II CONCURRENT ENGINEERING OF PRODUCT, PROCESS, SCHEDULE & FACILITIES

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1. Concurrent Engineering & Systems Approach

- Concurrency implies different systems and engineering functions performed at the same time in a consistent manner
- Facilities engineering is not a stand-alone process — highly dependent on what, how, when & how much to produce.
- What? = Products
- How? = Process
- When? = Production scheduling
- How much? = Production planning, forecasting

2. Product Design

- Functions
- Dimensions and shape
- Materials
- Quality and aesthetics

The product design is then described in:
- Engineering drawings: specify materials, dimensions, quality, assembly structure
  - Multiview drawing: third angle projection
  - Perspective drawing
  - Assembly drawing
- Parts list: Name, Descr., Drw. #, Quantity req., Material, Size, Vendor
3. Process Design

- Make-or-buy decisions -- break even analysis

\[ C = K + m \times \text{Number of units (x)} \]

- Break-even point

3. Process Design

- Process selection
  - Define elemental operations from product design
  - Identify alternative operations for each operation
  - Analyze alternatives -- depends on production quantity
  - Standardize process

- Process sequencing
  - Route sheet or routing (fig. 3.10, pp. 44-45)
  - Assembly chart (fig. 3.11, P. 46)
  - Operation process chart (fig. 3.12, p. 47) -- Combines above

- Computer-Aided Process Planning (CAPP)

4. Schedule Design

- How much to produce at a time (lot sizing)
- How long to produce
- When to produce (scheduling)

4.1 Market information

- Less specific information \Rightarrow general design
- More specific information \Rightarrow optimized design
- Volume, trend and life

4.2 PARETO ANALYSIS

- Uncertainty: most likely, optimistic, pessimistic
- Qualitative information (Table 3.4, p. 53)
- Variety vs. Volume (P-Q) analysis
4. Schedule Design

• Uncertainty: most likely, optimistic, pessimistic
• Qualitative information (Table 3.4, p. 53)

4.2 Pareto Analysis

• Variety vs. Volume (P-Q) analysis

5. Production Quantity & Equipment Requirement

5.1 Determining Capacity Requirements

• Quantity requirements (& processing time $\Rightarrow$ workload)
• Equipment requirements

5.1 Determining Quantity Requirements

• BOM matrix $B = [b_{ij}]$, $b_{ij} = \#$ of item $j$ required for 1 unit item $i$
• $X = D \times [I - B]^{-1}$, $D = \text{end-item demand vector}$, $X = \text{prod. reqmts.}$

5.2 Determining Input Requirements

5.3 Determining Equipment Requirements

5.3 Determining Equipment Requirements

- DECISION VARIABLES
• $D = (d_{1}, d_{2}, \ldots, d_{n})$:
• $X = (x_{1}, x_{2}, \ldots, x_{n})$

- OBJECTIVES
• Minimize total equipment cost

- CONSTRAINTS
• $d_{i} \leq d_{i} \leq c_{i}$
• $x_{i} \leq x_{i} \leq c_{i}$
• $d_{i} \leq d_{i} \leq c_{i}$

- SOLUTION ALGORITHM
• Linear programming