13 | Layout Strategies

OM 201
Principles of Operations Management

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Lecture Outline

Topics
- Basic layout types
- Improve efficiency through layout setting

Learning objectives
- To be able to apply layout efficiency in practical situation

Reference
- Roberta Russell & Bernard W. Taylor, (2009), *Operations Management along the supply chain* (Chapter 7) Ed 6, John Wiley &Son

Facility Layout
Definition & Objectives

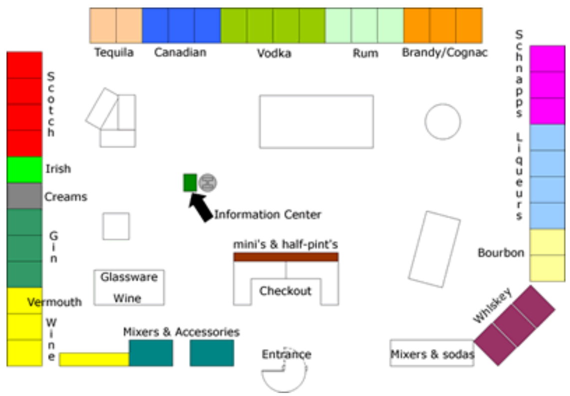
Facility layout is defined as…
The process that determine the placement of *departments*, *workgroups within departments*, *workstations*, *machines*, and *stock-holding points* within a facility

Objectives:
- Utilize space efficiently
- Utilize labor efficiently
- Eliminate bottlenecks
- Reduce manufacturing cycle time or customer service time
- Eliminate waste or redundant movement
- Improve safety measure

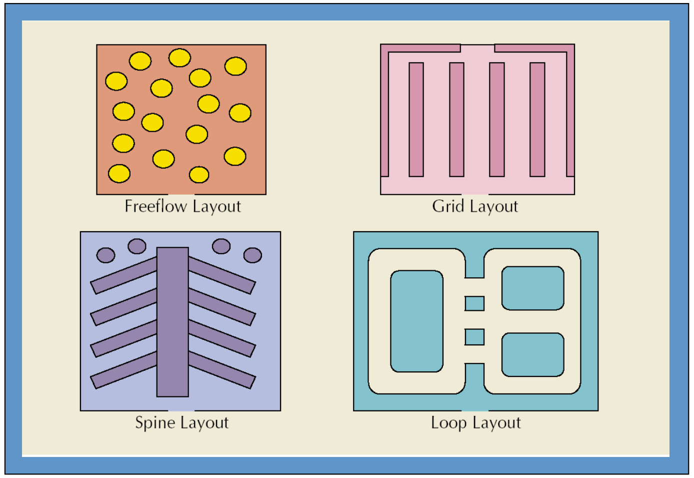
Facility Layout
Input Requirement

This process requires the following inputs:

- Specification of objectives of the system in terms of output and flexibility
- Estimation of product or service demand on the system
- Processing requirements in terms of number of operations and amount of flow between departments and work centers
- Space requirements for the elements in the layout
- Space availability within the facility itself



Types of Store Layout



Basic Production Layout Formats

1. **Process Layout (also called *job-shop* or *functional layout*)**
2. **Product Layout (also called *flow-shop layout*)**
3. **Group Technology (*Cellular*) Layout – *Hybrid Layout***
4. **Fixed-Position Layout**

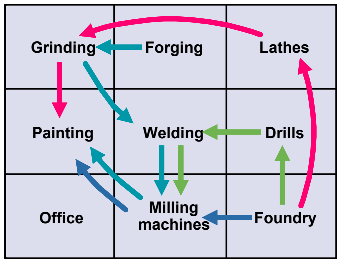
Process Layout – Interdepartmental Flow

- Definition
  - Similar equipment or functions are grouped together
  - Parts / system entities move through system in required sequence
- Given
  - The flow (number of moves) to and from all departments
  - The cost of moving from one department to another
  - The existing or planned physical layout of the plant
- Determine
  - The "best" locations for each department, where best means maximizing flow, which minimizing costs

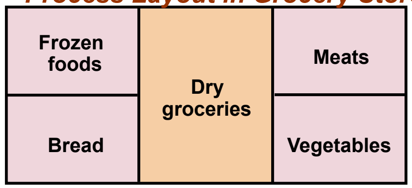
Process Layout

Examples

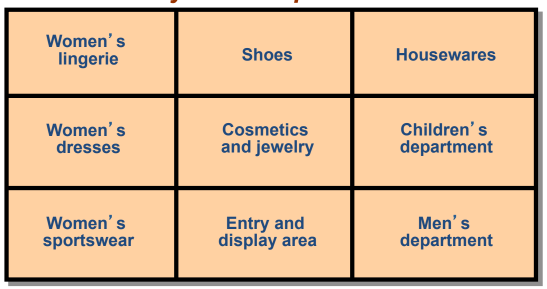
Process Layout in Manufacturing System



Process Layout in Grocery Store



Process Layout in Department Store



Other examples include
- Hospital
- University
- Governmental sectors
- Etc.

Process Layout

Systematic Layout Planning (SLP)

- ***Systematic Layout Planning***
  - Accounts for the importance of having each department located next to every other department
  - Using both *numerical flow* and *qualitative issue*
  - Is also guided by *trial and error*
    - Switching departments then checking the results of the "***closeness***" score
- Numerical flow of items between departments
  - Can be impractical to obtain
  - Does not account for the qualitative factors that may be crucial to the placement decision

Example of Systematic Layout Planning: Reasons for Closeness – Department Store

Code	Reason
1	Type of customer
2	Ease of supervision
3	Common personnel
4	Contact necessary
5	Share same price
6	Psychology

Example of Systematic Layout Planning:

Importance of Closeness

Value	Closeness	Line code
A	Absolutely necessary	
E	Especially important	
I	Important	
O	Ordinary closeness OK	
U	Unimportant	
X	Undesirable	

Example of Systematic Layout Planning:

Relating Reasons and Closeness

From	To 2	To 3	To 4	To 5	Area (sq. ft.)
1. Credit department	I / 6	U / --	A / 4	U / --	100
2. Toy department		U / --	I / 1	A / 1,6	400
3. Wine department			U / --	X / 1	300
4. Camera department				X / 1	100
5. Candy department					100

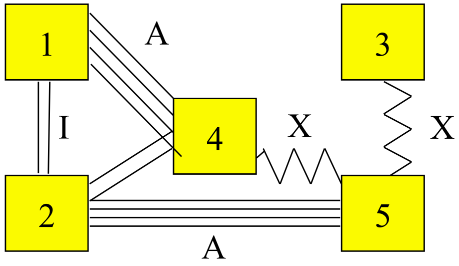
Closeness rating: Letter

Reason for rating: Number

(1) Credit Dept. and (2) Toy Dept. are given a high rating of 6.

(2) Toy Dept. and the (5) Candy Dept. are given a high rating of 6.

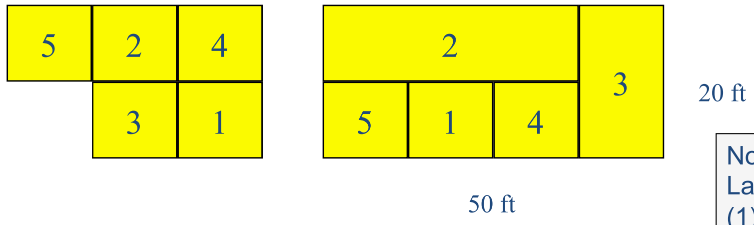
Example of Systematic Layout Planning:
Initial Relationship Diagram



Note here again, Depts. (1) and (2) are linked together, and Depts. (2) and (5) are linked together by multiple lines or required transactions.

The number of lines here represent paths required to be taken in transactions between the departments. The more lines, the more the interaction between departments.

Example of Systematic Layout Planning:
Initial & Final Layout



Initial Layout

Ignoring space and building constraints

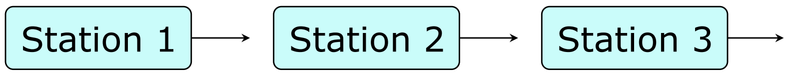
Final Layout

Adjusted by square footage and building size

Note in the Final Layout that Depts. (1) and (5) are not both placed directly next to Dept. (2).

Product Layout
Assembly Line Balancing Concept

Question: Suppose you load work into the three work stations below such that each will take the corresponding number of minutes as shown. What is the cycle time of this line?



Minutes per Unit	6	7	3

Answer: The cycle time of the line is always determined by the work station *taking the longest time.*

In this problem, the cycle time of the line is 7 minutes. There is also going to be idle time at the other two work stations.

Flow Shop – Line Balancing Process

1. Draw and label a precedence diagram.
2. Calculate the desired cycle time required for the line.
3. Calculate the theoretical minimum number of workstations.
4. Group elements into workstations, recognizing cycle time and precedence constraints.
5. Calculate the efficiency of the line.
6. Stop if theoretical minimum number of workstations on an acceptable efficiency level reached. If not, go back to step 4.

Line Balancing

$$\text{Cycle time} = \frac{\text{available work time}}{\text{demand}}$$

$$\text{number of theoretical workstations, } N_T = \sum \text{task times / cycle time}$$

$$\text{efficiency} = \frac{\text{output}}{\text{input}} = \frac{\text{total task time}}{(N_A \text{ stations}) \times \text{cycle time}}$$

Line Balancing Example

A company must produce 600 unit output in a 40-hour week. Given the following conditions, balance the assembly line

Work Element	Precedence	Performance Time (min)
A	-	1
B	A	2
C	B	2
D	A, E	4
E	-	3
F	C, D	4

Line Balancing Example

Assume that the line operates 8 hours per day.

Requirements

- Find the maximum production of this process

$$\text{Max Production} = \frac{\text{Production time per day}}{\text{Bottleneck time}}$$

- Balance this line in order to reach maximum production

Work Element	Precedence	Performance Time (min)
A	-	1
B	A	2
C	B	2
D	A, E	4
E	-	3
F	C, D	4

Case:

Layout Analysis of Pizza Place

See additional handout for details