Week - 2

L1 Facility Layout - Intro. & Types

- Facility layout refers to the specific arrangement of physical facilities. It is impt. when new facility is created, significant Δ in vol., new service is introduced, diff. process is introduced.
- purpose - minimize delays, maintain flexibility use labor & space efficiently, promote satisfac^{n}, provide maintenance, enhance facilities.
- Product layout - Arrangement based on seq. of opera^{ns} that are performed during the manufacturing of good. Conti. flow, mass produc^{n}, & flow shop processes. Eg. Credict card process, automobile assembly line

Store → Saw → Mill → Drill → Assemble →
Store → Grind → " → " → Assemble →
Store → Lathe → Grind → Mill → Assemble →

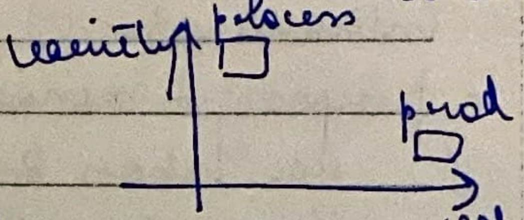
- Adv. →

1. smooth & logical flow lines
2. small in-process inventory
3. short produc^{n} time / unit
4. reduced material handling
5. little skills, training - short, simple
6. temp. storage
7. simple produc^{n} planning & control sys.

HQ.

M T W T F S S

- Disadv.
1. breakdown of 1 → leads to X assemblyline
2. Δ in design → major layout alteraᵗⁿˢ.
3. pace of producⁿ is by slowest machine
4. general supervision
5. high invest, duplicate machines for same work.



L3 * Process & Group Layout
- Process - Consists of collecⁿ of processing cells.
∴ All machines are involved in performing a particular process are grouped together. It is used for low-vol., dissimilar prod. Or when rapid Δs occur or other layouts are infeasible. Eg. Job shops
- Adv. -
1. better utilizaⁿ of machines
2. high degree of flexibility
3. low investment in machines
4. diversity of tasks, specialized supervision
- Disadv -
1. material handling is expensive
2. more producⁿ plans & control systems
3. long total producⁿ time.
4. large in-process inventory
5. tied up space & capital
6. higher grade of skills are req.

- Group – When productⁿ vol. for indi. prod. are not sufficient to justify product layout. By grouping prod. into logical prod. families, a product layout can be justified. Also c/d cellular layout. High degree of intradepartment flow. The families of products are formed dep. on the seq. of operaⁿˢ.
- Adv. –
1. increased machine utilizaⁿ
2. team attitude & job enlargement
3. supports use of gen. purpose equipment.
4. shorter travel distances & smoother flow lines than process layout.
- Disadv →.
1. general supervision req.
2. higher skill lvls. req.
3. balancing, or buffers & work-in-process storage are req.
4. lower machine utilizaⁿ

L3 Fixed Product Layout
- When prod. is too larger to move, Process is brought to product. Eg. Ship-build, aircraft, Developed by locating workstaⁿˢ around prod., work-piece remains stationary, equipmt & personnel movements are quite higher.

P.T.O.

- Adv. -

1. reduced material movement
2. promotes job enlargement
3. continuity of operaⁿ comes from team.
4. highly flexible
5. independence allows you to achieve min. total productⁿ time.

- Disadv. -

1. increased movement of labour & equipment
2. equipment duplicaⁿ may occur
3. higher skill req.
4. gen. supervision req.
5. costly positioning of material & machinery
6. low equipment utilizaⁿ

L4 Optimizing a product layout

- product layout is a high vol. sys. High vol. sys. are charac. by std. equipment to provide identical or similar opⁿˢ. The challenge is to obtain a smooth rate of flow of goods → line balancing problem.
- Cycle Time - Max. time allowed at each work staⁿ to comp. its set of activities on a unit

Min. → $\max(t_1, t_2, t_3 \ldots)$

Max. → $\text{sum}(t_1, t_2, t_3 \ldots)$

- The min. & max. cycle time determines the potential output rate of line.

$$\text{Output rate} = \frac{\text{operating time per day}}{\text{cycle time}}$$

- When there are no || activities the output must be in btw. min. & max. output rates
- $\text{Cycle time} = \frac{\text{total time}}{\text{desired output rate}}$
- $\text{Theo. min. no. of workstations} = \frac{\text{Total Activity time}}{\text{Cycle time}}$
- $\text{\% of ideal time / balance delay} = \frac{\text{idle time per cycle}}{\text{no. of ws.} \times \text{cycle time}} \times 100$
- Efficiency of line = 100 − % of ideal time
- ALB (Assembly Line Balancing) Model
  - A → set of activities to be assigned {1, 2 .. n}
  - W → set of WS available {1, 2 ... , m}
  - T_a → time req. to comp. activity a, $a \in A$
  - P_a → predecessors of activity a, $a \in A$
  - C → cycle-time

decision var —

$$X_{aw} = \begin{cases} 1 & \text{if act. a is assigned to WS w} \\ 0 & \text{otherwise} \end{cases}$$

$$Y_w = \begin{cases} 1 & \text{if ws. w is used} \\ 0 & \text{otherwise} \end{cases}$$

Obj. → $\min \sum_{w=1}^{m} Y_w$

the no. of ws that is used to assign activities. - HQ

Constraints

1. Cycle time - total activity time in any WS can't exceed cycle time

$$\sum_{a=1}^{n} T_a \times X_{aw} \leq C \times Y_w \quad \forall w \in W$$

2. assignment - each act. must be assigned to 1 WS.

$$\sum_{w=1}^{m} X_{aw} = 1 \quad \forall a \in A$$

3. precedence of activities must be followed.

$$X_{aw} \leq \sum_{a=1}^{w} X_{pu} \quad \forall a \in A, p \in P, w \in W$$

4. all decision var. must be binary in nature.

$$X_{aw} \in \{0,1\}, \; Y_w \in \{0,1\}$$