flexible relationship between the craftsman and his few assistants.

The introduction of machinery and large scale production changed the structure of jobs and the nature of work process. Jobs were divided and individual’s work was conditioned by work processes which were increasingly characterized by repetitive jobs, immediate dependence on the work of others and problems of man-machine relationships.
Thus the compensation work, the form of co-operation and the demands on working performance were central concerns. Subsequently, the writings of Taylor, Gulick and others laid the foundations of a theory of organization based on division of labour, technical consideration of task, time and motion study and allocation of jobs or positions. Thus consideration of work process and division of work were of primary importance.

Man has always been interested in easier ways of doing things, since he first thought of the wheel and cart to help him carry loads. There have always been persons who have taught to remove or lessen the drudgery associated with the various classes of work.

However these earlier attempts, at work study were not very systematic. It would, therefore be understood that work study should have its origin with the beginning of the Industrial Revolution.

The first point of impact of the Industrial Revolution was the British cotton textile industry. Early in the eighteenth century, mechanical devices, critically driven by water power, began to replace the spinning wheel and handloom. One of the outstanding names of this period was Richard Ark Wright (1732-1792). He displayed excellent managerial qualities and he was the first to realize the value of training human beings so that they renounce their desultory habits of work and identify themselves with unvarying regularity of the complex automation. He also devised and administered successful code of factory discipline.

In 1760, JR Perroset, a French man, made some systematic overall time studies on the manufacture of pins and arrived at a standard production rate. This was the first objective approach to a systematic study connected with productivity.

In 1762 Matthew Boulton started his factory at Soho. He used all the mechanical inventions in his factory and such inventions were superior and simple to apply, which were unknown in the past.
He had a trained body of highly skilled craftsmen whose work was much more accurate than that usually found in the Hardware trade of the English midlands at that date. His turnover was less £3,000 in 1763 and increased to £30,000 by 1767.

In (1771-1858), Robert Owen, the first man to look into the side of human element of labour in providing rest allowances for compensating fatiguing jobs.

In (1792-1891), Charles Babbage devoted much of his time to developing a calculating machine in the course of these experiments. Babbage visited a large number of factories both in Great Britain and the continent.

Babbage had anticipated much of Taylor’s thinking. He was clear that it should be possible to establish general principles bearing on the management of business undertakings. He was aware of some of the dangers of time study.

Frederick Winslow Taylor did much pioneering work in the field of work study. He developed a formula for maximum production including three elements.

a) A definite task, determined by study of the job leading to the best operation sequence.

b) A definite time, established by stop watch time study or from standard data.

c) A definite method developed by detailed experiment and recorded on an instruction card.

This formula is still fundamental for high productivity. It is still the basis of all modern work study methods.
Frederick Winslow Taylor (1856-1915) developed and proved the value of task system. The Industrial Revolution was an era which saw a peculiar brutalization of men in the very societies where the greatest and scientific and technical advances were made. A new impersonal relationship came about between employers and workmen. The tendency was to fit the worker to the machine.

Taylor decided the primary cause of conflicts was management, without knowing what the proper day’s work is, tries to secure maximum output by pressure. His conclusions were a definite task, a definite time and a definite method. He made it clear that if this approach is followed the gains to management may not be from extra efforts by workers but from elimination of waste, waste of worker’s time and waste of machine time.

It was Taylor who established the technique of time study scientifically. He broke down the cycle of operations in a job into small groups of motions called elements. Each element was timed separately and this facilitated break down of the total operation into an easily analyzable form. This made it possible to recognize isolate and eliminate preventive losses of efficiency.

Motion study Frank Gilbreth had worked as a brick layer. He revolutionized brick laying technique by applying principles of scientific analysis to it. When his brick layers were working the new instead of the old way, a very great and immediate increase in the output per man occurred. These brick rapid union rate upto that time had been 120 bricks per man per hour. This was principally because of the simplification of the work brought by Gilbreth’s. His study enabled to reduce the number of motions by the work men in laying brick from 18 per brick to 5 per brick.
Development of the principles of motion economy discovery of Therbligs and use of micro motion pictures for motion analysis are the result of the work of the Gilbreths. As Gulic points out, “work division is the foundation of organization, indeed the reason for organization”. Thus the central concerns of the traditional approach to organization theory is achieving efficiency till the work process through a careful definition of tasks into specialized jobs and then by co-ordination of the jobs through a hierarchy of administration units.

A familiar model of formula organization was developed by a German scholar Max Weber who was interested in formulating laws concerned with social behaviour. His ideal type of bureaucracy is a conceptional construction of elements needed for achieving efficiency in an organization. The main characteristics of this model are:

1. High degree of specialization
2. Hierarchical authority structure with limited areas of command and responsibility.
3. Impersonality of relationships.
4. The existence of a system control based on rules and
5. Formulation of precise, explicit and objective rules and regulation based on technical knowledge and rational thinking.

According to bureaucratic model, close control and conformity were considered essential for the efficient achievement of the organization objectives. The model developed by Weber has recently been referred to as the machine model because it views workers as mechanical instruments. This approach has been extensively reported by the writings of Merton, Gouldner, Selznick and March and Simon. The problems stemming from interactions, informal groups and leadership behaviour were neglected by the authors of the traditional model. Because of the limitations of this model, attention was paid to the study of human relation the work situation.
The well known Hawthorne experiments gave birth to what is known as the human relations approach to the study of organization.

The experiments and many subsequent studies produced a strong trend towards social and interpersonal considerations and the importance of economic and technical factors was often ignored. These researchers concentrated on such aspects as styles of supervision, interpersonal relations and informal organization and in demonstrating the importance of informal interactions – sentiment and satisfaction in determining the productivity of work group behaviour. However a review of several research findings during the last decade in this area has shown that the results are increasingly inconsistent contradictory and confusing.

2.5 MODERN APPROACH TO PRODUCTIVITY

The modern approach to study of organization and productivity attempts to provide an integrated framework which combines both the classical and the neo classical elements. It treats organization as a system of mutually dependent variables. The studies undertaken by the Tavistook Institute of human relations illustrated the usefulness of viewing organizations as socio-technical systems.

The analysis of socio technical system is important for the determination of optimum solutions for process and design. The task of process specifications that will produce the output most economically process design is concerned with selecting the work stations, managers have to give consideration to the behavioural consequences of arranging work situations. In an assembly line, the work is divided into individual tasks and assigned to consecutive operations on the line. The manager should give considerations to the need for designing work situations so as to create favourable interpersonal relationship in addition to meeting the technological specifications.
In industries where work groups operate under conditions of pooled interdependence, the manager should give consideration to the creation of sequential work groups that generate social motivation and promote productivity.

Up to some twenty years ago, the techniques for the analysis and evaluation of work done, were very limited in scope and application. Since then they have developed rapidly in quality and effectiveness and particularly in this range of work to which they can be applied work study is the most important concept in the process of increasing productivity. The growing complexity of new processes and equipment quite apart from rising prices, means that nowadays it is frequently necessary to make a considerable capital investment for each new plant employee. A modern trend therefore is for all technical staff are to be given some training in the principles of work study and for the design and layout of new plants and better processes to proceed with these principles in mind as well as purely technical considerations. In the case of product standardization and simplification, work study can be used to access the economics of various alternatives.

The note below shows how the work study helps in increasing productivity.

<table>
<thead>
<tr>
<th>Work Study</th>
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<tbody>
<tr>
<td><strong>Method Study</strong></td>
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<tr>
<td>To improve methods of production.</td>
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<tr>
<td>To achieve improved factory and work place layout improved design of meaning.</td>
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<tr>
<td>Equipment better working environment effective</td>
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<tr>
<td>Reduction of fatigue resulting in improved costing.</td>
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<tr>
<td>Use of material, plant equipment.</td>
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**Higher Productivity**
Earlier approach to productivity centered primarily on the factor like labour productivity machine productivity and the like. It is important that managerial productivity is also paid attention in order to reap the benefit of total productivity. Managerial productivity will certainly take care of the factor productivity.

The ratio of value added over total salaries of managements at best an aggregate measure of the productivity of the total management performance. However such an aggregate measure fails to distinguish between the poor and the outstanding performance of individual managers.

Managerial productivity lies in the better utilization of organization resources towards the attainment of the organization resources towards the attainment of the organization objectives. As the objectives will vary at different stages of the growth of an organization as well as and for different types of industries, there can hardly be evolved one yardstick that will suit all types of organizations.

2.6 PRODUCTIVITY MODELS

Productivity models are available to measure productivity at micro-levels, say of a workman a small section or of a department. At macro level, models have been proposed for a plant or an organization or a multi-unit corporation or industry.

The following major categorization is possible on the basis of approaches or concepts on which they have been constructed.

1. Production function models
2. Financial ratios as measures of productivity
3. Production based models
4. Product oriented models
5. Surrogate models
6. Economic utility models
7. Systems approach based models
1. Production Function Models

This approach represents one of the earliest attempts to measure productivity the model consider production as major activity of an organization and therefore infer that measurement of productivity is synonymous to measurement of productivity of the production function. Production function is perceived to be a function of several input factors.

Cobb-Douglas Function is the classic one and expresses the function as

\[ Q = a L^d K^e e^u \]

Where

- \( Q \) = output
- \( L \) = labour
- \( K \) = capital
- \( U \) = random measurement error
- \( a, d, f \) are constants.

Harns Ernst also proposed a model considering output to be a function of inputs as

\[ \text{Output} = F (X_1, X_2, X_3, \ldots, X_n) \]

Where \( X_1, X_2, X_3, \ldots \) are the inputs.

2. Financial Ratios

The financial ratios are used to assess the financial performance of a company. The research topic is confined to productivity measurement only. Therefore the study of financial ratios was taken up.

3. Production Based Models

These differ from the concepts of ‘production function’ in the latter emphasis is to arrive at a mathematical expression which describes relationship between the several inputs comprising the production function.
Under the approach of production based models, production of goods/services is perceived as the only output. Productivity is considered as a ratio of output (goods manufactured or services rendered).

Production based models can be categorized into two variations depending upon the way the valuation of output is carried out.

i) Output as value of production

ii) Output as value of addition models based on output as value of production.

Ruist proposed measurement of output as

\[
\text{Production Index} = \frac{\text{Production of Period}}{\text{Production of Base Period}}
\]

\[
= \frac{\sum_{j=1}^{q} \frac{h_j^o}{g_j^o}}{\sum_{j=1}^{q^o} \frac{h_j^o}{g_j^o}}
\]

where \( q_j \) = production of productivity

\( h_j \) = total number of man hours in production of product

\( O \) = refers to base period

Tsujimura proposed measurement of productivity as

\[
\text{Physical productivity} = \frac{Q}{L}
\]

Where \( Q \) = Quantity produced

\( L \) = Labour
4. Product Oriented Models

Bahiri Martin advocated construction of the product productivity index which is given by the total earnings of the product over the cost of producing that product.

A similar productivity through product costing approach is suggested by Horngren who suggests two measures.

a) Rate of return on investment
b) Transfer price

Smith proposed omni factor model which considered output as a summation of all products in terms of their marginal costs.

5. Surrogate Models

These models are selected which are difficult to define or are obtainable because of problems inherent in data collection and the like productivity measurement could be considered as

\[ P = \frac{\text{Actual Pay}}{\text{Standard Pay}} \]

6. Economic Utility Models

Productivity measurement under this model does not follow the conventional ratio concept of output to input and recommend use of multi ratios each ratio reflecting on a particular economic activity.
7. Measure of Productivity

Kendrick and Creamer the authors consider that a company’s productivity can be measured and analysed in basically three types of productivity indices.

a) Total Productivity Index

\[
\text{Total output} = \frac{\text{Total output}}{\text{All input factors}}
\]

b) Total Factor Productivity Index

\[
\text{Net output} = \frac{\text{Net output}}{\text{Total factor input}}
\]

Where

Net output = output – intermediate goods and services

Total factor input = manpower input + capital input

c) Partial Productivity Index

\[
\text{Output} = \frac{\text{Output}}{\text{One factor of input}}
\]

Input factors are considered as labour, capital and materials and the partial productivity index, so obtained are referred to as partial productivity of labour, partial productivity of capital and partial productivity of materials.

Faraday has suggested TPM (Total Productivity Measure)

\[
V = \frac{V}{M + Q + C}
\]

Where,

V = value of the total output

M = input of manpower

Q = input of materials

C = input of capital
Ramsay has proposed an extension over Faraday’s model and has suggested measurement of productivity as overall productivity measures.

\[(\text{OPM}_1)\ (\text{OPM}_2)\ \text{and}\ (\text{OPM}_3)\ \text{so that}\]

\[
(\text{OPM}_1) = \frac{C + P + M}{C - M} \\
\]

Where

\(C\) = total cost \\
\(P\) = profit \\
\(M\) = materials cost

Leon Greenberg and Craig and Harris, the authors have suggested Total Productivity measure

\[
Pt = \frac{Qt}{L + C + R + Q} \\
\]

Where,

\(Pt\) = total productivity \\
\(L\) = labour input factor \\
\(C\) = capital input factor \\
\(R\) = raw material and purchased parts input factor \\
\(Q\) = other miscellaneous goods and services input factor \\
\(Qt\) = total output

Mundel emphasizes the need for productivity measurement for productivity improvement and recommends, productivity index to be arrived as,

\[
\frac{\text{OMP}}{\text{IMP}} = \frac{\text{OMP}}{\text{IMP}} \times 100 \\
\]

The numerator in the above model refers to current performance index and the denominator to the base performance index.
Productivity evaluation centre (PEC) Virginia polytechnic institute and state university has also contributed a model to measure company productivity.

As per this model, TPF productivity index can be measured as

\[
Pt = \frac{\text{Output}}{\text{Input}}
\]

Output = sales + potential sales and again

\[
\text{Sales} = \text{net sales}
\]

Potential sales = change in inventory \( X \) \( \frac{\text{Sales}}{\text{Costs}} \)

Inventory of current period input

Change in inventories = inventory of last period

Costs = cost of goods sold

and input = costs + implied costs of capital

= costs + depreciation + opportunity cost on invested capital

= costs + depreciation + (inflation rate + 3\% (Net equity + debt))

Invested capital has been defined as comprising of net share holders equity and long term debts.

The model presumes that opportunity cost interest rate is 3 per cent more than the prevalent inflation rate.
2.7 Models Based on Output as Value Addition

The protagonists of this concept believe that there is no contribution from production function to the cost of materials and other parts purchased and as such only the value addition is the true output.

Faraday introduced value added concept in measuring productivity so that

\[
\text{Productivity} = \frac{V - Q}{M} \\
\text{and also} \quad \frac{V - Q}{M + C}
\]

Total productivity measure \(= \frac{C + P}{C}\)

Where

\(P = \text{profits}\)

Ramsay has also proposed value addition models

\[
\text{(OPM)} = \frac{C + P + M}{C}
\]

\[
\text{(OPM)}_3 = \frac{C + P}{C - M}
\]

The best known model on value addition is contributed by Taylor and Davis who have proposed.
Total factor productivity (TFP) as an index of productivity to be arrived at as

\[ TFP = \frac{(S + C + MP) - E}{(W + B) + (CKW + KF) Fb df} \]

Where

- \( S = \) sales
- \( C = \) inventory
- \( MP = \) manufacturing plant
- \( E = \) exclusions
- \( W = \) wage and salaries
- \( B = \) benefits
- \( K_w = \) working capital
- \( K_f = \) fixed capital
- \( Fb = \) investor contribution adjustment
- \( df = \) price deflator factor

\( S, \) Sales represents the sales billed deflated to a base year.

\( C, \) The inventory change is the difference between the closing and the opening of inventories of all three types i.e., raw materials, work in progress and the finished inventory all deflated to the base year.

\( MP – \) Manufacturing plant covers maintenance, repairs, manufactured item for R & D etc all produced within the plant.

\( E – \) The exclusions represent items purchased (supplies, components etc.) which do not result from production efforts.

Factor represents capital after depreciation for each year weighted by the rate of return in the base year. Taylor Davis model forms a major milestone in proposing methods of productivity measurement. It provides a detailed methodology of what to include or exclude from outputs and inputs and suggests as to how to deflate working and fixed capital to base values.
2.8 Productivity and Managerial resources

Harbison introduced and elaborated the concept of managerial resources in the following manner:

“I shall use the term organization as a shorthand expression for the integrated aggregation of those persons who are primarily involved in managing risk and uncertainty-bearing, planning and innovation, coordination, administration and control, and routine supervision of an enterprise, I shall refer to the persons who perform these functions as managerial resources. The other people employed in the enterprise, who do not perform these functions, will be referred to as labour resources”.

In a latter work (jointly with Myers) Harbison includes the following personnel in the managerial resources or the ‘Managerial hierarchy’:

1. Promoters, top administrative officers and directors who may be owners, part-owners or simply hired professionals.
2. Junior executives, administrators and other members of the middle management group.
3. Staff specialists, technological and experts such as scientists, engineers, lawyers and personnel and Labour relations officers.
4. First line supervisors.

An improvement in productivity is considered vital to achieve several corporate objectives. Measurement of productivity therefore provides an important tool and a yardstick. It helps to identify areas for corrective actions towards planning, redeployment of resources and other management controls to achieve betterment of performance. It provides measures for comparisons between the performance and the non-performance; between the performance in one period to performance in another or between organizations or plants of an organization.
Productivity in its highly simplified form and in conventional terms is considered as a ratio of outputs to inputs responsible for the output. In application, however, there are complications in interpreting inputs, outputs, their measures, conversions to common units etc. Productivity in its broader sense carries a different conceptual meaning when it represents performance of a system against the desired performance objectives. Depending upon the concepts considered, a number of models to measure productivity have been contributed by several authors.

Each of the models surveyed has certain presumptions and a background for its expression. These presumptions have been examined and a critical examination made of their short-comings as well as inadequacies against requirements of a desirable productivity measurement model.

**2.9 CONCEPT OF PRODUCTIVITY**

![Diagram showing the concept of productivity with Land, Material, Productivity, Labour, and Capital nodes.]  

Ratio of input to output effective utilization of resources like, land, labour, capital, material.
2.10 PRODUCTIVITY CONCEPTS AND MEASURES

Productivity is an overall measure of the ability to produce a good or service. More specifically, productivity is the measure of how specified resources are managed to accomplish timely objectives as stated in terms of quantity and quality. Productivity may also be defined as an index that measures output (goods and services) relative to the input (labour, materials, energy, etc., used to produce the output).

Hence, there are two major ways to increase productivity: increase the numerator (output) or decrease the denominator (input). Of course, a similar effect would be seen if both input and output increased, but output increased faster than input; or if input and output decreased, but input decreased faster than output.

Organizations have many options for use of this formula, labour productivity, machine productivity, capital productivity, energy productivity, and so on. A productivity ratio may be computed for a single operation, a department, a facility, an organization, or even an entire country.

Productivity is an objective concept. As an objective concept it can be measured, ideally against a universal standard. As such, organizations can monitor productivity for strategic reasons such as corporate planning, organization improvement, or comparison to competitors. It can also be used for tactical reasons such as project control or controlling performance to budget.

Productivity is also a scientific concept, and hence can be logically defined and empirically observed. It can also be measured in quantitative terms, which qualifies it as a variable. Therefore, it can be defined and measured in absolute or relative terms. However, an absolute definition of productivity is not very useful; it is much more useful as a concept dealing with relative productivity or as a productivity factor.
Productivity is useful as a relative measure of actual output of production compared to the actual input of resources, measured across time or against common entities. As output increases for a level of input, or as the amount of input decreases for a constant level of output, an increase in productivity occurs. Therefore, a “productivity measure” describes how well the resources of an organization are being used to produce input.

Productivity is often confused with efficiency. Efficiency is generally seen as the ratio of the time needed to perform a task to some predetermined standard time. However, doing unnecessary work efficiently is not exactly being productive. It would be more correct to interpret productivity as a measure of effectiveness (doing the right thing efficiently), which is outcome-oriented rather than output-oriented.

Productivity is usually expressed in one of three forms: partial factor productivity, multifactor productivity, and total productivity. Each one is now discussed.

2.11 PARTIAL FACTOR PRODUCTIVITY

The standard definition of productivity is actually what is known as a partial factor measure of productivity, in the sense that it only considers a single input in the ratio. The formula then for partial-factor productivity would be the ratio of total output to a single input or:

Managers generally utilize partial productivity measures because the data is readily available. Also, since the total of multifactor measures provides an aggregate perspective, partial factor productivity measures are easier to relate to specific processes. Labour-based hours (generally, readily available information) is a frequently used input variable in the equation. When this is the case, it would seem that productivity could be increased by substituting machinery for labour.

However, that may not necessarily be a wise decision. Labour-based measures do not include mechanization and automation in the input; thus when automation replaces labour.
Other partial factor measure options could appear as output/labour, output/machine, output/capital, or output/energy. Terms applied to some other partial factor measures include capital productivity (using machine hours or dollars invested), energy productivity (using kilowatt hours), and materials productivity (using inventory dollars).

2.12 MULTIFACTOR PRODUCTIVITY

A multifactor productivity measure utilizes more than a single factor, for example, both labour and capital. Hence, multifactor productivity is the ratio of total output to a subset of inputs. Subsets of input might consist of only labour and materials or it could include capital.

2.13 TOTAL FACTOR PRODUCTIVITY

A broader gauge of productivity, total factor productivity is measured by combining the effects of all the resources used in the production of goods and services (labour, capital, raw material, energy, etc.) and dividing it into the output. As such the formula would appear as:

One example is a ratio computed by adding standard hours of labour actually produced, plus the standard machine hours actually produced in a given time period divided by the actual hours available for both labour and machines in the time period.

Total output must be expressed in the same unit of measure and total input must be expressed in the same unit of measure. However, total output and total input need not be expressed in the same unit of measure.

Resources are often converted to dollars or standard hours so that a single figure can be used as an aggregate measure of total input or output. For example, total output could be expressed as the number of units produced, and total input could be expressed in dollars, such as tons of steel produced per dollar input.
Other varieties of the measure may appear as dollar value of good and services produced per dollar of input, or standard hours of output per actual hours of input. Total productivity ratios reflect simultaneous changes in outputs and inputs.

As such, total productivity ratios provide the most inclusive type of index for measuring productivity and may be preferred in making comparisons of productivity. However, they do not show the interaction between each input and output separately and are thus too broad to be used as a tool for improving specific areas.

Total factor productivity is a measure favoured by the Japanese, whereas labour productivity is the measure favoured by the United States. As such, the individual “Productivity” of the American employee tends to be the best in the world, in that an American employee can purchase more eggs per one hour of work than anyone else in the world. But as a measure of national productivity, the Japanese have, in the past, tended to be better performers.

2.14 FACTORS FOR PRODUCTION IN SPINNING MILL

In every factory, production efficiency depends on some factors or parameters. As like as other factory, production of Spinning Mill depends on some factors. The factors which influence the production of spinning mill are mentioned below:

- Raw material
- Labour
- Machinery
- Ends down
- Doffs
- Creeling
- Bobbin size
**Raw Material**

Raw material has an important impact on yarn quality and production. Let’s see how it affects on yarn production? There are many parameters through which we can easily assess the properties of cotton; first one is the fibre length which is the most important characteristic of cotton and is measured in terms of staple length, span length and effective length.

If fibres have good stable length it results in the form of high production because less twist per inch is required to give enough strength. Second one is the short fibres percentage; higher percentage of short fibres will result in the form of production losses due to more end breakage and higher twist per inch. Third one is the fibre maturity, in case of immature fibres it results in the form of production loss because the yarn made from these types of fibres have poor strength and also it produces breakage in spinning department.

Fourth one is the fibre strength which is the dominating feature of fibre. When fibre strength is higher it outcomes in the form of high production due to less twist multiplier. I think while choosing cotton we have to keep in mind all these factors otherwise it results in the form of great loss.

**Labour**

In all industries, the importance of labour cannot be denied. But in the textile sector specially in spinning mills labour plays a very crucial role because without their participation nothing could be done. For example if we take the example of the ring department in a spinning mill or you can say the production department, 400 workers are working in one shift and with their negligence it results in the form of production loss.
In the ring department we can calculate production in bags / day, so, with the workers carelessness it results in the form of loss of bags. In Bangladesh working in mills exists in three shifts so, the question does arise why production is different in these three shifts if they have the same number of workers? Due to workers inattention the rate of production is different because in textile mill they face different types of problems every day so, to overcome these problems they have made a reward system in the form of cash prizes. By comparing the production of these three shifts.

They decided which shift deserves for that prize. By adopting this system they can control this problem up to some extent. From our point of view we think that the proper way to improve productivity in textile mills is first to take those workers which are properly skilled secondly, with the passage of time arrange training sessions for their improvement and the most important thing is to increase their wages time after time. By adopting these things productivity can be improved.

**Machinery**

Machinery is the backbone of every industry. In the textile industry machines are working 24 hours hence it is important that its efficiency would be excellent. Let’s look at the comparison between the old and new machines. In spinning mills we analysed that, “why new machines are better than old machine “.

In the simplex department they have erected 10 frames and in which one of them is the old one. If we compare the old machine with the new machine in production point of view then, it is clear that new machines are better than old ones. We got some experimental results, from the new frame with the speed of 725 rpm the production is 45 bags/day while with the old machine with the same speed production is 35 bags/days because many factors involved in it like sliver and roving breakages, machine adjustments and stoppages.
If we compare these machines in energy point of view then old machine consumes more energy than the new ones. From the above discussion it is clear that the machine matters if we talk about productivity. While analyzing in ring department, during working stoppages may occur due to the following reasons.

- Ends down
- Doffs
- Creeling
- Bobbin size

These factors affect the productivity to a great extent. If we control these stoppages then production can be increased and it also has an impact on yarn quality which is improved under the same conditions of cost and labour charges.

**Ends Down**

The end down is due to the less strength of yarn and greater spindle speed. Adding to stops, no. of spindles per frame, lift of bobbin rail and cleanliness of the department also affects the production. More number of spindles on a frame increases its efficiency. Cleanliness means no fibrous mass is floating in atmosphere of ring otherwise ends down rate will be increased.

**Doffs**

Doffing means removal of full size package and replacing it with the empty one. During doffing, the machine is stopped and it is carried out by skilled workers. For coarse count like 7s, 10s etc, doff time is less and for finer count like 30s, 40s etc, time is more. For 20s it takes 90-110 min for complete doff. During doffing, it should be kept in mind that it should be carried out in the shortest possible time.
Creeling

The changing of the roving bobbin when it is empty and to replace it by a new full roving bobbin is called creeling. Creeling time should be as small as possible.

Bobbin

The production can be increased by increasing the bobbin size because with a bigger bobbin less doff is required per shift. The bobbin size depends on ring dia, but as we increase the ring dia, ends down rate also increases so it also has a limit. Usually 42mm ring dia is available on which 40mm dia bobbin can be prepared.

Maintenance

Proper maintenance of machine is necessary otherwise it results in the form of many problems like sudden shut downs and big production loss. In ATM maintenance is done on daily basis to overcome the problems which they are facing every day. Usually in ATM one machine is opened 30 in every department for maintenance.

Proper maintenance results in the form of efficient working of machine and good outputs. For example by proper maintenance and by proper preparation of roving it results in the form of minimizing the end breakage rate.

2.15 PRODUCTIVITY AND WORK STUDY

As we know, productivity is nothing but the reduction in wastage of resources. The resources may be men, machine, materials, power, space, time, etc. We have also seen from the definition of work study that it reduces wastage of time, effort and increases the efficiency of man and machine. Thus, the work study techniques lead to increase the productivity. Thus, productivity implies development of an attitude of mind and constant urge to find better, cheaper, easier, quicker and safer means of doing a job, manufacturing a product and providing service.
In general, a nation progresses if it improves its productivity and performance. If our country is to move forward, industries and agriculture are the two key areas where we must lay our emphasis for improvement in productivity.

In past, there has been regular upward revision in payment of wages/salaries in all industries but no noticeable improvement in productivity. The net result was sky-rocketing of prices of all commodities which made us lose our competitive edge in the world market for our products.

Our aim now must be to make people more productivity conscious, if we were to improve their standard of living. Productivity holds the key to prosperity of an individual, an organization and a nation.

Increase in productivity results in:

a) Increase in production and hence higher profits
b) Products produced will be cheaper
c) Revision in wages and declaration of bonus possible due to increased profits
d) Improvement in living standard of workers.
e) Brings prosperity to the nation.

Thus, work study is an organized effort to improve productivity, quality, and to reduce costs within an organization.