IE551
Production System Design

Instructor:
Assistant Prof. Dr. Rıfat Gürcan Özedmir

http://web.iku.edu.tr/~rgozdemir/IE551/index(IE551).htm

Course topics

- Chapter 1: Production systems, product design and process planning
- Chapter 2: Forecasting methods
- Chapter 3: Capacity planning
- Chapter 4: Facility location
- Chapter 5: Plant layout
- Chapter 6: Material handling and storage systems
Production process

- A production process consists of activities that are required in transforming an input set (human resources, raw materials, energy, money information, etc.) to valuable outputs.
Types of production – inventory systems

- Pure inventory systems
- Continuous production systems
- Intermittent production systems
- Project systems

Pure inventory systems

- The simplest form of DSS in the logistics field
- There is only a procurement activity (no production or complex distribution interactions)
- Absence of resource availability and other constraints (e.g., labor, machine time, raw materials, routing)
- Example: a retail store that buys products for immediate resale
Continuous production systems

- The manufacturing of a few families of technologically related products in large volume through fixed routings
- Two subsets:
  - Mass production
  - Process production

Mass production

- You may switch to another product’s manufacturing by performing slight changes in the physical elements

Big screw $\rightarrow$ smaller screw
Process production

- The physical elements are designed and placed so as to produce a specific product. Changing is impossible / costly!
- Some examples: Cement, sugar industries, refinery

Intermittent production systems

- Batch production of many products which share several processing centers
- Two types:
  - Flow shop
  - Job shop
Flow shop

- The products have the same routing and the production facilities can be arranged accordingly

Job shop

- The product routings vary widely and the facilities are arranged on a functional basis
## Job shop vs flow shop

<table>
<thead>
<tr>
<th></th>
<th>Job shop</th>
<th>Flow shop</th>
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</thead>
<tbody>
<tr>
<td>Production volume</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Product variety</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Process layout</td>
<td>Process</td>
<td>Product</td>
</tr>
<tr>
<td>Workload</td>
<td>Unbalanced</td>
<td>Balanced</td>
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<tr>
<td>Setup activities</td>
<td>More</td>
<td>Less</td>
</tr>
<tr>
<td>Flexibility</td>
<td>High</td>
<td>Low</td>
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</tbody>
</table>

## Project systems

- A special case of intermittent systems, the production effort is done infrequently, often once
- Coordination of a large number of complex items that must be scheduled according to specified precedence requirements
Product design

- Specifies materials
- Determines dimensions and tolerances
- Defines appearance
- Sets performance standards

Life cycle of a product
Phasing in new products

Annual demand

Time

Product A
Product B
Product C

Stages in the design process

Idea Generation → Feasibility Study
Feasibility Study → Product Feasible?
Product Feasible? → Final Design
Final Design → Prototype
Prototype → Process Planning
Process Planning → Manufacturing
Manufacturing → Design & Manufacturing Specs
Design & Manufacturing Specs → Idea Generation
Weighted rating technique for evaluation of design alternatives

<table>
<thead>
<tr>
<th>Factors</th>
<th>Relative weights</th>
<th>V.good (40)</th>
<th>Good (30)</th>
<th>Avg. (20)</th>
<th>Poor (10)</th>
<th>V.poor (0)</th>
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<td>Material status</td>
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<tr>
<td>Value added</td>
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<td>X</td>
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<td></td>
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<tr>
<td>Influence on current product</td>
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<td></td>
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</table>

Σ = 1.00  Σ = 30x0.20 + ... + 30x0.20 = 31.00

Process planning

Select the basic technology

Transformation process (evaluate the alternative technologies and select the best)

Select the suitable equipment
The design phase of a production process

1. Determination of the production stages

2. Determination of the alternative processes at each stage

3. Selection of some Alternatives
   \(3 \times 2 \times 2 = 12\) Alternatives left

4. Detailed analysis on alternatives

5. Selection of the best process