UNIT 11 OPERATIONAL MANAGEMENT ISSUES IN SMALL SCALE ENTERPRISE

Objectives

After going through this unit you should be able to:

- discuss production operations management aspects of small scale enterprises,
- identify features of production operations regards small enterprises,
- comment upon facilities development in SSE,
- discuss importance of enterprise maintenance and quality control

Structure

11.1 INTRODUCTION

In this unit you will learn in general the aspects of production and operations management (POM). Production Management has traditionally been associated with manufacturing. Today it encompasses a large variety of other activities concerned with the conversion of inputs into outputs using physical resources so as to provide the desired utility/utilities to the customer while meeting the organisational needs of effectiveness viability and quality. POM activities extend to hospitals, educational institutions, offices, Petrol Pumps, transportation (rail, road or air) maintenance workshops, banks etc. You cannot think of an activity which cannot be brought within the purview of POM. Graphically the concept has been represented as shown in Figure 1.

Figure 1 : Production and Operation Management — Some Cases

Sl. No.	Case	Input	Physical Resources Used	Output	Type of Input/ Output	Type of Utility Provided to the Customers
1.	Inorganic Chemicals Production	Ores	Chemical Plant and equipment, other chemicals use of labour	Inorganic chemical	Physical input and physical output	Form
2.	Outpatient ward of a general hospital	Unhealthy patients	Doctors, nurses other staff, equipment, other facilities	Healthier patients	Physical input and physical output	State
3.	Educational Institution	'Raw' minds	Teachers, books teaching aids	'Enlightened minds	Physical input and physical output	State

Sl. No.	Case	Input	Physical Resources Used	Output	Type of Input/ Output	Type Provi Custo
4.	Sales Office	Data from market	Personnel, office equipment and facilities, etc.	Processed 'information'	Non-physical input and non-physical output	State
5.	Petrol Pump	Petrol (in possession of petrol pump owner)	Operators, errand boys, equipment, etc.	Petrol (in possession of the car owner)	Physical input and physical output	Posse
6.	Taxi Service	Customer (at Railway station)	Driver, taxi itself, petrol	Customer (at his residence)	Physical input and physical output	Place
7.	Astrologer/ palmist	Customer (mind full of questions)	Astrologer, Panchanga, other books, etc.	Customer (mind hope-full)	Physical input and physical output	State
8.	Maintenance workshop	Equipment gone 'bad'	Mechanics, engineers, repairs equipment etc.	'Good' Equipment	Physical input and physical output	State
9.	Income Tax Office	'Information'	Officers and other staff, office facility	Raid	Non-physical input and physical output	State

Productivity

The only way our standard of living can be improved is to increase our per capita productivity. You can meet your requirements (or export the surplus to earn very valuable foreign exchange) only if you produce more. This increasing the per capita productivity as essentially the main mission of POM. Productivity is the efficiency of converting the inputs (such as labour, materials, equipment (machines), finances, time and space, technology and management skills) into tangible outputs (such as goods, services, enhanced sales or exports, greater customer satisfaction and higher operating efficiency). Mathematically

$$\text{Productivity } (p) = \frac{\text{Output (O)}}{\text{Input (I)}}$$

Thus productivity is not only achieving higher levels of output but also at the least cost of input which in other words is maximisation of resources or alternatively reduction of wastefulness. Productivity should not be confused with production. To increase production, you must produce more by merely using more labour, better machinery, more finances and more time.

11.2 PRODUCT/PRODUCTS SELECTION, DEVELOPMENT AND DESIGN

a) Products Selection is one of the key strategies decisions of any organisation which commits itself to the product/products selected for a long time to come. The organisation attempts to match the changes in environment, technology and consumer requirements while finalising the design.

b) Production Selection can be through any of the following processes:

(i) **Market research for existing products:** You will have to very carefully evaluate the economic viability keeping in view the market segment you wish to capture, the region you wish to dominate and the customer level you wish to serve.

(ii) **Research laboratories:** You will come across a large number of national organisations like National Research & Development Corporation who are continuously developing new products and are prepared to sell the patents. In ongoing organisations research projects, properly initiated can come up with good product variations, improved versions and even newer products to serve

better the same consumer needs. Such products have by far the least risk and good pay off.

(iii) Innovation and Technological Up gradation: You can achieve this by brain storming, use of consultants and selection of newer technologies, may be even at the drawing board stage, through a world wide research. While such products promise the highest pay off, they also carry the maximum risk.

Product development is a very detailed, deliberate and drawnout phase. The product should be deliberated upon in maximum possible detail. Various environmental factors internal as well as external, particularly the market reaction (test marketing, publicity, demonstrations, etc.) should be, thoroughly evaluated. More the time you spend on product development, better become your chances of success. You can build the pitch to such an extent that the product launching should be pulled by the market demand.

Product Design: You will have_ to keep the following considerations in view:

(i) Test effectiveness.
(ii) Quality commensurate with cost and market sustainability.
(iii) Maintainability and Reliability.
(iv) Servicing
(v) Ease of Production.

Design alternatives invariably are plenty. Decision matrix is the evaluation of various trade offs, A hypothetical chart is shown blow at Figure 2. It is wrong to go for cost reduction to remain competitive. Today's customer wants cost effective quality products.

Figure 2 Design Characteristics 'trade oft`

It is difficult to visualise any project design which is not affected by its features whether essential, desirable or optional. Value analysis also has a major role to play. Final selection of the product characteristics is the relative importance, you attach to various features and contributory elements given below

Function	Maintainability	Safety & Security
Reliability	Cost	Environmental Hazard
Accessibility	Appearance	Productionability

Activity 1

With respect to your own organisation or any other small organisation that you are familiar with, discuss the considerations affecting the choice of product design.

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11.3 DEVELOPMENT OF PROTOTYPE, SELECTION OF PROCESS AND PLANT AND MACHINERY

a) Prototypes are generally the hand made models which concretise the product formulation ideas. National Small Industries Corporation, has regional Prototype Development Training &' Testing Centres to cater to these needs of small entrepreneurs.

b) These ˛prototypes are thoroughly evaluated keeping in view the considerations covered above under the sub-heading "Product Design". A very detailed costing is done. Choice of raw materials is made. Material estimates are drawn. Various manufacturing processes are contemplated. Requirement of work force of different skills is estimated. Work norms to evolve labour costs are thought of. You would thus see that the development of prototypes, is a very vital stage before going ahead with the manufacture and launching of a new product or any improved version of the existing product. You can have the maximum pay off if you put product through value analysis. Value Analysis or Value Engineering is

a coordinated approach to isolate costs which neither increase life, nor add to use value, esteem value or quality. In other words it is achieving desired function at the lowest cost without sacrificing quality.

c) You have now reached the next stage of selection of plant and machinery and finalisation of process. The two are interrelated. If you go in for a conventional manufacturing process, you can manage with standard machinery available in the open market. But should you select a high tech process, you have necessarily to look for NC/CNC/ONC machines may even be based on robotics. These processes are no doubt costly but suit high volume operations particularly involving special purpose machines.

d) The last stage in the product development is the manufacture of Pilot Production Models. These are checked and re-evaluated for various functional aspects such as tooling, material estimating, rate of production, cost of production, quality control techniques reliability and maintainability. You are now ready to launch free flow production.

11.4 PLANT LOCATION

a) Plant location is a strategic decision and has to be arrived at after careful deliberations of various factors involved. It is a one time decision and cannot be retracted without paying heavy penalties. You may have to make this decision based upon the following considerations:

(i) Proximity to Market.
(ii) Nearness to raw materials.
(iii) Adequate power and water arrangements and other infrastructural facilities.
(iv) Transportation facilities and their costs.
(v) Labour and wages.
(vi) Laws and taxation.
(vii) Incentives, Land costs, subsidies Backward areas.
(viii) Climate.
(ix) Ecology and environmental factors.
(x) Political conditions.

Market: While considering the market you have no only to assess the existing segment and the region but also the potential growth, newer regions and the location of competitors. If your products are fragile and susceptible to spoilage proximity to market gets added weightage. Similarly if the transportation costs add substantially to your product costs, then also a location close to the market becomes all the more essential. If the market is widely dispersed, it is possible to statistically find out the point-which will provide the lowest cost of distribution. In case of goods for export, processing facilities gains importance. ,

Raw Materials and Supplies being near to raw materials allows you to get better supplier service and to save on incoming freight. Other supplies include tools, equipment, ancillaries, vendor supplies etc. Here you look for promptness and regularity of deliveries. If the raw materials are bulky low in cost or perishable and to be consumed as such locate the plant near to raw materials source. Suitable examples can be steel and cement industries. In the small scale sector these could be food and fruit processing. Meat: and fish canning, jams juices and ketchups etc.

Power Water and Other Infrastructural Facilities : Depending upon the types of industry these could assume disproportionate priorities. Power situation should be studied with reference to its reliability, adequacy, rates (Concessional if any) own requirements, subsidy for standby arrangements etc.

If power contributes substantially to your inputs costs and it is difficult to break even partly using your own standby source, you may essentially have to locate your enterprise in lower surplus areas such as Maharashtra or Rajasthan. Similarly adequate water supply at low cost may become a dominant decisional factor in case-of leather, chemical, rayon, food processing and such like industries. Just to give you an idea what gigantic proportions can water as a resource assume, please note that a

tonne of synthetic rubber requires 60 thousand gallons, a tonne of aluminium takes 3 lakhs gallons, a tonne of rayon-2 lakh gallons and a tonne of steel 30 thousand gallons of wate

Other infrastructural facilities include, telephone, telegraph, fax, telex, post office, roads, etc.

Transportation : Movements of materials involve huge costs. Packaging in case of delicate products adds considerably to the transportation charges. The most common media are rail, road, air and water. Liquids and gases can be effectively handled through pipe lines. HBJ pipe line is a very progressive step in this direction.

The cost of moving material per kilometer tapers off as the length of the hawl increases.

A break even analysis can be made to decide about the selection of the most economical media. Linear programming is commonly adopted for tackling transportation problems. Even a mix of two o~ three media may prove more cost effective. Some of the examples where transportation media becomes the deciding criteria for plant location are:

i) Jute industry on river Hoogly.

ii) Sea food industry next to port of embarcation.

Labour and Wages: Availability of sufficient labour skilled in the required trades and category is yet another factor for enterprise location. Presence of technical training institutes in the area prove useful. You can study labour relations though turnover rates, adsertism and liveliness of trade unionism. Such information should be available from existing industries of the area. Whether the labour is rural based or urban; is also a point to consider.

Wage levels prevalant in the area also have an important bearing on location decision. Higher regional norms are supposed to be compensated by increased output levels of traditionally industrial labour. While you may get cheaper labour in industrial backward areas, cost of their training and fall in efficiency may not allow you to take this course.

Laws and Taxation : Laws prohibit putting up polluting industries in prone areas. In order to control industrial growth laws are enforced to decor_-'^-[t] some areas while simultaneously encourage certain other areas.

Taxation is a centre as well as State Subject. In some highly competitive consumer products, its quantum may turn out to be the negative factor while its relief may become the final deciding factor.

Incentive: For balanced economic growth of the country, very lucrative backward area concessions such as subsidies, tax holidays for number of years, assured and cheaper power supply price concessions for state purchases etc. have been made available. Land also is available at a very much cheaper rate. A large number of entrepreneur have benefited from these incentives. Other factors being comparative this factor becomes the decision maker.

Climate : affects human efficiency and behaviour a great deal. Wild climate is conducive to higher productivity. Certain industries take jute and textil6s require high humidity.

Ecology and Environmental Factors : Manufacturing plants apart from producing solid waste can also pollute water and air. Stringent waste disposal laws, in case of certain industries, add to the manufacturing cost to exhorbitant limits.

We as the society members at large have no alternative but to pay this price for maintainance of our ecological balance in the longrun.

Political Conditions: Political stability is essential, for industrial growth. 'Community attitudes such as the "Sons of the Soil Theory" may not be viable in every case. You have also to look into the availability of community services such as housing, schools & colleges, recreational facilities and .municipal services.

There are many qualitative and quantitative, techniques adopted to interpolate the above factors to arrive at a logical decision. The simplest and most commonly adopted is weight rating method illustrated in Figure 3 below.

Fig. 3
Plant Location : Decision Marix

SL. NO.	FACTORS	FACTOR WEIGHT RATING	POTENTIAL SITES (WEIGHTAGES) S1 WEIGHT RATING	S1 TOTAL WEIGHT-AGE	S2 WEIGHT RATING	S2 TOTAL WEIGHT-AGE	S3 WEIGHT RATING	S3 TOTAL WEIGHT-AGE	S4 WEIGHT RATING	S4 TOTAL WEIGHT-AGE
1.,	Proximity to Main Market	11	12	(132)	16	(176)	13	(143)	17	(187
2.	Nearness to Raw Materials	11	19	(209)	12	(132)	17	(187)	13	(143)
3.	Infrastructural Facilities	5	8	(40)	4	(20)	7	(35)	5	(25)
4.	Transportation Costs	5	10	(50)	14	(70)	9	(45)	11	(55)
5.	Land Requirements & Costs	15	8	(120)	12	(180)	9	(135)	13	(195)
6.	Incentives	20	13	(260)	19	(380)	16	(320)	20	(400)
7.	Availability of Trained Labour	15	16	(240)	10	(150)	15	(225)	7	(105)
8.	Laws & Taxation	10	6	(60)	9	(90)	7	(70)	10	(100)
9.	Ecology & Environmental Factors	2	4	(8)	2	(4)	3	(6)	2	(4)
10.	Climate	6	4	(24)	2	(12)	4	(24)	2	(12)
				1143		1214		1190		1226

Activity 2

Talk to three entrepreneurs, one in manufacturing, one in trade and one in services business. Discuss with them to find out :

a) the factors considered by them in the location decision.

b) how have availability of transportation and labour affected their location decision.

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11.5 PLANT LAYOUT

Plant layout is an analytical and economic arrangement of various facilities lake workmen machines, equipment, materials, plant services, incoming, in service and outgoing materials, tool and intermediate storage and inspection areas with a view to achieving their optimum utilisation. The facilities layout also is a strategic decision since a layout once implemented cannot be changed easily. Some of the advantages of a good layout are:

i) Higher Productivity.
ii) Economic utilisation of floor space and other operating areas such as loading & unloading.
iii) Better supervision and control.
iv) Better working environment and employee safety.
v) Minimum material handling.
vi) Lower investment in plant and building with better maintenance. facility.

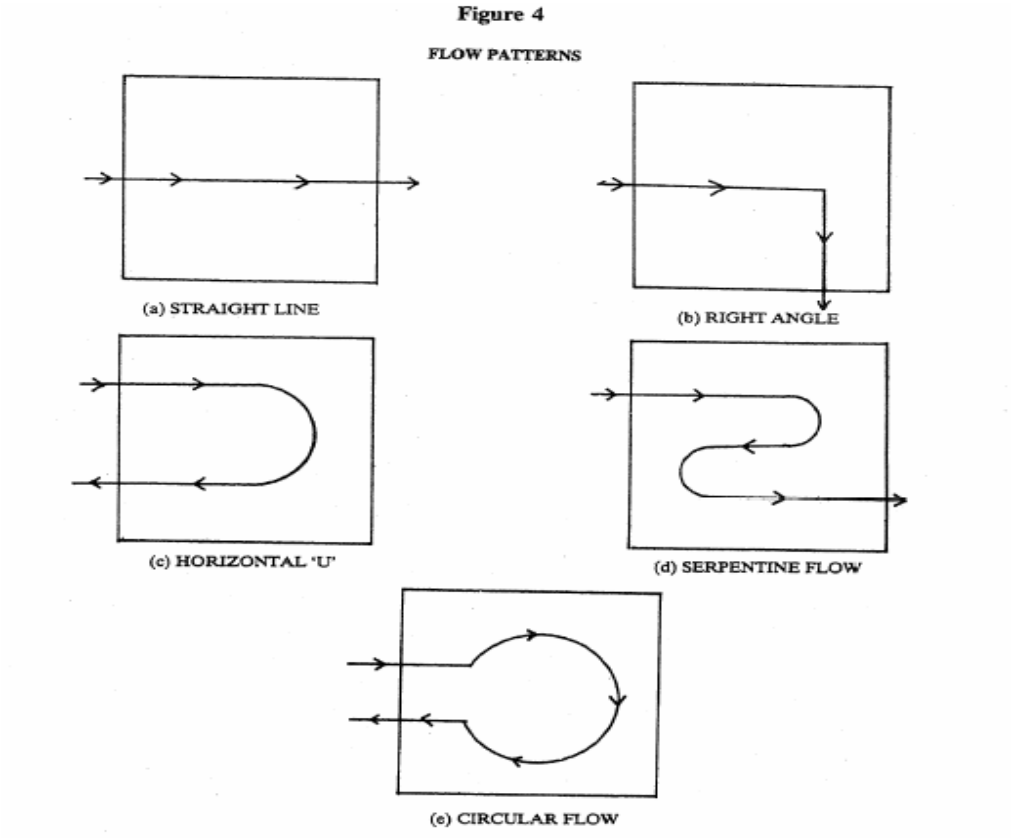
Flow Patterns: Basically there are three types of flow patterns viz. horizontal, vertical and the combination of the two. These patterns can be evolved by the use of flow process chart.

Activity charts and or flow diagrams. The best way of analysing a flow pattern is by the use of a Travel Chart. The basic types of horizontal flow nines are: in small stale Enterprise

i) Straight line
ii) Right Angle
iii) Horizontal "U"
iv) S flow and
v) Circular flow.

There are diagrammatically represented in Figure 4 below. The choice of a particular flow pattern would depend upon the types of the building, the types of the products, type of the raw materials used and their frequency of use; out inspection, packing and despatching requirements. Mostly the "U" flow and circular flow patterns are commonly used..

Figure 4



Activity.

Visit a restaurant which you can classify as being in the small sector. Comment upon how has the layout of facilities added to or detracted from the ease of movement. Could you suggest some alternative layout?

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11.6 INDUSTRIAL ENGINEERING

No production and operation management study is complete without the knowledge of industrial engineering commonly called Work Study. The ILO hand book states work study, as a term used to embrace the techniques of method study and work measurement which are employed to ensure the best possible use of human and material resources in carrying out a specific activity. A more descriptive definition as

given by British Standards Institute is: "Work Study is a. generic term for those techniques particularly, method study and work measurement which are used in the examination of human work in all its contents, and which lead to a systematic investigations of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvements."

Method study is the systematic and scientific evaluation of existing or proposed plans & performance of any work system and the evaluation of improvements through the analytical process of critical examination. Method study if concerned with reduction of the work content of the operation. While making suggestions for improvements, economy in human efforts, reduction of unnecessary fatigue and the development of a better physical working environment should be taken note of. Method study in its genealised field of activity can also be termed as work simplification. Conventional symbols used in work analysis are as under:

Standard Symbol	Name of Activity	Definition of activity
○	Operation	An operation occurs when information is given or taken, planning or calculation takes place operations could be 'do' make ready 'or' put away type.
→	Transportation	It occurs when an object is moved from one operation to another or from one place to another.
□	Inspection	To check and or verify qualitatively and or quantitatively.
D	Delay	A temporary halt or interference which comes up in the planned sequence of operations.
▽	Storage	It occurs when an object is intentionally kept aside.
□	Combined	Various combination of simultaneously occurrence of two activities.

Work Measurement: It is the application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance. It is concerned with the investigation and reduction of the ineffective time and the subsequent establishment of time standards for the operations based on the work content evaluated by method study. There are a number of work Measurement techniques. Some of these are mentioned below:

i) **Time Study:** This is a direct observational techniques in which an industrial engineer watches a worker's time and rates the work. It is a very simple and straight forward method but viewed with suspicion by the workers who think that all stop watch work is either to set a rate or to cut it.

ii) **Activity Sampling:** It is a random observation method under which state or condition of the object or person under study is noted for yes/no position from the proportions of observations in each category, inferences are drawn concerning the total work activity. Accuracy of the result will increase as the number of observations increase. Activity sampling is less presented by the workers while the results can be fairly accurate compared to time study, Work Sampling is based on the statistical law of probability and is derived from the statistical sampling facility provided by the mean and standard deviation of a sinomial distribution that closely approximates to a normal carve under certain set of conditions.

iii) **Predetermined Motion Time System (PMTS) :** Workers acceptance of time standard is very essential for any work norms to be effective. It has been engaging the attention of management theorists so as to avoid all irritants of the process. One such evolution has been the PMTS. Here each element of work such as reach, turn, grasp, move apply pressure etc. etc. have been broken down into very very small basic movements.

They could be 6f the order of 1/30th of a second and are determined by studying cine film records. Tables for times for these basic movements under varying conditions are published. These are universally acceptable. The industrial engineer now allocates precise timings for elements of work involved in his process under study by combination of various basic movements as given in the tables and totalling their timings. PMTS requires training since the definition of basic elements is not always obvious.

iv) **Synthesis and analytical estimating:** Within any organisation the same type of elements of work will recur even if the total job differs. Work measurement can be achieved if the times of all these elements are added together. If originally these timings were obtained by time study, then the process is called `Synthesis' whereas if obtained by the use of knowledge and experience, then the process is called analytical estimating.

Industrial Engineering has gained enormous importance the world over. It tells you the ways to improve productivity. Labour input costs cannot be worked out unless work norms have first been established. To work out correct work norms you have to report to industrial engineering. There are also essential for wage settlements with workers as also to draw up incentive schemes.

11.7 PRODUCTION PLANNING AND CONTROL

Production Planning consists mainly of the evaluation and determination of production inputs such as labour machinery and equipment, materials and utilities to achieve the desired goals. The definition of the goals is also a part of the Production Planning process. The process of Production Planning can be divided into the following three phases:

i) Allocation
ii) Routing
iii) Scheduling

Allocation: The marshalling of all the resources of production which will be required to perform the task is called allocation. This division is concerned with the provision of space, the supply of labour availability of machines and equipment and the provision of materials and spaces. Allocating of resources is done taking all the other commitments into consideration and the priorities allotted to various products.

Routing: includes planning of where and by whom work will be done, determination of both the path work will follow and the necessary sequence of operations.

Routing as applied to manufacturing is the application of predetermined orderly logical and economical sequence of operations through which materials, parts and sub assemblies must pass to prepare them during each successive operation for their subsequent development into larger sub assemblies or completed products. The Route card or commonly called Job Card is prepared by the Methods Dept. Products are prepared from materials processed within the plant, purchased from vendors, precured on sub contract from other manufactures or the combination of the *three. You must coordinate their routing so as to avoid held ups at the assembly line. It is - sometimes necessary to allow controlled banks at work stations. This helps maintaining the flow in following -manners:

i) Allows time minor machine changes or sequencing -
ii) Does not let the rejections due to stage inspection to interrupt the free flow.
iii) Rejections in the meantime can be reworked and put back on the line.
iv) Helps' tide over absenteeism for a short while.

Scheduling: Covers many portions of the manufacturing cycle. Master schedules are prepared for various periods of time. The ideal master schedule is the one that forecasts accurately specific items and the quantities to be produced daily' for the maximum number of days. The ideal schedule though is seldom realised in actual practice because it is not always possible to ensure all variable inputs to be available at the right time and right quantity.

Production Plan is drawn in advance, maybe three to six months. It starts with the corporate planning for the year. Annual aggregate plan dovetailing the requirements

of the Annual Marketing Plan is drawn up, indicating monthly schedules. Production Plan is issued in advance so that the requisite materials procurement and placement is done in time to avoid any bottlenecks in operations. A good production plan has two parts viz. Firm Schedule for the ensuing month and tentative schedule for the succeeding month or two months. The advantage of such a type of scheduling is the preplanning that can be done by concerned agencies such as Materials, Purchase, Finance etc. This way bottle necks can further be avoided.

In jobbing type of work or a Service Centre or over-hauling workshops where large, number of products serials are simultaneously progressed, computers are used for production planning and control. In certain cases spares/materials inventory alone runs into thousands, even lakhs of items. They have to be available just in time to avoid heavy inventory carrying and storage costs.

Production Control is the updating and revising procedure where according to the requirements of the implementation, the labour assignments, the machine allocations, the job priorities, the rates of lines flows, the schedule routes etc, may be: critically examined and changed. It is basically a monitoring and correcting mechanism which goes on throughout the production process of the already drawn production plan and schedule. For frequent revisions of schedules you need a supervisor to look after the changes, monitor them and communicate decisions fast on the production lines. For efficient contract, production schedules are drawn to as detailed a level in time as possible thereby exercising tight control over the smallest of deviations. In order to continually monitor the schedule, many control techniques are adopted, some of these are:

i) Periodic Production Review Conferences
ii) Reports and Returns and their review
iii) Charts & Graphs
iv) Growth Charts
v) Line of Balance
vi) CPM/PERT
vii) Computers

Integrative Nature of Productions Plans: PP&C is an effort to optimise the process of conversion of raw materials into finished goods. PP&C therefore has to be an integrated function to derive maximum benefit out of planning. The procurement and inspection of raw materials the inventory levels of in process and finished goods, Quality Control, plant maintenance, production costs, manpower and training and the machinery equipment all have their influence on the planning of production operations.

Activity 4

a) From your nearest industrial area, choose a sample of 10 small enterprises. Discuss with them to find out what methods of production planning and control are being used by them.

b) In case you think the methods used are not adequate what methods would you like to suggest?

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11.8 WORDS SERVICES AND THEIR MANAGEMENT

In the modern complex production operations environment, for every hand engaged directly in production, there are a number of hands supporting his effort. Without this it would be impossible for the production man to carry out his functions smoothly and uninteruptedly. A fine anomaly can be drawn from our defence services. For every ground soldier in the front line, flier in the air or a seaman in the high seas, there are 3 to 5 inert supporting him from behind. To achieve efficiency in production, work services such as materials, procurements and personnels training, plant maintenance, Quality Control, R&D, PP&C, healthy, safety, fire fighting supervision, etc, have to be equally if not more efficient. In costing work services are accounted as overheads. Due to technological advancements works, services costs, have gone many times higher than purely production costs. But these high costs are offset against increased productivity. Work services practically include every functional aspect of an enterprise except the workforce directly deployed on production lines and may be the personnel functions. Some of these functions are mentioned in brief in the succeeding paragraphs.

Material Management: Materials account for 70 to 80 per cent per unit cost of production. Thus it deserves and occupies a high place in POM. You should be already aware of various inventory management techniques such as ABC & VED Analyses. ABC deals with the calculation of 'annual costs of each item in the inventory and listing them in descending order of value. You will notice that 5 to 10 per cent of the top number of items account for about 70 per cent of the total consumption value. They need the most attention. Call them `A' items. Next 15 to 20 per cent of the items account for about 20 per cent of the total consumption value. They are called `B' items. Persue them periodically. Remainder 70 to 80 per cent of the items account for about 10 per cent of the total consumption value. Call them `C' items. Delegate their responsibility to the lowest functional level. You would have seen that ABC Analysis is based purely on grading the items according to the usage alone. Some items even though less costly in monetory value, may be vital for running the plant. These could be machinery spares, test equipment and other stores required for plant maintenance. Hence ABC Analysis should be done in conjunction with VED Analysis. VED stands for vital, Essential & Desirable. Vital items should be, taken case of at the highest materials management level while essential items can be dealt with at middle level and desirable items can be delegated to the lower levels. Newer techniques are being practiced in the sphere of materials management. There is a concept of Zero Inventory where materials are procured in the quantity immediately needed and are passed on to production line straight away. While all these new concepts are efforts towards costs cuttings and have their pay offs they are not able to eliminate conventional well beaten techniques.

Plant Maintenance: i) Sophistications in technology have led to very high cost general as well as special purpose machines such as NC/CNC/DNC machines. Similarly tools, gauges and test equipment have become highly costly. It is not only the high initial costs but also the penalties you will have to pay in case of their breakdowns (even very temporary) that have made the plant maintenance as such as an exceptional area of POM, meriting specific attentions at the corporate level. In the technological sphere, specialisation like plant Engineering has come up. Failures a[r]e a natural phenomenon. You at best can achieve longer MTBF (Mean Time Between Failures there are basically four types of maintenance systems viz.

i) **Breakdown Maintenance:** This is a crises situation and has to be dealt with on war footing. Its possibility cannot be completely eliminated. In the organisational set up, maintenance special Repair Personnel are earmarked and they swing into action moment the breakdown occurs leaving all other routine work aside.

ii) **Scheduled Maintenance :** Normal wear and tear of any equipment can be determined statistically to a fairly accurate state. Keeping this in view the equipment manufacturer issues periodic inspection and servicing schedules along with the equipment which should be meticulously followed just as is done in case of aircraft, locomotives and other critical ground equipments.

iii) **Planned Maintenance:** It is slightly different than the scheduled maintenance in that the maintenance plan is issued y the plant Engineer the equipment being put through planned maintenance is made available for.

the duration. Normally planned maintenance so executed that it causes the least amount of disruption in the production activity. It is thus carried out either during off shift hours or on weekly off days.

iv) **Preventive Maintenance :** It consists of routine actions taken in a planned manner to prevent breakdowns and ensure operational efficiency economically it starts with daily cleaning, oiling and inspection by the operator himself and goes on to periodic lubrication turning- up and testing by the maintenance department. Faults noticed by the operator or his superior during the usage are reported and immediate repairs get done before the fault causes a breakdown.

v) **Other aspects of plant maintenance**; include all other areas of equipment management, operation of services and facilities such as:.

i) Maintenance of buildings and other equipment on the shop floor.
ii) Maintenance of transport external as well as internal like conveyors, forklift trucks, cranes etc.
iii) Provision of standby power, water and other facilities like air conditioning, compressed air, water coolers etc,
iv) Housekeeping including seweraging, gardening footpaths.
v) Health, fire fighting and industrial safety.

Miscellaneous Works Services

i) Materials Handling : In any manufacturing orgainsation, the product has to pass 'through many processes before assuring its final stage. It has been computed that on an average 50 tons of various materials are moved to achieve one ton of finished goods. Material handling costs money and yet does not add any value to the product. Some of the factors to be considered while tackling the material handling aspect are:

a) Should be as nearly automatic as possible to keep the cost low.
b) Use gravity as an aid.
c) Movements should be in straight line & as straight as possible like frictionless rollers.
d) Moves to be in straight lines.
e) For fixed paths use conveyors.
f) Integrate production control, inventory control and material handling.

Some of the Material Handling Equipment are

a) Chutes, inclined rails,gravity roolers, conveyors,
b) Conveyors such as powered rollers, belt or chain conveyors, apron conveyors and overhead conveyors.
c) Elevators overhead -runaway, trolleys & lifting stocks.
d) Cranes-fixed, overhead as well as mobile.
e) Trucks and other wheeled vehicles.

ii) **Fire Fighting :** Fire prevention measures have become a statutory obligation. Requisite fire fighting equipment such as extinguishers, beaters, water and sand buckets should, Lie provided. Today highly sophisticated electronic fire alarm: systems having audio as well as video signalling are available. Fire fighting contingency plans should be drawn up and left updated. It should cover on duty as well as off shift situations. Proper unit areas for workers and entrance for fire-men and equipment should be earmarked. Men should be properly trained in the handling of the equipments. More practices should be periodically carried out. It is always better to takeout an insurance policy against loss due to fire. Still 'more important is to review it periodically with the help of insurance advisors or consultants.

iii) **Accident Prevention :** A safety officer should be appointed by name. Proper position should be put up at prominent places with work areas. Gloves and goggles etc should, be provided for hazardous jobs. Exhaust fans in the areas where fumes got generated should be required. Gangways should be kept clear. No oily surface, regular scraping of shop floors, guards on machines and conveyors are some more measures to achieve accident prevention.

iv) **Health, Hygiene and First Aid:** Environment should be kept as clean as possible. Adequate latrines and urinals with running water, water coolers, electric fans, exhaust fans etc. are some of the essential requirements for a healthy and

conducive work environment. A first aid post with trained staff must be established on the, shop floor. Certain percentage of men should be trained in first aid specially resuscitation due to electric shock and such take serious accidents.

v) **Energy Management :** This is gaining tremendous importance not only as a cost saving measure but a national emergency. Maintain your power lines to correct specifications specially the switches. Mechanical power transmission should be properly adjusted, well lubricated and with least friction. Switch off power tools even when not in use for short intervals. Electric motors should be of very good quality and correct rating.

11.9 QUALITY CONTROL

Quality is the performance of the product as *per* the commitment made by the producer to the consumer. A product is called a quality product only when it satisfies certain criteria for its functioning. Bureau of Indian Standards is doing a yeoman service by designing and laying down various criteria for a _very large number of industrial and domestic product. A product should not only satisfy the criteria at the time of manufacturing but the same performance should be available over a reasonable length of time:

Quality assurance is a strategic decision. Thus it is the responsibility of all functional managers viz. Purchase, Production, Operations, Warehousing (Storage) and the transportation and packaging. Quality implementation is total organisational effort.

Control Charts

i) Variations in any process can be described in terms of central tendency and dispersion. Central tendency is for the samples to stay as close to the criteria as possible while dispersion is described as the extent to which the variation from the criteria exists you have also to understand a bit more of statistics before we can apply it for evolving our quality control measures. Central limit thereon states that the means of the samples tend to follow a simple statistical distribution called normal distribution.

ii) Therefore the procedure you follow will be:
   a) Take a few samples at a time. Measure their quality characteristics.
   b) Find the mean of the sample. Also measure its range of dispersion.
   c) Gather statistics for the ranges and the means of the various samples taken over frequent .or regular intervals of time.
   d) Plot these statistics approximately on a graph paper.
   e) You have your control chart ready now to guide you as to when a particular process needs to be rectified and in what manner.

iii) Based on the sample size, there is a definite relation between the standard deviation of the population and the standard deviation of the sample mean. In other words inspection of samples means statistical inspection of the whole manufactured lot.

$$\frac{\text{Population}}{n}$$

U population
where
standard deviation
means
value of the measured characteristic
mean of the values of x observed of "the sample
sample size.

x chart

i) This is the control chart for the control tendency. It is also called the average control chart. You fire the lower and the upper control limits for the values of x. Usually these limits are ± 3 which give an accuracy of 99.97 per cent of the results. Fig. below indicates it graphically:

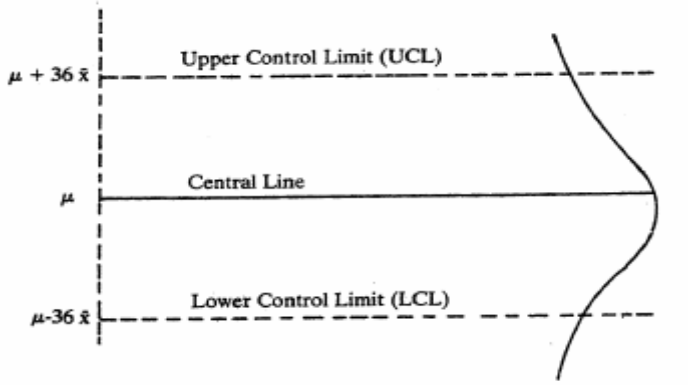

Fig. 5 : X Chart for Control Process

An illustrative example is given below

A company using an automotive machine fills one leg sugar boxes with a lower limit of 1.000 and upper limit of 1.005 the machines has natural process variability of 0.0003. The three sinma limits of the machine therefore are 3x0.003=0.0009 leg on either side which means a total dispersion of 0.0018.

Since the specified dispersion is 0.005, the automatic machine is adjusted to fill 1.0025 Kg. boxes. This becomes the Central line. You are now ready to set up an x chart to detect when the machine goes out of the control. Weigh samples of n = 5 boxes and record x the average weight per box for each sample.

Using the formula $X \frac{\text{population}}{n}$

We got

$$\frac{0.0003}{5} = 0.000134 \text{ Kgs. and}$$

$$3 \times 0.000134 = 0.0004$$

Critical Examination

The chart represents four samples, a total of 20 one kg. 1.0034
1 kg. boxes. It will be seen that the fourth samples is on the 1.0029
upper control limit of the sample dispersion. All four 1.0025
samples show the tendency for positive values progressively 1.0021
indicating thereby that more sugar is being put into the 1.0016
boxes than what was intended and that the machines need fewer adjustment.

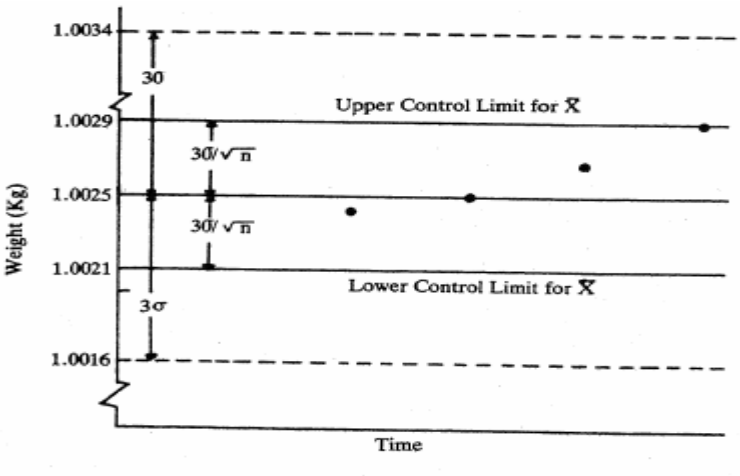

Fig. 6 : X Chart

R chart

Range control chart are for studying the dispersion. Range is the difference between the maximum value and the minimum value of the observations in a sample. We use the samples range for controlling the dispersion of the population. The formula are:

$R = d_2 \times pop.$

and $R = d_3 \times pop$

values of d_2 and d_3 for a given sample size n are read off from standard statistical and quality control tables.

The control limits for R charts are determined differently. There is no need for lower control limit which is zero for n<b

Now you apply the formula $R = d_2 \times 6\ pop$

We have already seen that 6 pop is 0.0003 and the value of d_2 from the tables for n=5 is 4.918.

Hence R =0.0003 x 4.918

= 0.00148

Critical Examination

It will be seen that all four samples are close on the Centre line. Hence no statistically significant shifts are present. Hence the automatic weighing machine needs no adjustment as far as the range of the dispension is concerned.

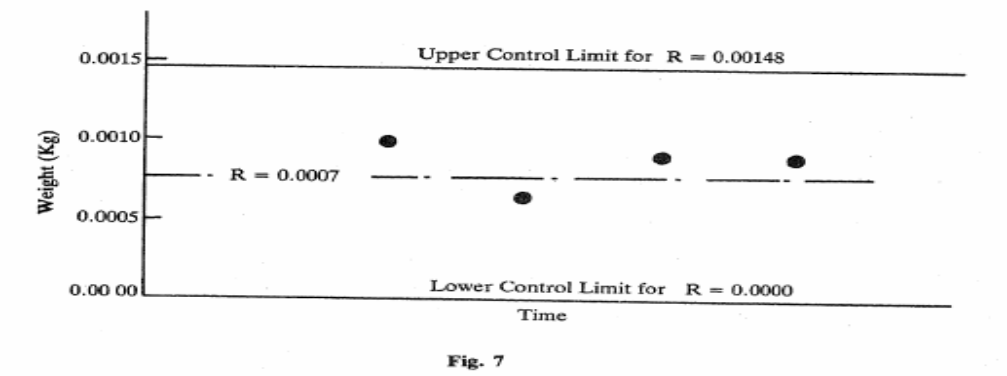

Fig. 7

Acceptance Sampling Plan

i) The sampling procedure consists of taking a small sample comprising in number, of items from a consignment of N number of items and accepting the consignment only if the number of defective items in. the sample is less than or equal to a cost number C or else rejecting the consignment.

ii) An OC curve (operating characteristic curve) is typical of a particular sampling plan. Different sampling plans give size to different OC Curves.

In using the Acceptance Sampling flan, there is a further probability that the lot may be accepted even of the quality is not really good. Also conversely the lot may be rejected if the quality is actually good. The first type of risk is called the consumer's risk and the second type is called the producer's risk.

Average Outgoing Quality Level

i) You know that on the basis of a sampling plan a lot is either accepted or rejected, if rejected it undergoes 100 per cent inspection at the suppliers or the consumer's and before its acceptance. The chance of bad quality entering the consumer's plant due to rejection of a lot is zero. The lead danger to the incoming quality is from the accepted ones. At any value of per cent defectives in the lot, there is a corresponding probability of acceptance of the lot. The defectives entering the

plant due to the acceptance of the lot are = Probability of Acceptance (Pa) X Percent Defectives in the lot (p). This is the Average Outgoing Quality Level. For each possible value of a p there is a corresponding ADO value. You as the company are interested in knowing the maximum value of ADO. This is the maximum risk your company is exposed to under the given sampling plan.

ii) The example below will illustrate the ADQL concept better.

The probabilities of acceptance of the lots of uniform size under an acceptance sampling plan are

Actual Per cent Defectives in the submitted lots	Probability of Acceptance
1.2	0.731
1.4	0.650
1.6	0.570
1.8	0.494
2.0	0:423
2.5	0.278
3.0	0.174
3.5	0.106
4.0	0.062
5.0	0.020
6.0	0:006

What maximum bad quality can enter the plant, under this sampling plan.

Solution

It is required to calculate the ADQL under the sampling plan because ADQL is the maximum limit of the bad quality entering into the Plant.

Actual Per cent Defectives in the submitted lots (P)	Probability of Acceptance (pa)	Average Out going Quality (ADQ x pa x P)
1.2	0.731	0.8772
1.4	0.650	0.9100
1.6	0.570	0.9120
1.8-	0.494	0.8892
2.0	0.423	0.8460
2.5	0.278	0.6950
3.0	0.174	0.5220
3.5	0.106	0.3710
4.0	0.062	0.2480
5.0	0.020	0.1000
6.0	0.006	0.0360

Therefore the Average Outgoing Quality Limit (ADQL) is 0.9120. This is the maximum risk to which the plant is exposed under the given sampling plan.

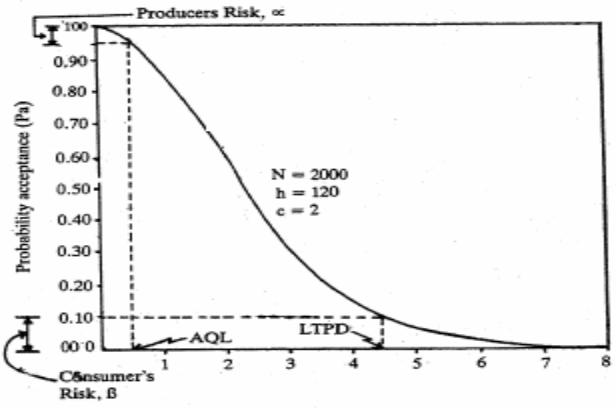

Fig. 8 Percent defectives in the lot (PD)

Double Sampling

The double sampling procedure consists of taking first a sample of size n, and in inspecting it for- defectives. If the number of defectives is less than or equals cut off number C_1, reject the lot. If the number of defectives are more than C_2, reject the lot. If the number of defectives are in between C_1 and C_2 then take another sample of a different size u_2. If the number of defectives in the combined sample of u_l+u_2 is less than or equal to C_2 then accept the lot. Otherwise reject it.

TQM (Total Quality Management)

The scope of quality management is not just devising a sampling plan for the acceptance/rejection of the incoming materials and controlling manufacturing process conditions. It is infact a job at every step of the company's activities.

Cost of Quality Control

i) There is no hard and fast rule as to what percentage of product costs should contribute towards the costs to be incurred for ensured quality standards. There are so many inponderables that it is difficult to precisely define this cost.

ii) However it should remain a minor percentage of the product cost is not disputed. That is why you do not go in for cent per cent inspection of each and every component. Furthermore, this percentage should remain as low as possible. It would depend on:

   a) Type of Product: its functional use, the hazard involved in the use penalties for failure etc.
   b) Quality awareness prevailing in the organisation by implementation of concepts of TQM, ID and QC.
   c) Costs for ensuring higher quality standards. You can go on improving in the quality if costs are no consideration and also if functional requirements so dictate. There is no optimum value between quality and product costs.

Activity 5

a) From the sample that you collected for activity 4 also collect information of quality control methods used.
b) Are these methods appropriate?
c) What modifications would you like to suggest?

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11.10 SUMMARY

The concepts of productivity, product selection, location, location decision, value engineering and quality awareness are as important determinants of success for a small enterprise as they are for a large scale one. This unit, on operational management issues, discusses in detail some of the underlying operational management concepts in relation to SSE and explain the significance of utilisation of these concepts for a small entrepreneur.

11.11 SELF-ASSESSMENT QUESTIONS

1) What are the important considerations in a product design selection? Explain with the help of an example.

2) Discuss the process of prototype development.

3) How do availability of, transportation facilities and labour affect the location decision? What in your opinion are the three most important variables affecting the, location decision?

4) What do you understand by method study and work measurement? How relevant do you think these are for a small scale enterprise?

5) What are the tools of production planning and control that a small entrepreneur can use? Comment with the help of an example.

6) Explain the various quality control tools that can be used by small entrepreneur.