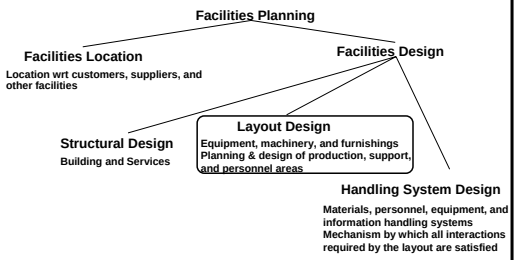
1

Facilities Planning



2

Facility Layout

- Developing a facilities layout is a critical step in the facilities planning process.
- Facilities Planner must be CREATIVE and COMPREHENSIVE in generating layout alternatives.

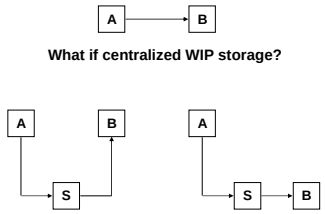
3

Facility Layout

- Which comes FIRST, the material handling system or the facilities layout?
- Layout is effected by:
  - Centralized vs. Decentralized Storage of WIP, Tooling, & Supplies
  - Fixed Path vs. Variable Path Handling
  - Unit Load Size
  - Degree of Automation
  - Type and Level of Inventory and Control of Materials

4

Facility Layout



5

Facility Layout

Handling less is BEST -- Number of times material is handled
Not necessarily the handling distance

Layout or MHS First ? -- BOTH

Sequential approach that considers a number of alternative handling systems and the corresponding layout alternatives.

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Facility Layout

- Layout Types
  - Product layout
  - Group layout
  - Fixed layout
  - Process layout

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Layout Applications

- Layout of Specific Functions
  - Manufacturing
  - Receiving and Shipping
  - Storage and Warehousing
  - Office Planning
    - » Personnel requirements
    - » Make use of traditional layout approaches
    - » Often an emotional issue
  - Facility Services
    - » Specification of *what* services are required *where*
    - » Integration of the facility services into the overall facility plan
  - Nonmanufacturing Applications
    - » Can adapt traditional techniques to these applications and apply a systematic approach

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Manufacturing

- Facilities Planning for manufacturing should be a major part of corporate strategic planning.
- Emphasis on improved *quality*, decreased *inventories*, and increased *productivity* encourages the design of manufacturing facilities that are *integrated, flexible*, and *controlled.*

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Manufacturing

- Layout and Handling System affected by
  - Product mix and design
  - Processing and materials technology
  - Handling, storage, and control technology
  - Production volumes, schedules, and routings
  - Management philosophies

Classification	Requirements	Layout Type
Job Shop	Low Volume / High Variety	Process or group
Mass Production	High Volume / Low Variety	Product
Batch Production	Med. Volume / Med. Variety	Any layout type

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Manufacturing Systems

- Transfer Lines
  - Series material flow from one workstation to the next
    - » Production rate governed by slowest operation
    - » High volume applications
    - » High level of automation
    - » Inventory buffers can be used between workstations to compensate for some variations between workstations
  - Facilities planning for transfer lines is relatively simple
    - » Processing equipment is arranged according to processing sequence
    - » Typically, straight line or rectangular flow paths are used

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Manufacturing Systems

- Flexible Manufacturing Systems
  - Network of workstations
  - Accommodates various processing sequences
  - Flexibility achieved by material handling system and general purpose machines
  - Designed for small batch (low to medium volume) and high variety
  - Justified on economies of *scope*
- Components
  - Processing equipment
  - Material handling equipment
  - Computer control equipment

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Flexible Manufacturing System

- Design requirements for an FMS material handling system:
  - Random, independent movement of palletized workparts between workstations. (AGVs, cart-on-track system)
  - Temporary storage of workparts.
  - Convenient access for loading and unloading.
  - Compatible with computer control.
  - Provision for future expansion.
  - Adherence to all applicable industrial codes.
  - Access to machine tools.
  - Operation in shop environment.

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Flexible Manufacturing System

- Designed for responsiveness to change; therefore, the FMS and the material handling system must be able to adapt to changes in
  - processing technology
  - processing sequences
  - production volumes
  - product sizes
  - product mixes

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Modular Design Concepts

- Flexibility achieved by:
  - Modular office equipment
  - Modular workstations
  - Modular material handling equipment
  - General purpose production equipment
  - Expandability of the total system design

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Modular Manufacturing System

- Integration of independent production units and modular material handling system.
- Designing modular, expandable systems is very challenging.
- Modular manufacturing system is characterized by
  - Standardized handling and storage components
  - Independent production units
  - Flexible material delivery system
  - Centralized work-in-process storage
  - High degree of control

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Modular Facilities

- Use of an interconnecting spine for material transport and movement of people.
- Standard size modules to allow functions to be interchanged if relationships change.
- Expand by extending the spine and adding modules -- creates minimal disruption to the existing facility.
- Alternative spine configurations: straight line, "T", or "X".

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Modular Design Concepts

- Facility Relayouts can be caused by
  - Changes in the design of an existing product or in the product set to be produced.
  - Changes in the production sequences or in the processing equipment.
  - Changes in the production quantities and schedules, which prompt capacity changes.
  - Changes in organizational structure or management philosophy.
- Changes in requirements for space, equipment, and people.

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Modular Material Handling

- Plan flexible, standardized systems for handling, storing, and controlling material within the facility.
  - Build in flexibility.
  - Standardize methods: unit loads, equipment, etc.
  - Integrate into a system as opposed to separate pieces serving only part of the facility.

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Handling and Storing Work-In-Process

- **Issues**
  - **Centralized versus decentralized storage**
  - **Shop floor control and material tracking**
  - **Reduced WIP inventory levels**
  - **Controlled material movement to production areas**
  - **Reduced damage due to handling and storage**
  - **Automatic encoding of production data**
  - **"Just-in-time" production**
  - **Increasing levels of automation: CAE, CAD, CAM, MRP, RTIC, CAPP**
  - **Rapid tool changing for minimizing setups and reducing lot sizes**

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Handling and Storing WIP

- **In-process *handling* includes movement of material, tooling, and supplies to and from production units, as well as handling at the workstation.**
- **In-process *storage* includes the storage of material, tooling, and supplies needed to support production. Typically, applies to material in a *semifinished* state of production.**

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Handling and Storing WIP

- **Rules of Thumb**
  - **Handling less is best**
  - **Maintain physical control of materials**
  - **Eliminate, combine, and simplify**
  - **Moving and/or storing material incurs costs.**
  - **Pre-position material**
- **Design requirements for WIP handling system**
  - **Establish control requirements**
  - **Determine process flow methods**
  - **Establish inventory points and levels**
  - **Consider workplace layout**
  - **Determine load increment and container design**
  - **Evaluate WIP storage methods**
  - **Determine distribution method**
  - **Design control system**

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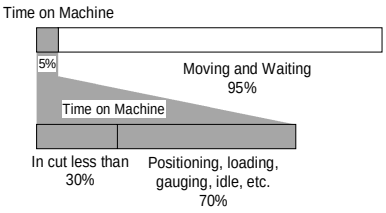
Handling and Storing WIP

- **Processing time versus WIP time**



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Handling and Storing WIP

- **Poor planning of WIP storage and control may result in these problems:**
  - **Materials are frequently lost**
  - **Materials are cannibalized from a different order**
  - **Large inventory discrepancies exist and are only discovered at audits**
  - **High material obsolescence costs**
  - **Crowded, unorganized conditions on manufacturing floor**
  - **Missed production schedules are the rule rather than the exception**

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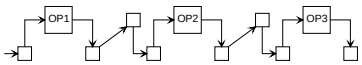
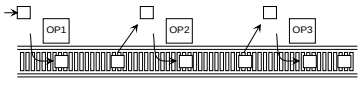
Handling and Storing WIP

- **Modular manufacturing and material handling techniques can aid WIP handling and storage.**

Conventional Approach



Reduced WIP



  - **Neither case is modular -- if processing sequence changes, the facility layout must change**

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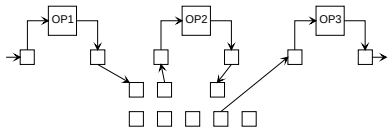
Centralized WIP Storage

- Provides the opportunity to use automated storage and retrieval
- Provides a controlled storage environment
- Can aid in creating modular systems



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Material Control

- Types of control
  - Inventory control
  - Shop floor control
  - Quality control
  - Location control
  - Loss control
  - Position control
  - Fiscal control
- Material Tracking / Data Transmission
  - From the material/equipment interface
  - From the material itself
    - » Bar Code
    - » Optical Character Recognition
    - » Magnetic Stripe
    - » Smart Tag
    - » ROM or PROM

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Conclusion

- Depending on *volume, variety, and value* of products to be processed, different levels of automation, types of layouts, and material handling systems will be appropriate.

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