Aim of Production System:

To produce goods and services required for human consumption in the right quantity with the right quality at the right time in the most economical way.

A Typical Production System has:

- Value Addition at different operations.
- Use of various tools & techniques.
- Performance Indicators like Production, Productivity, Efficiency, Effectiveness.
- Production System can be Mass/Continuous, Batch, Job, Project.

Classification of Production System:

on the basis of
- Size – small, medium & large
- Input – Man, m/c, material, money, management, information, energy
- Output – Goods and services.

Production System transforms a set of inputs into desirable outputs

Transformations can be:

- Physical as in Manufacturing
- Locational as in Transportation
- Exchange as in Retailing
- Storage as in Warehousing
- Physiological as in Hospitals
- Attitudinal as in Welfare Organisation
- Informational as in Communication
- Gratificational as in Entertainment
Production is defined as step-by-step conversion of one form of material into another form through chemical or mechanical process to create or enhance the utility of the product to the user.

A system is defined as a collection of elements which are interdependent and independent to achieve objective.

- A system consists of many sub-systems.
- A car is a system. Take out carburetor (sub-system) & the system as car cease to exist.
- A heap of sand is not a system. Take out a particle of sand and heap of sand is still there.

**Generalized Model of Production System:**

[Diagram of a generalized model of a production system]

**Categories of Production Systems:**

1. Make to Stock  
   e.g. TV, Motors, Nuts & Bolts, Bearings etc.
2. Make to Order  
   e.g. Custom Tailored Clothing, Special Purpose M/c etc.
3. Assemble to Order  
   e.g. Computer System
Types of Production System:

1. Project Production
2. Job Production
3. Batch Production
4. Mass Production
5. Continuous Production

1. Project Production
The work is carried out at the site of the work rather than in factory. All resources such as tool, material, labour etc. are brought at the site of production. Generally construction projects and heavy and large product based projects like ship building are example of project production.
A fixed position plant layout is recommended for this type of production system.

2. Job Production
The Job production system is for low production volume.
Following are its characteristics:
1. Commonly used to meet a particular customer need.
2. Production lot size is generally small.
3. Product variety is high.
4. Production equipments are mostly general purpose and flexible to meet specific customer order which varies from time to time.
5. Highly skilled labour is needed to handle the equipments, as variety and product range are very high.
3. Batch Production

The Batch production system is for medium production volume of same variety. At regular intervals, the production order is repeated.

Following are its characteristics:
1. Commonly used to meet repeated customer orders.
2. Production lot size is medium and in batches.
3. Product variety is moderate.
4. Production equipments are general purpose but suitable for higher production volume.
5. Specially designed jigs and fixtures may be used to reduce set-up time and increase production rate.
6. Reasonably high skilled labour is required but less as compared to Job production. This is due to relatively less variety and variation.

4. Mass Production

The Mass production system is for high production volume of identical parts.

Following are its characteristics:
1. Particularly suited for high demand items.
2. Production lot size is very high and production rate is continuous.
3. Product variety is very low.
4. Special purpose tools and equipments may be needed.
5. Skill Level of workers may be moderately low as repeated work on same machine is needed.
6. Entire plant is designed to cater to few special varieties of products.
7. Requirement of special purpose machine for special purpose operation needs higher investments.

5. Continuous Production

The continuous production system is for continuous production of a product.

Following are its characteristics:
1. Particularly suited for very high and regular demand items.
2. Production is continuous.
3. Product variety is very low.
4. Special purpose tools and equipments are needed.
5. Skill Level of workers may be low as continuous work on same machine is needed.
6. Entire plant is generally automated and computer controlled.
7. Higher investments are required for system monitoring and controlling.

Fig. 1.3 Type of Production System : Effect on some factors and preferred layout
<table>
<thead>
<tr>
<th>Product Variety</th>
<th>Production Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

**Legends:**
- P: Project Production
- J: Job Production
- B: Batch Production
- M: Mass Production
- C: Continuous Production
Comparison between Production System to produce products & Production System to produce services

<table>
<thead>
<tr>
<th>Production System to produce products</th>
<th>Production System to produce services</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Tangible</td>
<td>Intangible and perishable; consumed in the process of their production</td>
</tr>
<tr>
<td>● Can be produced to inventory for “off the shelf” availability</td>
<td>Availability achieved by keeping the productive system open for services</td>
</tr>
<tr>
<td>● Minimal contact with ultimate consumer</td>
<td>High contact with clients or consumers</td>
</tr>
<tr>
<td>● Complex and interrelated processing</td>
<td>Simple processing</td>
</tr>
<tr>
<td>● Demand on system variable on weekly, monthly and seasonal bases</td>
<td>Demand commonly variable on hourly, daily and weekly bases</td>
</tr>
<tr>
<td>● Markets served by productive system are regional, national and international</td>
<td>Markets served by productive system are usually local</td>
</tr>
<tr>
<td>● Large units that can take advantage of economics of scale</td>
<td>Relatively small units to serve local markets</td>
</tr>
<tr>
<td>● Location of system is in relation to regional, national and international markets</td>
<td>Location dependent on location of local customers, clients and users</td>
</tr>
</tbody>
</table>

Service Organizations

The output of certain production systems is a service rather than a tangible product. e.g. Hospitals for health care, Beauty Salons for good looks, Consultation Firms for advice, Banks for loans and money related services, Airlines for transportations etc.

In service organization the output is consumed in the process of its production.

Better management of the system that provides the service, consistent with customer preferences and requirements, will lead to greater profitability for the firm.

Distinctive Features of Service Organizations

1) Customer is a participant in service department
   Input/ Resource
   Immediate interaction with operation
2) Production and Consumption occur simultaneously
   Services not inventoried
   Capacity to provide service must be available when demanded
3) Service capacity is time perishable
   Synchronous demand/ capacity
   Forecasting/ capacity adjustment challenging
4) Site selection dictated by customer location
   Multiple, local area sites
5) Operations are labour intensive
   New technology difficult to implement
   Employees characteristics influence the services
6) Services are intangible
   Units of output difficult to define/ measure
   Q.C. system difficult to establish
Life Cycle Approach to Production Management

Life cycle of a production system has different phases, which are same as that of human beings. We can identify eight distinct phases as:
1. Birth of the production system
2. Product Design & Process Selection
3. Design of the system
4. Manning of the system
5. Start-up of the system
6. System in the steady state
7. Revision of the system
8. Termination of the system

Some typical products at various levels of product life-cycle are shown below:

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Fig. 1.4 Stages in Product Life cycle

Fig. 1.5 Typical Products at various levels of PLC in Indian Industry
Every stage in the production system is concerned with different levels of managerial decisions as shown in Figure:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth of System</td>
<td>Goals? Product / Service?</td>
</tr>
<tr>
<td>Product Design &amp; Process Selection</td>
<td>Form &amp; Appearance of product? Technology – how should the product be made?</td>
</tr>
</tbody>
</table>
| Design of system                   | Facility Location
|                                   | Physical Layout
|                                   | Determine demand, perceived quality                                     |
| Manning the system                 | Assigning jobs to workers
|                                   | How job to be performed, measured? Compensation of worker                |
| Start up of the system             | How to get system into operation? How long it will take to reach desired stage? |
| The system in Steady state         | How to run system- day to day? improve the system? deal with operational problems? |
| Revision of the system             | New technology threats/ opportunities
|                                   | Revision of markets
|                                   | Newer methods of manufacture
|                                   | Newer products
|                                   | Innovation                                                               |
| Termination of system              | How does a system die? How to salvage resources? Sell out/ merger/ sell m/cs |
MAJOR CONSIDERATIONS at various stages

Birth of System
STAGE I : MAJOR CONSIDERATIONS
- Future long term trends of growth
- New Products
- Technologies
- Consumer Preference Patterns
- Industrial Climate
- Govt. Policies
  - Basic Desire, Commitment, Experience
  - Available or Projected Resources

Product Design & Process Selection
STAGE II : MAJOR CONSIDERATIONS
- During Design of Product or Service
  - Customer Needs
  - Behavior of Materials
  - Available Processes of Manufacture
  - Economics
  - During Process Selection
  - Available Technologies
  - Economics
  - Required Specifications

Design of system
STAGE III : MAJOR CONSIDERATIONS
- SURVEYS AND FEASIBILITY STUDIES
  - ECONOMICS OF
    - Mass Production
    - Batch Production
    - Job Production
    - Project Production
    - LAYOUT PLANNING
    - QUALITY ASSURANCE
    - DEMAND FORECASTING

Manning the system
STAGE IV : MAJOR CONSIDERATIONS
- Work Measurement
- Setting of Production Standards
- Wage Incentives
- Capacity Determination
- Planning Resource Acquisitions

Start up of the system
STAGE V : MAJOR CONSIDERATIONS
Problems of
  - Installation
  - Training of Personnal
  - Coordination
  - Learning Phase

The system in Steady state
STAGE VI : MAJOR CONSIDERATIONS
- Setting Production targets
  - Scheduling, sequencing of jobs
  - Inventory Control
  - Quality Control
  - Production Control
  - Cost Control
  - Maintenance

Revision of the system
STAGE VII : MAJOR CONSIDERATIONS
- Evaluation of competitor's product
  - Newer Methods of manufacture
  - Consideration of New products or innovating existing product with better design or function
  - Revision of New Markets for existing products

Termination of system
STAGE VIII : MAJOR CONSIDERATIONS
- Evaluation of existing resources for salvation purpose
  - Consideration of better option available like sell out / merger with other company / selling various machines separately.
Examples

Set out below are some suggested examples of products that are currently at different stages of the product life-cycle:

<table>
<thead>
<tr>
<th>INTRODUCTION</th>
<th>GROWTH</th>
<th>MATURITY</th>
<th>DECLINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third generation mobile phones</td>
<td>Portable mobile</td>
<td>Personal Computers</td>
<td>Typewriters</td>
</tr>
<tr>
<td></td>
<td>DVD Players</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-conferencing</td>
<td>Email</td>
<td>Faxes</td>
<td>Handwritten letters</td>
</tr>
<tr>
<td>All-in-one racing skin-suits</td>
<td>Breathable synthetic fabrics</td>
<td>Cotton t-shirts</td>
<td>Shell Suits</td>
</tr>
<tr>
<td>iris-based personal identity cards</td>
<td>Smart cards</td>
<td>Credit cards</td>
<td>Cheque books</td>
</tr>
</tbody>
</table>

Productivity

Productivity is defined as the ratio of output to inputs

\[
\text{Labor Productivity} = \frac{\text{Units Produced}}{\text{Hours Worked}}
\]

\[
\text{Capital Productivity} = \frac{\text{Output}}{\text{Capital Input}}
\]

\[
\text{Material Productivity} = \frac{\text{Output}}{\text{Materials Input}}
\]

Productivity measures the capability of processing inputs to convert to outputs. It simply measures how much output is produced relative to the inputs of labor, capital (plant and equipment), and technology. A process may be productive but may not be efficient.

Factors that facilitate productivity improvement:

Technological Innovation:
- faster machines, eliminate heavy physical work and repetitive operations
- increased capital investment, complex machinery, skilled operators

Effective Management
- Employee motivation, better marketing, etc.

Efficiency

Efficiency denotes the maximum utilization on one’s given resources. Efficiency is generally a relative term, used for comparison. Its focus is on the best utilization of resources. Elimination of some adjacent bank branches as a result of merge of two banks would attain greater efficiency, while a termination of employment due to teller machines would cause greater productivity.