Garment Production Management

Week 4

Layout planning and analysis

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Recap-previous week

- Concepts of garment manufacturing processes
- Garment manufacturing procedures
- Optimization techniques (Cut order planning and assembly line balancing) in cutting and sewing sections

Lecture Learning Outcomes

1. Understand process selection and capacity planning
2. Analyze different types of layout
3. Identify suitable layouts for different garment manufacturing systems
4. Understand layout efficiency measures

Session outline

- Process selection and capacity planning
- Plant layout and facility design
- Lay out planning concepts
- Types of layouts

Process selection & facility layout

- **Process selection:**
  - Process selection is demand driven (based product type)
  - Decision on how goods are produced (e.g. garments) or services delivered
  - Plan for new products or services
  - Occurs periodically due to technological changes in products, equipment, and competitive pressures

Capacity planning & process selection depend on:

- Forecasts
- Design of products and services
- Technological considerations

Process selection

- It is the way production of goods and services are organized
- Process selection has major implication for:
  - Capacity planning
  - Facility layout
  - Equipment selection
  - Profitability of facilities-effective utilization of facilities
  - Design of work systems

Process selection

- Process selection focus on two key questions:
  - How much variety of products?
  - How much volume of products?
- Volume and variety are inversely related
- Variety of products determine flexibility of personnel and equipment
  - The lower the variety, the less the need for flexibility
  - The higher the variety, the greater the need for flexibility

Process selection

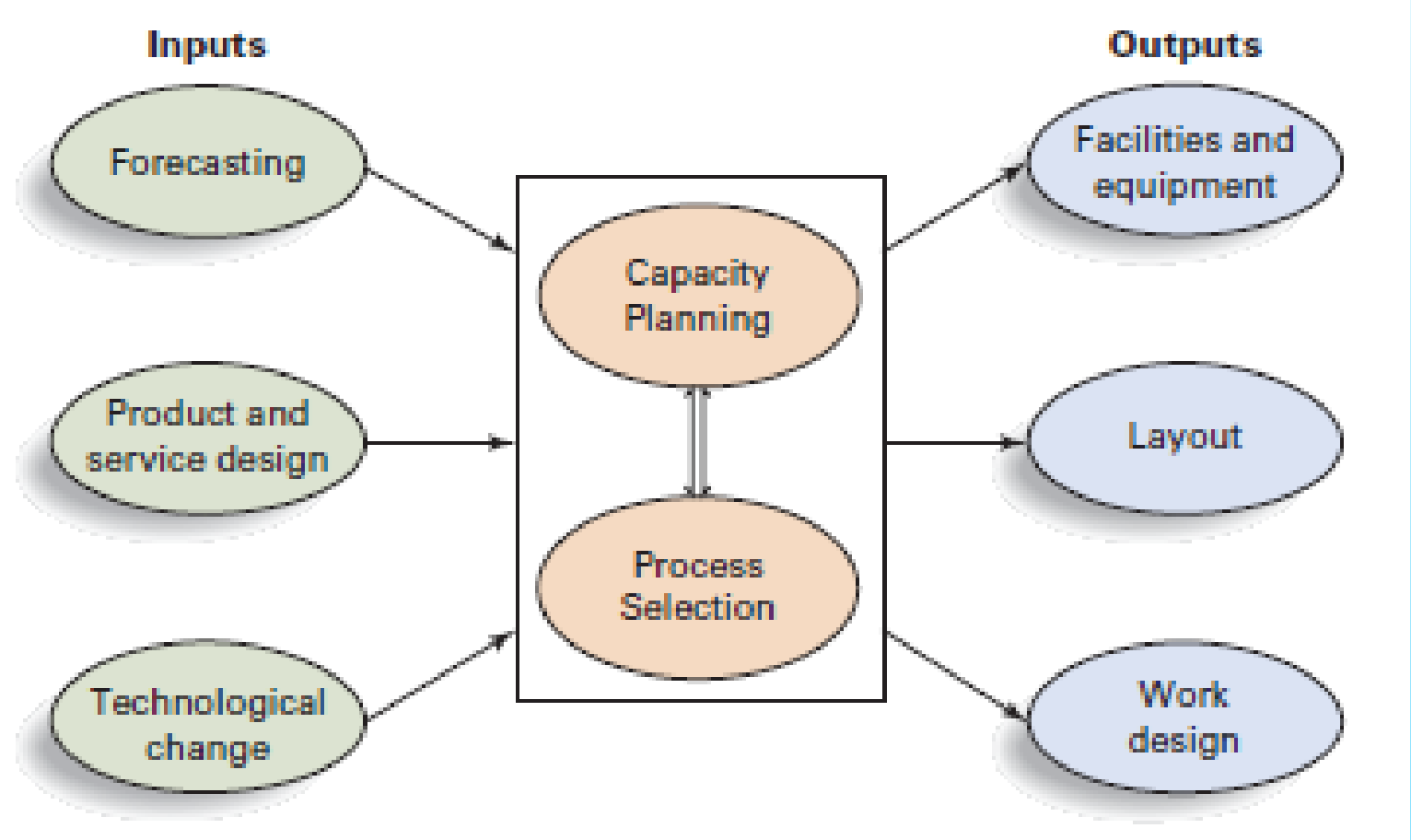
Process selection depends on organization's process strategy:

- Capital intensity: The mix of equipment and labour
- Process flexibility: The degree of adjustment to changes in processing requirements

This can be changes in:

  - Product or service design
  - Volume processed
  - Technology

Process selection and facility layout



- Process selection and capacity planning determines :
  - Facilities & equipment
  - Layout
  - Work design

Figure 1: Process selection and facility layout

Source: Process Selection & Facility Layout. https://www.rblacademy.com/wp-content/uploads/2023/05/Session-8.pdf

Plant layout

What is plant layout or facility layout?

- Physical arrangement of production facilities (factory floor machinery and equipment)
- Logical arrangement of workstations and equipment
- Helps smooth and faster work flow, lower cost and improve efficiency
- Configuration of departments, work centers and equipment
- Floor plan of the physical facilities

Plant layout and facility design

- Facility design is a macro level or strategic level decision about
  - Plant or facility location
  - Building structure
  - Utilities
  - Infrastructure and supporting systems
- Facilities layout decisions are required for:
  - Designing new facilities
  - Re-designing existing facilities

Facility layout planning

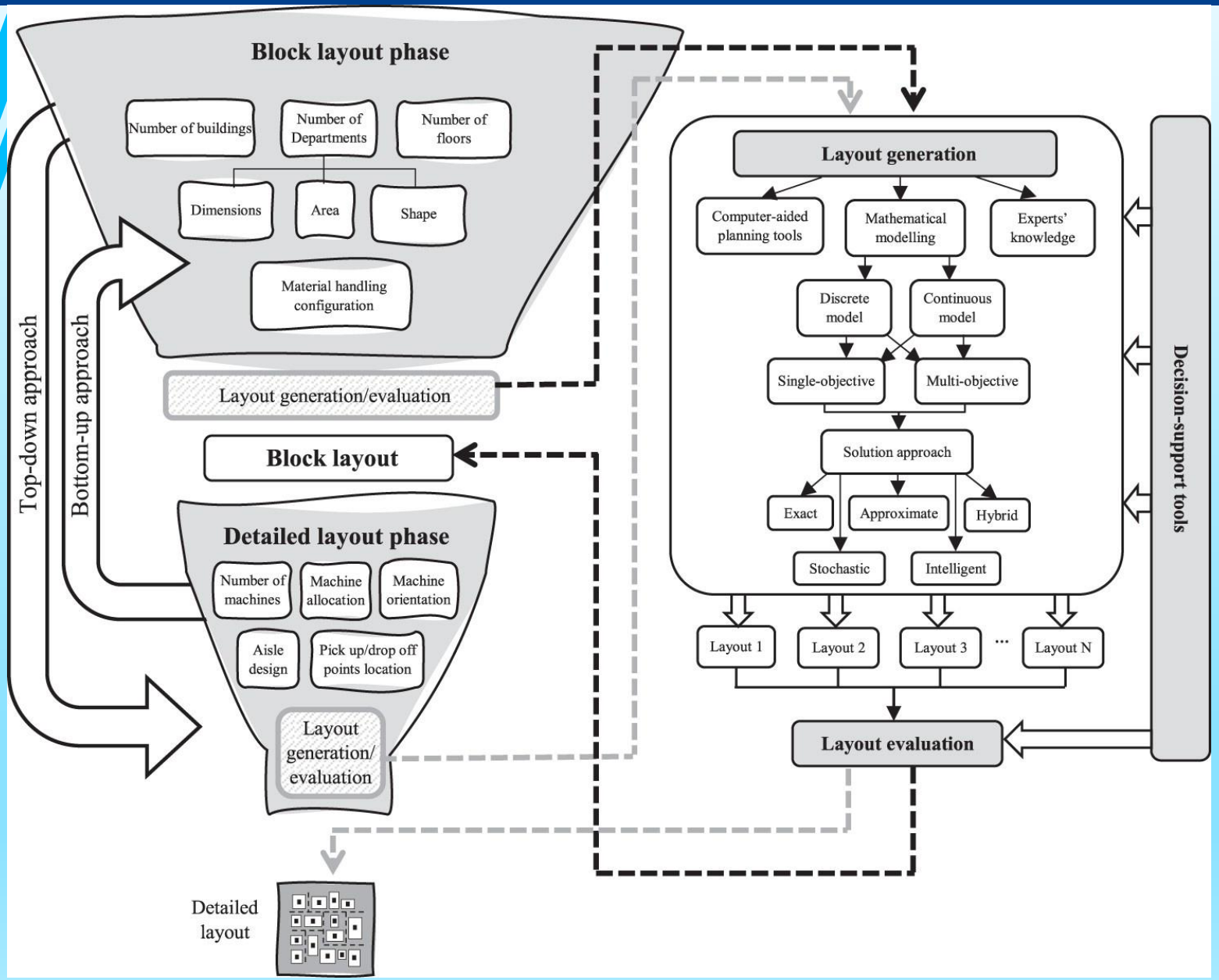


Figure 1: Facility layout planning architecture

Pérez-Gosende, P., Mula, J., & Díaz-Madroñero, M. (2021). Facility layout planning. An extended literature review. *International Journal of Production Research*, *59*(12), 3777–3816. https://www.tandfonline.com/cms/asset/d2678f5e-2062-434b-9c46-1020feece39a/tprs_a_1897176_f0001_oc.jpg

Plant layout and facility design

- Studies show productivity is affected by many factors [1]
  - Poor facility layout
  - Poor material handling system
  - Improper space utilization
- Well-designed layout can be measured by:
  - Number of garments produced (total output)
  - Average processing time
  - Total travel distance of workers from one workstation to another
  - Number of workstations
  - Resource utilization (workstations and labour)

Layout designing methods

- Systematic Layout Planning (SLP) method is a layout planning procedure [2].
- This method helps to identify, visualize, and assess:
  - Various activities
  - Relationships
  - Alternatives involved in facility layout

Plant layout in garment industry

The main principles are:

- **Minimum travel:** Workers and materials must pass through the shortest distance
- **Sequence:** Machineries and processes arranged in a sequential order
- **Effective utilization of space:** Every foot of existing space should be effectively utilized
- **Compactness:** due to harmonious fusion of all the related factors layout should look well integrated and compact
- **Safety and Satisfaction:** Comfort and convenience of the worker
- **Flexibility:** allow modifications with minimum complications and at minimum cost

Layout designing methods

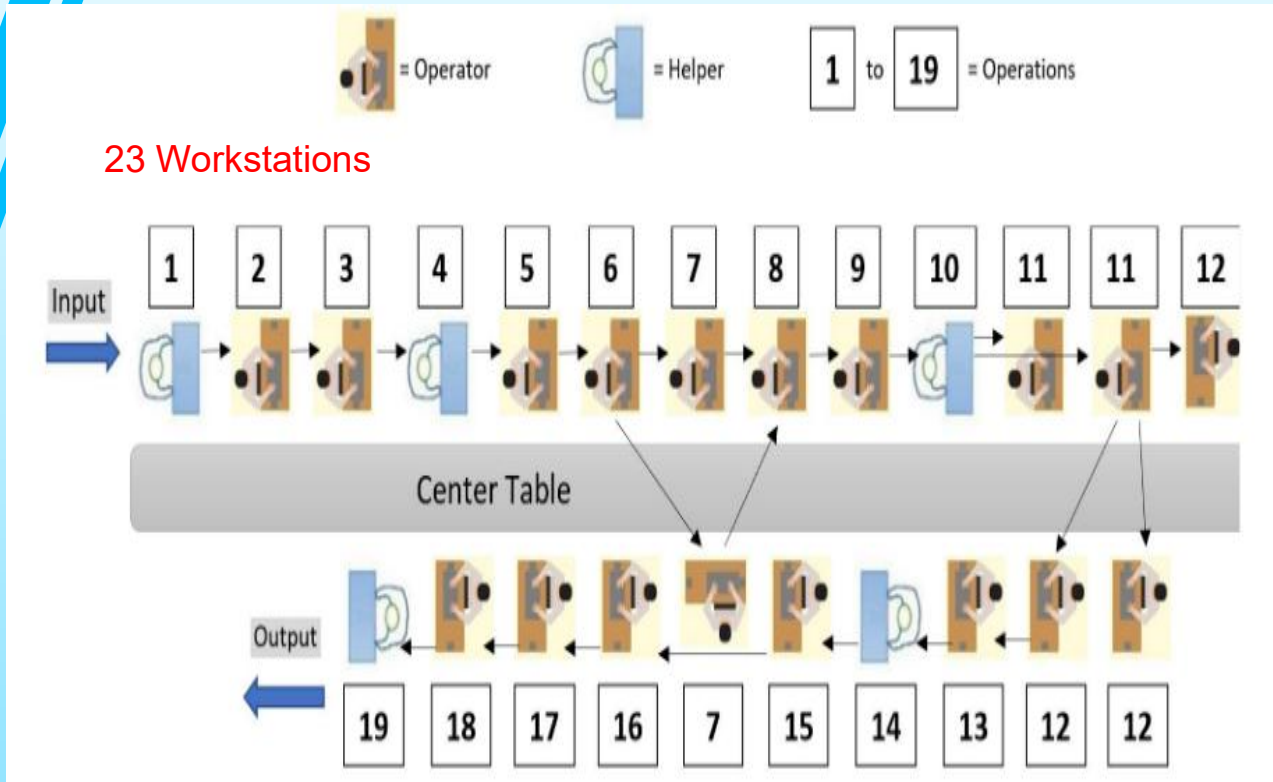


Figure 1: Existing layout

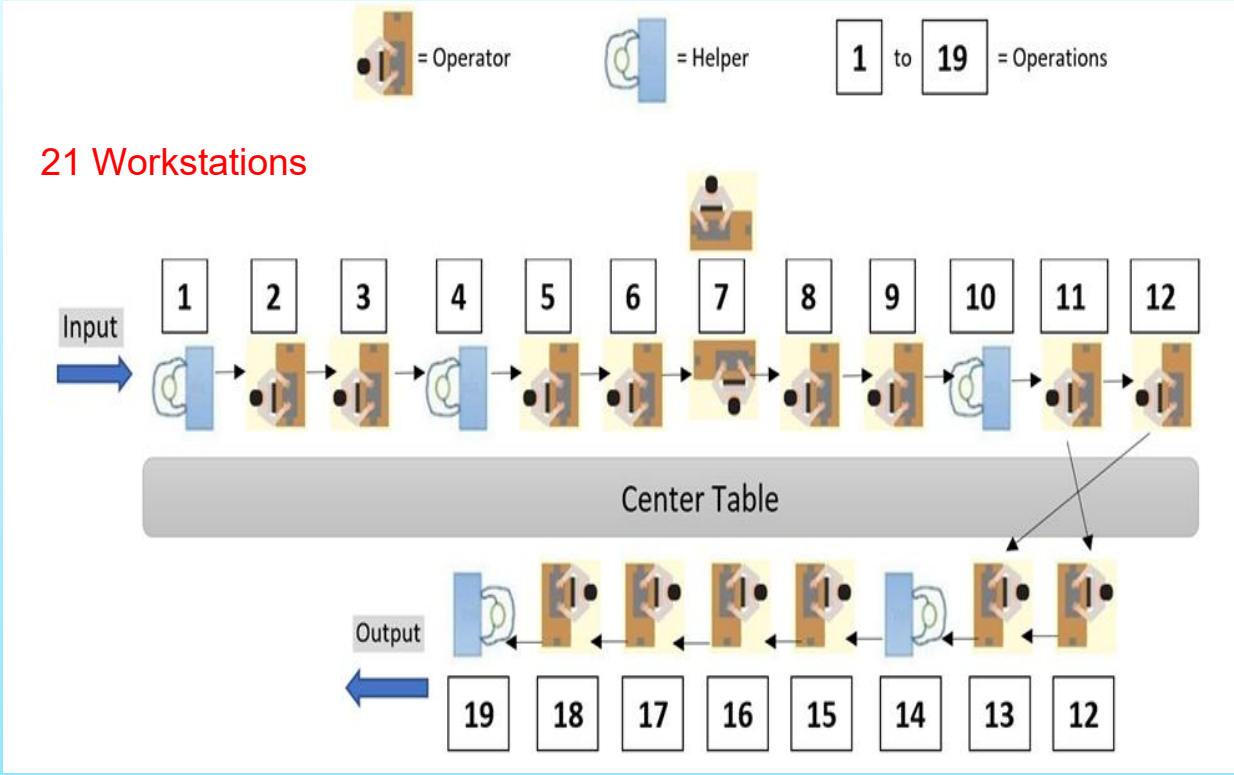


Figure 2: Proposed layout

Rahman, S.S. (2023) “IMPACT OF LEAN MANUFACTURING ON PRODUCTIVITY AND LAYOUT DESIGN IN SEWING SECTION OF A GARMENT INDUSTRY”, International Journal of Industrial Management, 17(3), pp. 152–161. doi:10.15282/ijim.17.3.2023.8955.

Features of a good layout

- Aisles, entry, and exit points are planned
- Efficient utilization of three-dimensional workspace
- Conducive workspace to human comfort and safety
- Flexibility for changes in products or styles
- Simple & easy to monitor layout
- Minimize material transfers and
- Use the shortest routes in sewing lines
- Effective communication and information flow system within the line layout

Software used in layout planning

Common layout planning approaches or algorithms

- Automated layout design program (ALDEP)
- Computerized relationship layout planning (CORELAP)
- Computerized related allocation of facilities technique (CRAFT)
- Computer Aided layout planning (CALP):

Objectives of layout design

- Facilitate a smooth flow of work, material, and information
- Use workers and space efficiently
- Avoid bottlenecks
- Minimize material handling costs
- Eliminate unnecessary movement of workers or material
- Minimize production time

Benefits of plant layout

Why we develop a good plant layout?

- Efficient labour utilization
- Easy manufacturing and maintenance
- Enhanced productivity
- Manufacturing flexibility
- Effective utilization of staff, machines, materials, and equipment
- Reduction of accidents, hazards, and inventory handling cost

Types of layout

- Product layout: Flow shop (linear sequential movement)
- Process layout: Functional layout
- Combination layout: Hybrid layout (combines two or more layouts)
- Cellular layout: Group technology
- Fixed position layout: projects;workstations or machineries go to jobs/tasks

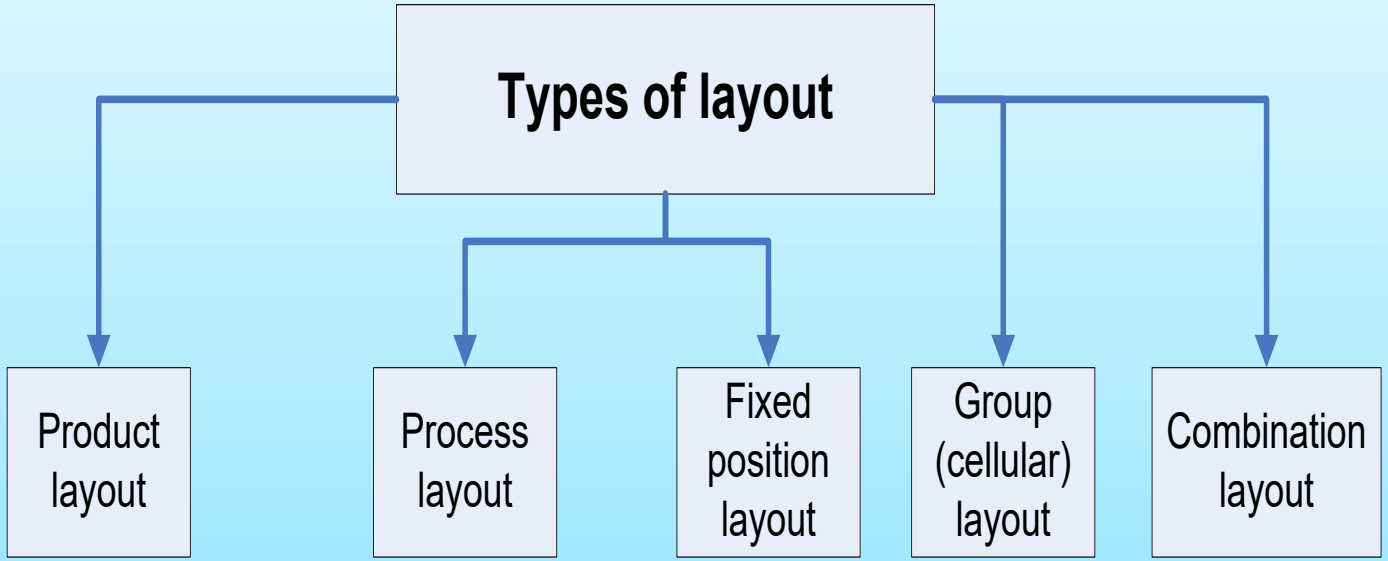


Figure 2: Types of layout

Source: Author's creation

Types of layout

Product layouts

- Facilities organized to match with the sequence of manufacturing operations
- E.g. Repetitive processing

Process layouts

- Facilities with similar functions are grouped together for wide variety of products
- E.g. intermittent process (products that require variety of processing requirements)

Group/cellular layout

- Heterogeneous machines are grouped into cells
- Each cell is in charge of manufacturing the complete product
- E.g. a lean methodology (SMEDs)

Types of layout

Hybrid/combination layout

- Combinations of pure types of process + product layouts.
- e.g. cellular layouts and flexible manufacturing systems

Fixed product layouts

- Product do not move rather the facilities circulate around
- Projects require layouts (tools, machinery, men and other materials) are brought to this location

Product layout

- Smooth and rapid flow large production volume to improve utilization of equipment
- Highly standardized goods or services (repetitive processing)
- Specialization of equipment and labour for standardized tasks
- High degree of labour and equipment utilization
- Processing sequence determines machines and auxiliary services
- Machines are not shared by different products (for a strict product layout)
- Special purpose machines are used to perform required function quickly and reliably

Product layout

Advantages

- A high rate of output (productivity)
- Low unit cost due to high volume less in-process inventory(WIP)
- Less throughput time
- Perfect line balancing
- Reduced material handling cost
- Manufacturing cycle is short
- Unskilled workers can learn and manage the production

Disadvantages

- Machine breakdown cause stoppages of machines in the next activities
- A change in product may require the facility modification (Lack of flexibility)
- The line output is decided by the bottleneck machine
- Comparatively high investment in equipment is required

Process layout

- Departments or other *functional* groupings for similar kinds of activities
- Example:Intermittent processing *machine shop*
- Suitable to produce wider range of products
- Less efficient and have higher unit production costs
- Some manufacturers are moving away from process layouts to capture some of the benefits of product Layouts (flexible and yet efficient; low unit production costs)
- Cellular manufacturing, group technology, and flexible manufacturing systems represent efforts to move towards this ideal

Process layout

Advantages

- Better machine utilization, and fewer machines
- Flexibility of equipment and personnel
- Fewer machines & lower cost of general-purpose machines
- Higher utilization of production facilities
- High flexibility on work distribution between machinery & workers

Disadvantages

- Backtracking and long movements may occur in the handling of materials
- Reduce material handling efficiency
- Material handling cannot be mechanized which adds to cost

Cellular layout

- Workstations are grouped into cells
- Enables companies to produce a variety of products
- Groupings are determined by operations for similar items, or part families
- Parts follow the same route, although minor variations (e.g., skipping an operation) are possible
- Cells become miniature versions of product layouts

Cellular layout

- A smooth flow of work with minimal transport or delay
- Easier for managers and supervisors to:
  - Control each cell
  - Monitor production processes
  - Identify bottlenecks
  - Implement improvements
- Cross-training becomes more manageable
- Employees in a cell work closely together that promote communication and collaboration

Group (cellular) layout

Advantages

- Smooth work flow
- Better utilization of workstations
- Short travel distance
- Better productivity and quality of work
- Faster throughput time or shorter Leadtime
- Higher workers moral and flexibility
- Minimal work in process inventory
- Increased flexibility

Disadvantages

- Require high manpower skill
- Needs production planning and control
- Complexity of balancing material flow
- Lower utilization of workstations compared to functional layout
- Applied for low
- Increased setup cost

Classification based on material flow path

- **Linear or straight line**
  - Smooth product flow without any unnecessary turns or hurdles
  - Each worker performs a specific task
  - Minimize material handling
  - Reduce waiting times
- **S-shaped layout**
  - Facilitates a continuous flow of materials and products
  - Reduces bottlenecks and interruptions in production
  - Cut components enter at one end and finished good leaves at the other end

Classification based on material flow path

- **L-Shaped layout**
  - Optimizes floor space utilization
  - Maintains good communication flow between work stations
  - Minimizes unnecessary movement of materials and products
  - Reduces production time and labor costs
- **U-shaped layout**
  - Facilitates effective communication between workstations
  - Enhances coordination and collaboration among workers
  - Reduces unnecessary movement
  - Workstations are arranged within easy reach

Classification based on material flow path

Performance metrics	Product (Line) layout	Process (functional) layout	Cellular(group) layout	Combination (hybrid) layout
Material travel distance	Short	Long	Short(U-Shaped)	Moderate
WIP/inventory	Low	High	Low (single piece flow	Moderate
Workstation utilization	High(dedicated)	High (centralized)	Moderate	Good
Flexibility	Low	Very high	Moderate/high	Very high
Throughput time	Short/ Fast	Long/Slow	Short/Fast	Medium
Space utilization	Very good	low	Average	Average

Table 1: Comparison of layouts based on performance metrics

Summary

- Process selection and capacity planning are strategic decisions in garment manufacturing process
- Process selection and capacity plan affects decision on:
  - Layout design
  - Design of world systems and equipment selection
- Based on the nature of products (volume or variety), various types of layouts can be efficient
- Classification of layouts is based on material flow path or types of products
- Layout performance can be measured by material travel distance, inventory level, utilization of space and machine, flexibility and throughput time
- Computer software or algorithms are used in layout planning

References

[1] Anucha, Watanapa., et al., (2011), “Analysis Plant Layout Design for Effective Production”, retrieved from www.iaeng.org/publication/IMECS2011.

[2] Jain, Swati, and Tarun Kumar Yadav. "Systematic layout planning: A review of improvement in approach to pulse processing mills." *International Research Journal of Engineering and Technology (IRJET)* 4, no. 5 (2017): 503-7.

[3] Rahman, S.S. (2023) “IMPACT OF LEAN MANUFACTURING ON PRODUCTIVITY AND LAYOUT DESIGN IN SEWING SECTION OF A GARMENT INDUSTRY”, International Journal of Industrial Management, 17(3), pp. 152–161. doi:10.15282/ijim.17.3.2023.8955.

[4] Pérez-Gosende, P., Mula, J., & Díaz-Madroñero, M. (2021). Facility layout planning. An extended literature review. International Journal of Production Research, 59(12), 3777–3816. https://doi.org/10.1080/00207543.2021.1897176

Thank You !

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