UNIT 2 PRODUCTION SYSTEM: ISSUES AND ENVIRONMENT

Objectives

Upon completion of this unit you should be able to:

- Appreciate the role of Production Management in the organisational setting
- Understand the systems approach to production
- Have a brief idea about the characteristics of a production system and types of production control systems
- Comprehend the procedure of designing a production system
- Appreciate why productivity improvement should be emphasised in a production system
- Take stock of the upcoming issues of production system viz. Group Technology (GT) and Optimised Production Technology (OPT)
- Assess the impact of changes in the field of Information Technology (IT) on production Systems

Structure

2.1 INTRODUCTION

In this unit we will be able to learn about various aspects of production/operation systems. The collection of all interrelated activities involved in producing goods and services is called a Production system. A production system consists of five principal components: Inputs, Conversion/Creation process, outputs, Feedback and Managers. The inputs to a production system consist of the resources that are transformed into the desired outputs (goods and services) as well as the resources needed to support the overall production process. The major output of a service system is customer satisfaction. Conversion process in the production system typically changes the shape and/or composition of raw material and other inputs. In a service organisation the service is created.

One of the important aspect of managing a production system is to determine the relative roles of people and machines. With rapid changes in technology, now a days machines are capable of performing more tasks as compared to the people. Robots for example can performed more menial and dangerous tasks. The biggest challenge before a production ope[r]ations manager is to manage this **Human-Machine Interface.**

In this unit we will be dealing with such important issues as: What role and especially reactive role is being played by production system in the context of organisational setting?, Why it is essential to view the production system It - the systems view point?, What is the procedure of designing a production system'?, Why it is important to achieve

productivity improvement in order for production system?, Why it Is important to achieve productivity improvement in order for production system to be both efficient and effective?, What contributions are made by upcoming issues of production system such as GT and OPT to the overall cost effectiveness of the production-system. In What ways the recent developments in the field of IT are influencing the production systems and what resultant economic benefits can be reaped?

Comprehension of these aspects shall puts you in good stead when confronted with such issues in your working situations.

2.2 ROLE OF PRODUCTION MANAGEMENT

Production Operations Management is concerned with proper management and utilisation of those enterprisse resources which are required to produce goods and/or services. With the growth of service industries the term Operations Management has come to be used which emphasises production of both goods and services. In the wake of increased competition the business organisations are compelled to develop their overall corporate strategies to remain viable, For achieving this the functional level strategies should contribute to the coherent strategy of the organisation. It is often seen that individual functions dominate the corporate strategies. The following table (2.1) shows the relative dominance of one or the other functional area in the corporate strategy.

Table 2.1: Changes in the dominant role of functions in corporate strategy formulation

Period	Typical function	Reasons
1945 to 1965	Production/Operations	During this period, in most industrial sectors world demand was greater than world capacity. Companies could typically therefore, sell all they could make and hence the production/operations function tended to hold sway in strategic debate.
1965 to early 1980s	Marketing	In about the mid-1960s, the imbalance between available world capacity and world demand had begun to be redressed. The outcome was that in most markets selling products became increasingly difficult. Hence the advent of marketing's strategic role which came to the fore from this time onwards.
Early 1980s to present day	Marketing and/or finance	The recession which occurred in the late 1970s and early 1980s resulted in many companies experiencing financial difficulties and witnessed a spate of corporate failures. Already gaining ground, these events stimulated the emergence of the finance/acounting function and its role in strategic formulation.

Hill, Terry, 1992, The Essence of Operations Management, PHI, New Delhi, p.10.

2.2:.1 The reactive role of Production/Operations Management

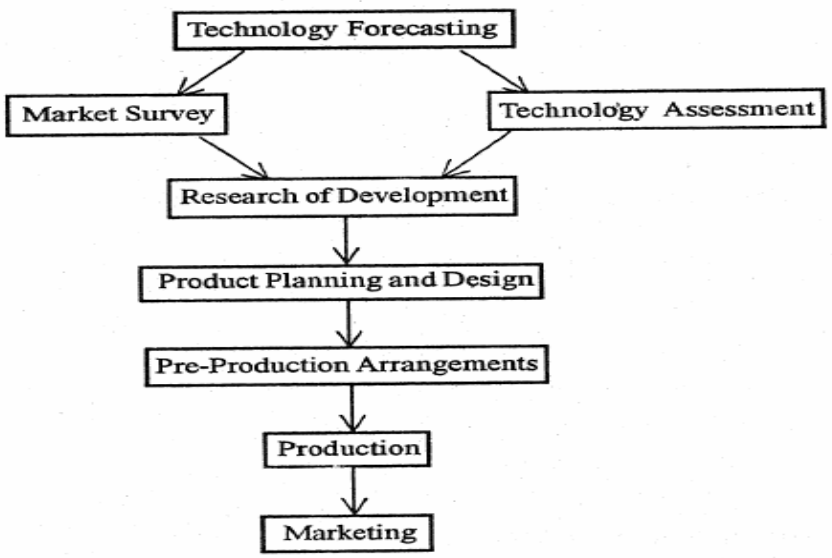
Many companies do not find it necessary to incorporate the functional area perspectives while formulating corporate strategies. Most companies embrace the marketing and financial constraints in their strategic response but fad lo incorporate the critical aspects of Production/Operations Management. One reason for this is the typical characteristics traits of Production/Operations Manager. A Production/Operations Manager should have the ability to handle the strategic aspects of Production/Operations Management consistently. The second trait of Production/Operations Manager is their disdain for the written word, because they rely more on verbal communication. The need of the hour is to document all the activities so that it may be possible to systematically review the Production/Operations Problems and to incorporate them into the strategies. Even the Production/Operations Mangagers also have a tendency to view themselves as holding a reactive corporate brief and rarely they feel the need to take part in strategic debates. Companies also view the role of Production/Operations Management as a short term and. reactive and do not stress the long term nature of this task.

2.3 PRODUCTION/OPERATIONS MANAGEMENT: A SYSTEMS VIEW POINT

Production operations management is greatly influenced by the rapid economic change and the technological advancements. The classical management cycle of planning implementation and control is very much applicable in the production management. According to Ogawa "Production of management may be defined as the planning, implementation and control of production activities conducted by an organisational entity with define performance objectives subject to modifications according to ambient conditions."

Today's production management is not confined to the plant level manufacturing activities only. But it encompasses all other preceding activities such as preparation, product planning and design, as well as R & D. It takes into consideration, socio-economic changes. Forecasts about future technologies are the fountainhead activities, which are followed by market surveys and technology assessment (for example in terms of pollution control studies). The socio-economic factors provide the foundations to R & D activity of an organisation which yields product planning and design. It is followed by the preparation stage which includes planning, sequencing, scheduling, equipment selection, materials procurement, personnel mobilisation etc, Hence Production Management calls for integrated actions which cover the whole spectrum as depicted in figure 2.1.

Fig. 2.1 Areas of Production Management



Ogawa, E., 1984, *Modern Production Management: A Japanese Experience*, Asian Productivity Organisation, Tokyo, p3.

The production systems which are responsive to rapid changes in the market place are capable of reducing the lead time between product development and manufacturing which is also known as the startup period between product design and actual production.

2.3.1 Production System Model

A production process consists of 1) objective, 2) input, 3) processing, 4) output, and 5) control and adjustment (the word "control" is used hereafter to mean both control and adjustment).

1) A clear-cut objective should be established for any production activity. Characteristics of the finished product should be defined together with applicabel Production techniques. For example, in the case of canned crab meat; the should not be defective and should contain a specified a tuna or beef

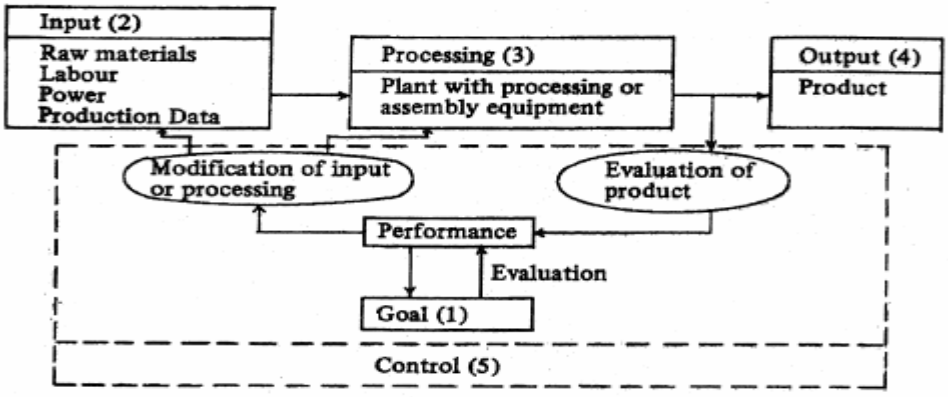
2) “Input” refers to resources used in the production of canned crab meat, such as crab meat, wrapping paper, can, human labour, utilities, and data.

3) "Processing" means the transformation of the resources into a product which in this case is canned crab treat. Production equipment is utilized for processing.

4) “Output” is the product itself.

5) “control” refers to the evaluation of the output with reference to the objective and to the subsequent adjustment or modification when required. All these principal elements and their interrelationships are depicted in the following figure (2.2).

Fig. 2.2 Production System



Ogawa, E., 1984, *Modern Production Management: A Japanese Experience*, Asian Productivity Organisation, Tokyo, p7.

For smooth production it is essential that proper coordination should be achieved between the production function and preparation stage.

A favourable relationship should be maintained between input and output throughout the entire production process. This relationship should realise the fixed objectives with the use of minimum resources.

2.3.2 Characteristics of Production Systems

A production system is characterised by the following:

a) System discrimination

b) Interrelationship among systems

c) Stratum formulations

d) Specialisation of functions

e) Increase of entropy

f) Isofinality

a) **System Discrimination:** A production system consisting primarily of input and output does not have the wider connotations involving all phases from technology forecasting to manufacturing all these other phases arc considered as pant of the production environment. This definition process is called system discrimination.

b) **Interrelationship Among System:** The closed relationships that exist between production and pre-production arrangements is known as the interrelationships between systems. Similarly the relationships among production systems and other systems also exist.

c) **Stratum Formulation:** A production system consisting of various strata of corporate hierarchy wherein each stratum has a role to play depending on the size of the firm. It enjoys benefits as a result of the stratum performance. Examples of strata are: headquarters, administrative departments, factory and production field.

d) **Specialisation of Functions:** As the production system expands it trends to have large number of hierarchical strata each performing specialised functions. According to Adam Smith the integration of specialised functions produces maximum results,'

e) **Increase of Entropy:** According to Ogawa entropy is a measure of the degradation of the matter and the energy in the universe to an ultimate state of inert uniformity. To check this deterioration process fresh blod must be infused in every production system e.g. old employees should be replaced by new once and old machines should be replaced by new machines employing new technologies. Otherwise the organistion and equipments may become obsolete. To cope up with rapid change of technological innovation the organistion as well as production system needs to be rejuvenated.

f) **Isofinality:** Isofinality is the process of reaching the same goals by different routes. There are different approaches to converting the inputs to outputs. For example some organisations may heavily rely on buying required parts from outside suppliers while others may insist on in-house production of parts. Although both the organisations have an identical objective of efficient production.

2.3.3 Production Systems-Two Types of Control

Control is the basis for production management. The `input-process-output' relationship should be controlled irrespective of size of the production system. There are two types of production system controls: a) Feedback control b) Feedforward control

a) **Feedback Control:** In this type of control mechanism first the output is obtained as a result of input and processing. Then it is measured using some measuring instruments. The result of the measurement is seldom in agreement with the goal. Therefore specifications normally have tolerances. Adjustments are made in processing and/or inputs if statistically significant number of products fall outside the tolerance range. In common parlance of production management, it is called "the principle of exception". In these situations control charts which are based on the Statistical Quality Control (SQC) are used as a control tool.

b) **Feedforward Control:** In this type of control mechanism, input is checked against pre-specified standards, prior to processing as well as output phases. For example at Toyota Production System, every work station is equipped with 'Bakayoke' which detects and physically removes defects in an automated fashion. Preventive maintenance of machines is another example of feedforward control, wherein the life of each critical machine component is determined first and it is replaced just before it breaks down. The feedforward control system collects measurement data, compares them against the specifications and initiates modifications on input if and when the need arises.

For attaining economic efficiency, both types of control must be simultaneously used in a production system. The role of production management is two folds:

1) First is to ensure that the performance satisfies the production goal

2) The second one is to modify the production goal to suite the changes in technology and demand in the market place.

A production system can acquire its competitiveness through the simultaneous application of these two types of production control system.

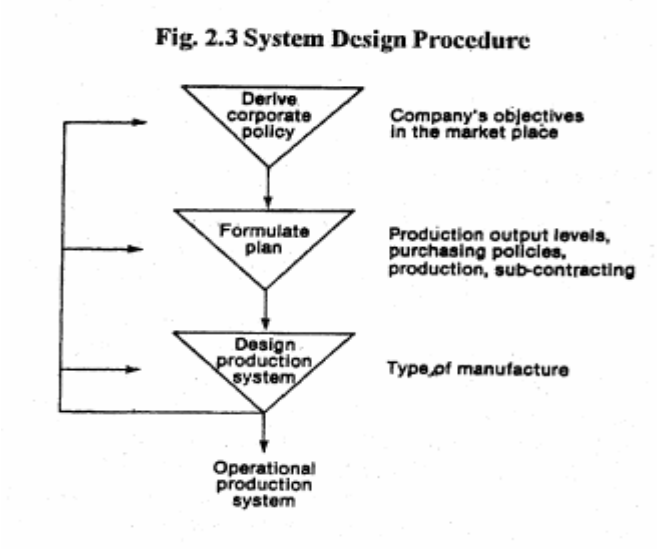
2.4 PRODUCTION SYSTEM DESIGN

Various machines and processes in the factory must be organised to snake the most effective use of their capabilities. A production system consist of three elements of 'input transformation –output'. Design of a production system aims to achieve the right mix of varying proportions of these elements. The production system design must be effective in its overall context, e.g. a production system may be very efficient and effective but there may not be adequate demand in the market place for its products. Such holistic approach requires that both internal and external factors must be identified and their impact on the organisational effectiveness is assessed. Some of the external factors are: Competition, supply demand trade unions, financial institutions and government policies. The

corporate strategy has to be formulated which should take into account the functional level policies including that of output and input policy from production system. Some of the internal factors which are relevant at the transformation stage are' Customer specifications delivery dates, complixity of products and technical factors such as selection of equipment, material handling equipments etc. Some of the operations decisions regarding the organisational structure; quality control, capacity planning, product control mechanism, personnel decisions (viz. number of operators required, shift working, form of payment etc.) In some of these personnel decisions trade unions also influence the technical decisions like the extent of automation, shift working, payment of wages and incentive etc..

All these factors have bearing on the design of production system. The process of production system design has been diagrammatically shown in the following figure (2.3).

Fig. 2.3 System Design Procedure



Clews, G. and Leonard, R. 1991, Technology and production, Heritae Publisher, New Delhi, p.89

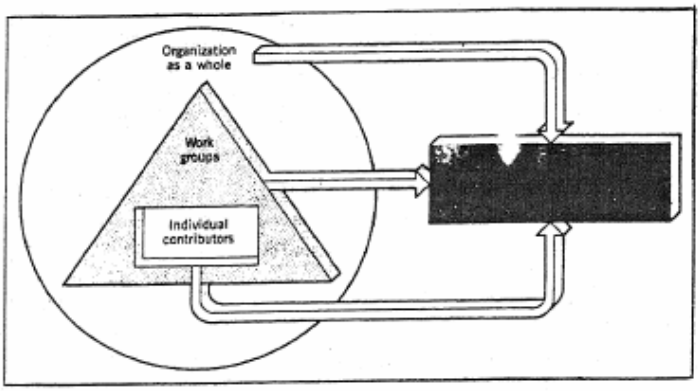
2.5 PRODUCTIVITY IMPROVEMENT

Productivity is one of the major performance criteria for evaluating a production system. Productivity is function of the relationship between production, input and output. Productivity improvement results when a given output is achieved with less input or a given output is achieved with less input. Productivity improvement is equally useful for service industries. In recent times productivity has improved through extensive use of computers and sophisticated machines. Both input and output can be expressed in terms of energy units. Material energy represents raw material and equipment, and mental energy represents brain work. Productivity improves when waste is either decreased or eliminated, materially or mentally so that a larger percentage of energy input is obtained as the output.

Productivity is a summary measure of the quantity and quality of work performance with optimal utilisation of scarce resources. It identifies success or failure in producing goods in right quantity, of good quality and with good use of resources. Productivity involves doing a job in the best possible way all the times. In figure 2.4 the productivity is shown as a criteria of work achievement that applies to individuals groups and organisations. Manager should be able to influence the productivity of their subordinates. The manager should also be able to integrate these performance contributions to achieve the high levels of productivity at the organisational levels,

Researchers are rigorously trying to study the applications of operations management to achieve the productivity improvement in the service industry. In order to maximise the output and minimise the input it is necessary to control the whole of production system. It results in effective utilisation of human and other resources. Japanese industrial organisation have followed this philosophy in their productivity improvement drives.

Fig. 2.4 Levels of Productivity Accomplishment in Organisationa



Schermerhorn Jr., J.R., 1989. *Management for Productivity,* John Wiley and Sons, New York p. 18.

2.6 UPCOMING ISSUES OF PRODUCTION SYSTEMS

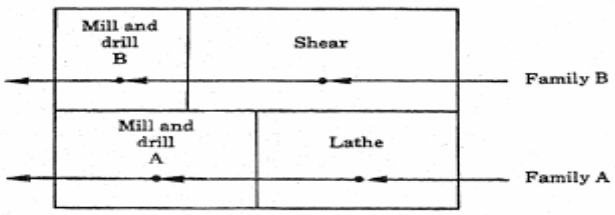
Some new concepts such as Group Technology (GT) and Optimised production Technology (OPT) have increasingly gained recognition in the production management discipline. These concepts provide economies in production and add efficiency to the production system.

2.6.1 Group Technology (GT)

GT is the relatively new concept in production operations management. The objective of GT is to take advantage of mass production systems in smaller batch production systems. The idea of GT is to classify parts into families so that efficient mass plant layouts can be designed for these families of parts. To illustrate the concept of GT following example is given:

A production facility produces two families of parts A and B. The first family of parts requires operations on a lathe, milling, machine and drilling machine. The second family of parts require shearing, milling and drilling operations to be performed. The traditional process is shown in the following figure (2.5). In this layout shears,-lathe, milling machines and drilling machines have been grouped in separate departments. As parts from each family pass through milling and drilling departments in batches, new setups on machines must be performed. On the other hand, the group concept shown in the figure below establishes a separate machine grouping of milling drilling machines for each part family. In this system the number of setups are reduced and the system operates as a mass production line.

Fig. 2.5 Group Layout



Evans, J.R. et al., 1984 Applied Production and Operations Management, West Publilshing Company, New York, p. 18.

In a group layout system the different machines are ground together which are necessary for the production of families of parts. Many benefit can accrue from the GT.

i) The design of new products can be greatly assisted by examining the design of related parts
ii) With GT in place, production control becomes easier as scheduling becomes less complex and material handling costs can be reduced
iii) The savings in setup times and increased production potentials also results from the GT
iv) In essence, GT provides for inherent advantages of mass production system in a batch process.

Students are required to go through unit 18 to read more on Group Technology.

2.6.2 Optimised Production Technology (OPT)

In recent times OPT has received a lot of attention of the management thinkers and Production Operations Management Practioners. OPT comprises two parts:

i) The conceptual base of the system
ii) The software package (OPT/SERVE) which support the system.

OPT is a sophisticated control system based on finite loading procedures by concentrating on bottle necking work centres. It is concerned with shop floor control.

Some of the fundamental insights of the OPT are as follows:

i) In any production system the capacity of all the parts are not the same. There are some bottle necking work centres which have capacity constraints. The important task of Production Operations manager is to load the system in such a way to optimise the output without violating any of the capacity constraints.
ii) The bottle necks govern both throughout and inventory levels in the system.
iii) It is essential to reduce the bottle necks by increasing available capacity wick in turn will increase the total flow of the system thereby realising hitherto unused some of the" existing capacities of other processes. No advantage can be gained by increasing capacity of non bottle neck processes. The principles of OPT philosphy have universal applicability consequently they help in enhancing existing control systems and the effective management of the Production Operations Manager.

2.7 PRODUCTION SYSTEMS AND INIFORMATION TECHNOLOGY

IT/Information System (IS) are having major impact on this functional area. A large number of tools are provided by the IT such as Computer Aided Designing (CAD), Computer Aided Manufacturing (CAM). Flexible Manufacturing System (FMS), Computer Integrated Manufacturing (CIM). The IT system have contributed immensely to the MIS of an organisation. In an efficient IT systems the information flows electronically. The extent of automation is also increasing as various versions of automated equipment such as Directed Numerically Controlled (DNC), Numerically Controlled (NC) and Computerised Numerically Controlled (CNC) machines are available for use in the POM area. These machines are designed and developed in accordance with the latest IT principles. For controlling the operations of CNC machines a computer programme is written in APT (Automatically Programmed Tools) and Compact II language. IT has come to be used to control a physical process also. The collection and analysis of data for Statistical Process Control (SPC) is done through analog device. Data is analyzed with the help of a digital computer which in turn gives signal to take the corrective actions if process goes out of control.

The increasing use of Robotics is another manifestation of the impact of It on POM. A Robot is a mechanical device which has the flexibility and ability to grab hold and move the items on the shop floor. 'A Robot is a cost-effective substitute of-human efforts. Another area in which ITAS is facilitating the manufacturing operations is the Decision Support System (DSS). A DSS is logical extension of MIS and it aids in decision making: It enables managers to perform a "what -if ' type of analysis. Expert Systems (ES) are computer programs that mimic human logic and solve problems like a human expert. The Knowledge and skills Field are captured in a computer programme which

should be periodically updated to include new facets of knowledge. The use of ES in scheduling programmes is wide spread. Odyssey is a business oriented expert system which is used for solving the computer scheduling problems. The following table gives an idea of the areas in which ES have been developed.

Table 2.2 Expert System IN P/OM

Name	Use	Explanation
xcon (expert Configurer), Digital Equipment Corp.	Configuration	Checks sales orders and then specifies the components needed to configure the computer system
Authorizer's Assistant American Express	Credit	Helps determine the appropriate level of credit, based on a variety of criteria
.Consultant, IBM	Bids	Helps field service representatives prepare bids by analyzing elements in the request for quotation
PROPLAN	Scheduling	Schedules machine parts based on facilities available, machine capability, and geometric features of the parts.
SPC (Statistical Process Control), Automatix, Inc.	Process control Data are statistically analyzed to guide modifications to the manufacturing process to anticipate malfunctions	DELTA (Diesel Electric Locomotive Trouble-shooting), General Electric Maintenance Assists maintenance Personnel in isolating and repairing various faults in diesel electric locomotives
FADES (Facilities Design Expert System)	Layout	Develops a good facility design in situation where quantitative tools and human judgment can be combined.

If. Raghav Rao and B.P. Lingaraj, "Expert Systems in Production and Operations Management: Classification and Prospects," Interfaces, 1 &(November-December 1988): 80-91.

2.8 SUMMARY

This unit has attend to provide a broad (framework) of Production Operations System. The production Operations management plays a crucial role in the context of a bussiness organisation. It plays a domminant role in the process of corporate strategy formulation. A system's view point has been offered in this unit which takes into consideration the linkage between production and pre production stages: Various characteristics of production system such as discrimination, inter-.relationships among systems, stratum formulation, Specifications of functions, increase of entropy and is ofinality have been explained. Two types of production control system viz. feedback control system and feedforward control system have been described. In the next section, procedure of design of the production system has been outlined. Productivity is one of the major performance criteria for evaluating a production system. Two important concepts of Group Technology (GT) and Optimised Production Technology (OPT) have gained in popularity in the recent times. The underlying concepts and resultant economic benefits which can be derived from both of them. have also been discussed. Rapid advancements in the field of Information Technology (IT) leaves one awe-struck. It is having major impact on the way the business organisations work, The impact of IT on Production systems has been outlined with particular emphasis on CAD/CAM, FMS and Robotics.

2.9 KEYWORDS

Decision Support Systems (DSS) Entropy

Expert Systems

Feedback Control System

Feedforward Control System

Flexible Manufacturing System (FMS)

Group Technology (GT) isofinality

Optimised Production Technology (OPT)

Production System Model

Production System Design

Productivity Improvement Robotics

Stratum Formulation

System Discrimination

2.10 SELF-ASSESSMENT EXERCISES

1. "A production system is characterised by its inputs, transformation process and outputs." Indentify for the following production systems the inputs, conversion/ creation process and major outputs:

   a) Automobiles manufacturing

   b) Architecture consultant

   c) Private nursing home

   d) Thermal power plant

2. The discussions given in the unit regarding design of a production system are useful only for a large organisation. In your opinion whether this statement is true or false. Give logical justification of your answer.

3. Froth your own knowledge and experience describe the working of production systems like FMS, GT and OPT in different organisational settings.

4. Distinguish between feedback and feedforward control systems. Whether the implementation of any one type of production control system is sufficient?

5. With a sound IT system in place, the information flows electronically in an organisation. How the MIS of an organisation can be benefitted by it?

2.11 FURTHER `READINGS

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