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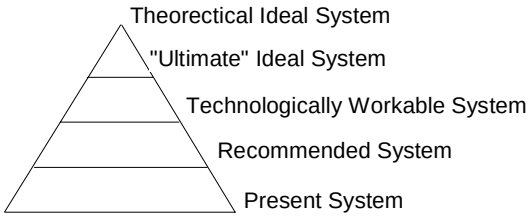
Facility Layout Procedures

- **Nadler's Ideal Systems Approach**



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

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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.**

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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.

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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

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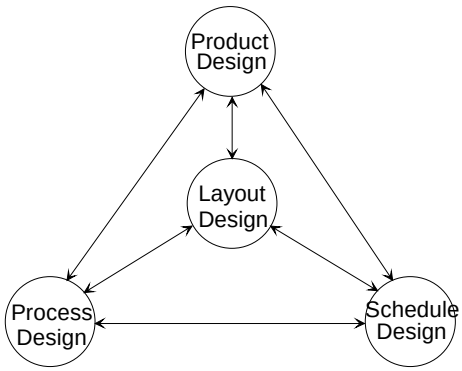
Information Gathering



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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.**

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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.

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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

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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 decisions concerning the level of *vertical integration*.
  - Output is often a parts list or bill of materials

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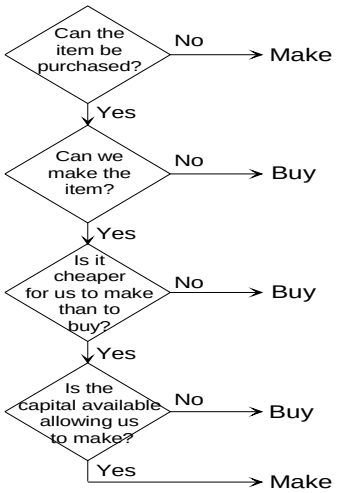
Make versus Buy Decisions



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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.

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Process Design

- The assembly chart and the operation process chart depict a single assembly sequence.
- The particular sequence can have a major impact on space and handling system requirements.
  - » Consider the manufacturing of large truck axles. With an operation process chart, an assembly line might be used and require excess handling equipment.
- A precedence diagram can be constructed to show the necessary ordering without making other implicit assumptions.
  - » It is a directed network representation of the operations. The assembly and operation process charts are trees.
- A number of alternative assembly and operation process charts should be constructed from the precedence diagram.

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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.

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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.

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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.**

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