Facility Layout Procedures

- Nadler’s Ideal Systems Approach
  - Theoretical Ideal System
  - “Ultimate” Ideal System
  - Technologically Workable System
  - Recommended System
  - Present System

  Idea is to divorce oneself from the present system and thinking and to work from the top or ideal solution down.

Information Gathering

- Need to answer the following questions:
  - What is to be produced?
  - How are the products to be produced?
  - When are the products to be produced?
  - How much of each product will be produced?
  - For how long will the products be produced?
  - Where are the products to be produced?

- Answers are obtained from:
  - Product design
  - Process design
  - Schedule design

Facility Layout Procedures

- Apple provides a detailed sequence of planning steps that are similar to systematic layout planning discussed below.
- Reed also provides a procedure that relies heavily on the layout planning chart.
- Systematic Layout Planning
  - Developed by Muther
  - Relationship Diagramming
    - A variation of SLP and Apple’s ideas.

Information Gathering

- Product Design
  - Specify the end product in terms of dimensions, material composition, etc.
- Process Design (Planning)
  - Determines how the product will be produced.
- Schedule Design
  - Production planning, Capacity planning
  - Specifies the production quantities and schedules the production equipment.

Systematic Layout Planning

- Procedure developed by Muther and built around the activity relationship chart
  - Understand relationships between activities
  - Build relationship diagram
  - Create space relationship diagram
  - Convert the space relationship diagram into alternative facility layouts
  - Use the procedure to develop a block layout for a facility and to develop detailed layouts for each activity

  This procedure is not a mechanical process. It requires intuition, judgement, and experience. But if applied properly, it does provide a comprehensive layout planning approach.
Product Design

- Determine which products to be produced
  - Typically done by top management based on market research and forecast information
- Detailed design for individual products
  - Aesthetics
  - Function
  - Materials
  - Manufacturing Considerations
- Uncertainty involved in the products to be produced must be considered. Minor changes are inevitable, and major changes are possible. Tradeoff must be made between a flexible system and a system optimized for the current product generation.

Product Design

- Design data for products contained in
  - Photographs of product or prototype
  - Exploded drawings
  - Individual part engineering drawings
  - Parts lists
  - Bills of materials
  - Assembly charts
- Design for automation programs focus on
  - Dimensional reduction in assembly
  - Parts elimination
  - Parts standardization

Make versus Buy Decisions

- Can the item be purchased?
- Can we make the item?
- Is it cheaper for us to make than to buy?
- Is the capital available allowing us to make?

Process Design

- Selecting the required processes
  - Define elemental operations
  - Identify alternative processes for each operation
  - Analyze alternative processes
  - Standardize processes
  - Evaluate alternative processes
  - Select processes
  - Output is usually a route sheet.
- Sequencing the required processes
  - Assembly chart provides this information.
  - Operation process chart is a combination of the assembly chart and the route sheet.
  - Provides an overview of the flow within a facility.
  - Provides a basis for the layout of a facility.

Process Design

- How a product should be produced?
  - Information summarized on
    - Parts list
    - Bills of materials
    - Route sheet
    - Operation process chart
- Who should do the processing?
  - Make versus Buy decisions
    - Determines the scope and magnitude of activities within a facility.
    - Depends on the decision concerning the level of vertical integration.
    - Output is often a parts list or bill of materials

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Schedule Design

- How much to produce (lot sizing) and When to produce (production scheduling)
- Information concerning production volumes, trends, and predictability of future demands are needed. (Marketing information)
  - Uncertainty associated with future production demands must be considered when planning the facility.
- Pareto's Law often applies
  - 85% of the production volume is from 15% of the products in the product line.
  - Impacts facility design decisions
    - If it holds, then a mass production area for the 15% and a job shop arrangement for remaining 85%.
    - If it doesn’t hold, then a general job shop arrangement may be required.

Schedule Design

- Must make some aggregate capacity planning decisions.
- Three phase approach:
  - Determine the quantity of components to produce including scrap allowance based on the estimated production requirements for each product.
  - Determine the equipment requirements for each operation.
  - Combine the operation requirements to obtain overall equipment requirements.
- Schedule design is important in determining space requirements.
  - We’ll discuss it more, later, in that context.

PP&S Design

- Recently, more emphasis has been placed on improving communications between the design functions.
  - Concurrent Engineering is the resulting integration of product, process, and schedule design.
  - The thrust of Computer Integrated Manufacturing (CIM) is to provide the information links that will connect all design and operating functions.
    - Computer-aided design (CAD)
    - Computer-aided process planning (CAPP)
    - Computer-aided scheduling (CAS)
    - Computer-aided layout (CAL)
    - Computer-aided logistics systems (CALS)
  - All have been developed as pieces of a CIM system to aid product, process, schedule, and layout designers.