CHAPTER ONE

OPERATIONS MANAGEMENT: AN OVERVIEW

Objectives:

On successful completion of this chapter, you should be able to:

- Define the term operations management
- Distinguish operations management from production management
- Distinguish service operations from manufacturing operations
- Explain the evolution of operation management
- Identify the operation management decision making areas
- Understand the current trends in operations management
- Explain the operations strategy
- Measure the productivity of any organization

1.1. Operations management general concept:

What is operation?

Operation is where the organizations goods & services produced. Operation is common to all organization-be it small or large, private or government, local or international, manufacturing or serice giving.

*What is management?*Management is the process of planning, organizing, leading, and controlling an organization's human and capital resources in order to accomplish its objectives.

What is operations management?

By bringing the above definitions of operation and management together, operations management can be defined as:

- The administration of process that transforms inputs of labor, capital and materials in to output bundles of products and services that are valued by customers.

- The coordination of an organization's resources and a transformation process that will end up with the production of goods and services.
- The essential features of the production functions are to bring together people, machine, and materials to provide goods or services there by satisfying the wants of the people.
- An activity which deals with processes that produce goods and services that people use every day. Process is any activity or group of activities that takes one or more inputs, transforms and adds value to them, and provides one or more outputs for its customers.
- Operation management refers to the direction and control of the processes that transform inputs in to products and services. Broadly interpreted, OM underlies all functional areas, because processes are found in all business activities.

In nut shell, all definitions consider operations management as the management of transformation process that *converts input into output*. By and large, managing operation is crucial to each area of an organization because only successful management of resources (people, capital, information, and materials) can meet its goals.

1.2 Brief History of Operations Management

Historically speaking the field of operations management has involved in a very short span of time. Its roots however go back to the concepts of division of labor advocated by Adam Smith in his book "the Wealth of Nations" in 1776. In 1832, Charles Babbage, a mathematician extended Smith's work by recommending the use of scientific methods for analyzing factory problems. However, the era of scientific management as it is known started with the work of F.W.Taylor in 1878 who subsequently came to be recognized as the "Father of scientific management". Taylor is credited with recognizing the potential improvement to be gained from analyzing the work content of the job and designing the job for maximum efficiency.

Taylor described his management philosophy in a book “the principles of scientific management” published in 1911.This event more than any other ,can be considered as the beginning of the field of operations management. The colleagues, contemporaries and followers of Taylor were many and included the following people.

Frank and his wife Lillian Gilbreth are recognized for their contributions to motion study. Gilbreth developed the concepts of ‘Therbligs’ for motion study in1911.

Lillian Gilbreth wrote the book ‘The psychology of management which was one of the earliest works concerning the human factoring organizations.

In 1913, Henry Ford developed the concepts of mass production and arranged work situations in to an assembly line with moving belt. In 1913 also, Henry Gant made his best known contributions in charting the production schedules using a visual diagrammatic tool which is popularly known as Gant Chart and is an effective practical tool even today.

In 1931, Harrington Emerson applied Taylor’s ideas to develop organizations structure and suggested the use of experts in organizations to improve efficiency.

Wilson developed the concept of Economic Order Quantity (EOQ) in 1928 which is still recognized as the classical work in the scientific analysis of inventory systems and works of subsequent researchers were essentially further refinements of Wilson‘s lot size formula.

In 1913, F.H Dodge, H.G Roming and W.Shewhart developed the concepts of sampling inspection and published statistical tables. Earlier in 1924, W. Shewhart pioneered the concepts of statistical quality control and developed control charts for monitoring the quality of production processes.

In 1933, Elton Mayo conducted his famous experiments at western electric‘s Hawthorn plant looking in to human and social aspects of the work. More over in 1937, L.H.C. Tippett developed the concepts of work sampling to gauge the level of machine and man power utilization and for setting work standards.

In 1950 two major developments that influenced operations management were the emergency of techniques of operations research beyond military context and developments in engineering offered by L.D Miles. The OR is the applications of scientific methods to study and devise solutions to managerial problems in decision making. Using mathematical models and the system approach OR has developed solve resource allocations scheduling, processing, inventory, location, out and control problems.

Techniques of value engineering helped in efficiently identifying the unnecessary costs so that products and systems could perform their functions at a minimum costs.

Development OR techniques to production in computers led to computerized applications of industrial engineering and management problems.

In the late 1950s scholars and researchers in the field began to generalize the problems and techniques of manufacturing management to other production organizations such as petroleum, chemical and other process industries leading to emergency of the concepts of production management as a functional management discipline. In the late 1960s the concept of operations management expanded to include the service sectors as well. Only recently the service sector has received as much attention as production sector from the point of view of scientific management of systems operations. Other notable developments in recent past has been just in time(JIT) ,group technology(GT), cellular manufacturing

system(CMS), flexible manufacturing system,(FMS), computer aided design/manufacturing(CAD/CAM) etc. Thus, future of operations management looks bright.

1.3 Manufacturing operation Vs Service operation

**Similarities between manufacturing and services*

Every organization whether manufacturing or service giving, has processes (transform input in to output) that must be designed and managed effectively. Some type of technology be it manual or computerized must be used in each process. Every organization is concerned about quality, productivity, and the timely response to customers. A service provider, like a manufacturer, must make choices about the capacity, location, and lay out of its facility.

Ever organization deals with suppliers of outside services and materials, as well as scheduling problems. Finally, matching staffing levels and capacities with forecasted demand is universal problems.

**Differences between manufacturing and services*

The difference between manufacturing and service operations are shown as follows

More like a manufacturing organization	**More like a service organization**
-Tangible, durable product -Output that can be inventoried - Low customer contact - Long response time - Regional, national or international market - Large facilities	-intangible perishable product - output that can't be inventoried - high customer contact - short response time - local market -small facilities

- Capital intensive - Quality and productivity easy to measure - High degree of uniformity of input& output - Ease to automate etc.	- labor intensive -quality and productivity is difficult to measure - high degree of variety of input and - high degree of variety of input and -difficult to automate etc.

The first distinction arise from the ***physical nature of the product***: manufacturing goods are tangible and durable products whereas services are intangible, perishable products often being ideas, concepts or information.

The second distinction also relates to *the physical nature of the product*: manufactured goods are output that can be produced, stored, and transported in anticipation of future demand. *Creating inventories* allow managers to cope with fluctuation in demand by smoothing output levels. By contrast, service cannot be pre-produced.

A third distinction is related to ***customer contact***: Most customers for manufactured products have little or no contact with the production system.

Primary customer contact is left to distributors and retailers. However, in many service organizations the customers themselves are inputs and active participants in the process. At a college, for example, the student studies, attends lectures, takes exams, and finally receives a Diploma. Hospitals and entertainment centers are other places where the customer is present during the provision of most of the services.

Some service operations have low customer contacts at one level of the organization and high customer contact at other levels. For example, the branch offices of parcel delivery, banking, and insurance organizations deal with customers daily, but their central offices have little direct customer contact.

Still a related distinction is ***response time*** to customer demand. While manufacturers generally have days or weeks to meet customer demand, many services must be offered within minutes of customer arrival. The purchase of fork lift may be willing to wait 16 weeks for delivery. By contrast, a grocery store customer may grow impatient after waiting five minutes in a checkout line. Because customers for services usually arrive at times of their choosing, service operation may have difficulty matching capacity with demand. Furthermore arrival patterns may fluctuate daily or even hourly, creating even more short term demand uncertainties.

- ✓ Two other distinctions concern the ***location*** **and** ***size*** of operation. Manufacturing facilities often serve regional, national, or even international markets and therefore, generally requires larger facilities, more automations and greater capital investment. In general, service cannot be shifted to distant locations. For example, a hairstylist in Addis cannot give a hair cut to someone in Arba Minch. Thus, service organization requires direct customer contact and must locate relatively near their customers.

- ✓ Still other distinction is the ***measurement of quality and productivity***. As manufacturing system tends to have tangible products quality and productivity is relatively easy to measure. The quality of service system, which generally produces intangibles, is harder to measure.

1.4. *Operations management decision making areas*

Operations management is essentially function concerning decision making with respect to operation system so as to render the necessary customer satisfaction at lowest cost. Operation managers manage all activities in the

transformation of input in to output by making three broad types of decisions.

a) ***Strategic (long term) decisions***: - a decision is said to be strategic if it has a long term impact influence a large part of the system and is difficult to undo once implemented. This decision in the context of oppression systems are essentially those which deals with the design and planning (long range or intermediate range) aspects. Some examples of such decisions are:

i. Product selection and design: - what product or services are to offer constitute crucial decisions. Wrong choices of products or a poor choice of design of the product may render our systems' operations ineffective and non competitive.

ii. Process selection and planning: - choosing optimal processes of conversion systems is an important decision concerning choices of technology, equipment and machines. Process planning pertain to careful detailing of process of resource conversion required and their sequence includes in such decisions are the aspects of mechanizations and automations.

iii. Facilities location: - is a long term decision which concerns decision regarding location of production system or its facilities. Poor locations may spell operating disadvantages for all times to come. There for it is important to choose right locations which will minimize total delivered to customers cost (production and distribution costs) by virtue of location. Evidently such a decision calls for evaluation of location alternatives against multiplicity of relevant factors considering their relative importance for the system under considerations.

iv. Facilities lay out and materials handling:- is a strategic decisions which are concerned with relative locations of one department (activity center) with another in order to facilitate material flow, reduce handling costs, delays and congestion, provide good housekeeping, facility co ordinations etc. There are many factors that influence the lay out decision which the decision maker should consider.

v. Capacity planning:-is a long term decisions which concerns the acquisition of productive resources.

Capacity may be considered as the maximum available amount of output of the conversion process over some specified time span. Capacity planning may be over short term as well as on a long term basis.

The above mentioned five decision areas will be described in detail in the following units.

b) ***Operational (short term) decisions***: - operational level decisions deal with short term planning and control problems. Some of these are:

i)*Production planning, scheduling and control*: - in operation scheduling we wish to determine the optimal schedule and sequence of operations, economic batch quantity, machine assignments, and dispatching priorities for sequencing. Production control is a complementary activity to production planning and involves follow up of the production plan.

ii. Inventory planning and control:-this problem deal with determinations of optimal inventory levels at raw materials, in processes and finished goods stage of production system. How much

to order, when to order are two typical decisions involving inventories. Material requirement planning (MRP) is an important upcoming concept in such a situation.

iii. Quality assurance: - quality is an important aspect of production systems and we must ensure that whatever products /services is produced it satisfies the quality requirements of the customers at lowest cost. This may be termed as quality assurance. Setting standard of quality, control of quality of products, processes are some of the aspects of quality assurance.

Iv. Work and job design:-these are problems concerning design of work method systems and procedure methods improvement, eliminations of avoidable delays, work measurement, work place lay out, ergonomic considerations in the job design, work and job restructuring, job enlargement etc.

v. Maintenance and replacement: - these include decisions regarding optimal polices for preventive, scheduled and breaks down maintenance of the machines repair policies and replacement decisions. Maintenance is extremely crucial problem area particularly for a developing economy such as ours because it is only through a very effective maintenance management that we can improve capacity utilization and keep our plant and machinery productive and available for use.

vi. Cost reduction and control:-for an ongoing production system the role of cost reduction is prominent because through effective control of total cost of production, we can offer more competitive products and services. Cost avoidance and cost reductions can be achieved through various productivity techniques.

c. ***Controlling decisions***: - In every system, the actual accomplishment of objectives may not be as planned for various reasons. It is there for very important to monitor the actual performance by measuring the actual output or some performance indicators. The decision in control system should consider cost benefit aspects of control in mind. If cost of control exceeds its benefits, it becomes counterproductive. Thus selective control must be exercised employing the exception principle or Pareto's law. While taking these decisions, one must bear in mind the general objective of OM. Let us see the objectives of OM.

Objective of operations management

In general term, the objective of operation management is to produce goods and/or service in required quantities and quality as per the schedule and at a minimum cost i.e. to maximize the value created. Briefly, the difference between the value of input and the value of output represented the value created (profit or customer satisfaction) through production activities. Quality, quantity, and time schedule are the objectives which determine the extent of customer satisfaction. If an organization can provide for these at a minimum cost then the value of goods created or services rendered enhance and that is the only way to remain competitive –which is the objective of OM.

1.5.Productivity measurement

1.10.1. Measuring productivity

It has been said, "If you can't measure it, you can't manage it". This is particularly true of productivity.

Now we come to the main question of how we know that we are managing our operation system well. This concerns the efficiency with which we are

converting the input in to outputs. This conversion efficiency can be roughly gauged by the ratio of: **Output /inputs** (a term which generally known as productivity of the system).

Productivity is used for making comparison or to measure improvement. Productivity is a relative term i.e. it gives sense only when we compare it with: company's previous performance, with other similar company's performance or with the performance of leader of the industry.

Many measures of productivity are possible, and *all are rough approximations*. Values of output may be measured by: what the *customers pay (dollar values of the output)* or simply by the *number of units* produced (in manufacturing industry) or *customers served (in service industry)*.

The values of inputs can be measured by: *their cost* or simply by the number of *hours* worked.

Productivity may be expressed as:

- *Total factor productivity measure*:-is the ratio of all output to all input i.e. total outputs/total inputs. Total inputs include all resources used in the production of goods and services: labor, capital, raw materials, and energy.
- *Multi factor productivity*: - measures only a sub set of these inputs.

  i.e. **output**/ (l*abor + capital)*, **output**/ (*labor+ capital + materials)*, **output**/ (*materials + energy).*

- *Single factor (partial productivity) measure*:-is the ratio of output to a single resource (inputs).

  i.e. *output/labor, output/capital , output/material, output/energy* etc.

Commonly used partial productivity

* Labor productivity

-Units of output per labor hr

-dollar output per labor hr

* Machine productivity

-units of output per machine hr

-tons of output per machine hr

*Capital productivity

-units of output per dollar inputs

-dollar output per dollar inputs

* Energy productivity

-units of output per kilowatt hr

-production value per barrel of fuel

-units of output per energy cost

Numerical examples

Example1. Three employees process 600 insurance policies in a week. They work 8 hrs per day, 5 days a week.

Required calculate labor productivity?

Solutions

Labor productivity=output/inputs.

Where, output is number of insurance policies processed and input is hours worked.

$$Labor\ productivity = \frac{600\ polices}{(3\ employees)\ X\ (40\ hrs/employees)}$$

$$= \quad 5 \text{ polices/hours}$$

Total or multifactor productivity measures are generally preferable than partial productivity. The reason for this is that focusing on productivity improvement in a narrow portion of an organization may actually decrease total productivity. See the following example.

Example: ABC Furniture Company produced 10,000 chairs, with annual labor and equipment cost of $50,000 and $25000 respectively. Total productivity can be calculated as:

Productivity: chairs/dollar input $= \frac{10000 \text{chairs}}{\$50000 + \$\ 25000} = 0.133 \text{chairs/dollar input}$

Labor productivity, however, is measured for this example as:

$$10{,}000/50{,}000 = 0.20\ chairs/dollar\ inputs - labor.$$

Suppose that a $10,000 reduction in labor can be achieved by investing in a more advanced machine. Labor productivity will increase to: 10,000/40,000=0.25 chairs/labor- dollar. Thus, from a productivity perspective, it would appear that this investment is attractive. If, however, that annual cost with the new equipment increases to $40,000 then, total productivity will be:

$$\frac{10{,}000}{\$40{,}000+40000}=0.125\,chairs/dollar\,inputs$$

And hence overall productivity would decrease. It is necessary, therefore to examine the simultaneous effects of all changes on productivity.

NB: These measures must be compared with both performance levels in prior periods and with future goals. If they are not living up to expectations, the process should be investigated for improvement opportunities.

Productivity is more difficult to measure in service organization than in manufacturing organization. In manufacturing, physical inputs and outputs are easy to identify and the values of outputs are easy to measure. For service, the value of an output is often intangible. For instance, how does one assess the value of healthy patient?

Productivity measures in service organization are often stated as: benefit/cost ratio.

Exercise

A furniture company has provided the following data for the year 2000 and 2001:

	2000	2001
Output	*22000*	*35000*
Inputs		
- *Labor*	10000	15000
- *RM & supplies*	8000	12500
-*Depreciation*	700	1200

-Others	2200	4800

Required:

1. Compute total productivity for year 2000 and 2001
2. Compute multi factor productivity for labor, and RM & supplies, and labor, capital and others for the year 2001.
3. Compute partial productivity for labor, and RM and supplies for the year 2000

Measurement is only the first step in improving productivity. Understanding the factors which affect productivity and selecting the appropriate improvement factors in any given situation is the second step.

1.5.2. Factors that affect productivity

In this section a comprehensive view of all the factors which might affect the productivity of operations will be explained.

Factors which might affect productivity can be categorized in to: external and internal.

External factors which affect productivity includes: government regulation government investment policy, competition from other firms, suppliers capacity, and customers demand etc. These factors are outside the control of the firm. These factors may affect both volume of output and the availability of scarce inputs. Even though external factors are difficult to control, firms can do much to improve productivity within the external constraints.

* ***Internal factors*** that affect productivity includes: product, process, capacity and inventory, and work force.

-*product*: is factor which can greatly affect productivity. Let us see three points here.

It is generally recognized that *R&D* leads to new product technology which improve productivity. On the other hand too much product innovation may slow down process innovation and lead to productivity decline.

Product diversity may leads to greater productivity through increased sales and economics of scale. But product diversity may reduce productivity too, by not focusing the process and spreading operation too thin.

Value engineering is a product improvement approach used to produce the product more cheaply. The idea is to simplify the product or substitute material so the product performs the same function at lower cost.

Process: process design also affects productivity. The improvement factors related to process includes process flow, automation, lay out and selection of process types.

Within a given process there are many ways to organize the flow of information, materials and customers. This flow can be improved by better lay out or by process flow analysis that results in improved productivity.

Automation is the key method to improve productivity. It appears that the substitution of capital for labor is a powerful key to improve productivity.

Management of capacity and inventory: this is still other factor that affects productivity.

Capacity can almost never be matched exactly to demand, but careful capacity planning can reduce both excess capacity and bottlenecks due to insufficient capacity. This results in productivity improvement. Along the same lines, inventory can be a hindrance or a help to a firm’s productivity.

Too little inventory will leads to lost sales. Too much inventory will leads to higher cost of capital. Both lead to reduce productivity.

Work force: is perhaps the most important of all, and it is receiving a greater deal of attention today. Productivity is determined by workers health, education, and better nourished labor force.

1.5.3. Improving productivity

There are several ways in which operations manager can improve productivity. These may be classified as:

*increasing output while keeping input constant

*decreasing input while keeping output constant

*increasing output at higher rate than increasing input

*decreasing output at lower rate than decreasing input

*increasing output while decreasing input (Most challenging but effective).

These can be represented by the following figures.

