Ch 2

Wednesday, October 23, 2024 4:02 PM

In order to make a Facilities plan:

1. Product Design

- Product Determination
- Detailed Design
  - Product must meet needs of customer
    - QFD quality function deployment
    - Benchmarking
  - Documents
    - Exploded assembly drawing
    - Exploded parts photograph.
    - Component part drawing

2. Process Design

- Process identification
  - Make or Buy decision.
  - BOM (bill of materials)
- Process Selection
  - CAPP
    - variant
    - generative
    - route sheet (for in-house parts)
- Process sequencing
  - Assembly chart
  - operations process chart
  - Precedence diagram.

3. Schedule Design

- production quantity (lot size)
- production scheduling
- marketing
- Process Requirements
  - Scrap estimate + num. of machines
  - Rejection Allowances.

$F = \frac{SI \text{ (scrap estimate)}}{HER}$

not necessary unit like I

H in minutes

there could be maintenance so:

H = availability - maintenance

$\frac{I_k}{\text{every \#}} \times \text{time}$

or = WL / AT

Like time

$I_k = O_k + d_k I_k$ for a ~~single~~ operation.

but we use:

for all ← $I_n = \frac{O_n}{(1-d_1)(1-d_2)\ldots}$ or $I_k = \frac{O_k}{1-d_k}$

→ * if there is rework then:

$I_{\text{after rework}} = O_{\text{rework}} + O_{\text{operation before.}}$

$O_{\text{rework}} = I_{\text{before it}}\, d_{\text{before it}}\, (1 - d_{\text{rework}})$

$I_{\text{rework}} = I_{\text{before it}}\, d_{\text{before it.}}$

---

scrap = $I_k - O_k$.

cost = scrap × its cost.

① $R = \begin{cases} 0 & x < \\ \text{price} \times x & < x < \end{cases}$

$C = \text{cost} \times Q$

$P = \begin{cases} -CQ & x < Q \\ R - CQ & < x < Q \end{cases}$

②

	Q
x	probabilities using: $p(x) = \binom{Q}{x} p^x (1-p)^{Q-x}$

③

	Q
x	P(Q, x) at their Q

④

	Q
x	P(Q,x) × p(x) at their places

⑤ بجمع اللي نفس ال Q وبشوف مين اعلى ربح.

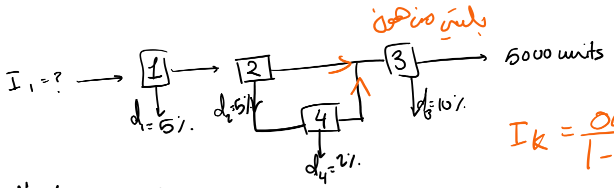
Management tools:

- Affinity Diagram
- Interrelationship Diagraph

- Affinity Diagram
- Interrelationship Diagraph
- Tree Diagram
- Matrix Diagram
- Contingency Diagram
- Activity Network Diagram
- Prioratization Matrix

Scrap estimate problem.

Sunday, October 27, 2024 8:40 PM



What is I_1?

$$I_k = \frac{O_k}{1-d_k}$$

$$I_1 = \frac{O_1}{1-d_1} ✓ \; ? \longrightarrow O_1 = I_2$$

$$\frac{O_2}{1-d_2} ✓ \longrightarrow I_3 = O_2 + O_4$$

$$= I_2(1-d_2) + \underline{I_4}(1-d_4)$$

$$I_4 = I_2 \cdot d_2 \text{ (rework)}$$

$$\text{so } O_4 = I_2 d_2 (1-d_4)$$

$$I_3 = I_2(1-d_2) + I_2 d_2 (1-d_4)$$

$$I_3 = \frac{O_3}{1-d_3} = \frac{5000}{1-0.10} = 5555.555$$

$\underline{\underline{I_2}}$ بصير عندي مجهول واحد وهو

$$5555.555 = I_2(1-0.05) + I_2 \times 0.05 (1-0.02)$$

$$I_2 = 5561.56 \simeq 5562$$

round up.

$$\text{so } O_1 = I_2 = 5562$$

$$\boxed{I_1 = \frac{5562}{1-0.05} = 5855}$$

$$I_k = \frac{O_k}{1-d_k}$$

$$I_3 = \frac{5000}{1-0.10} = 5555.55 \simeq 5556 \text{ units.}$$

$$I_3 = \underline{O_2} + O_4 \longrightarrow \quad I_2 = \frac{O_2}{1-d_2} \quad \text{so } O_2 = I_2(1-d_2)$$

$$I_4 = I_2 \cdot d_2$$

$$5556 = I_2(1-0.05) + I_2 \times 0.05 (1-0.02)$$

$$5556 = I_2 0.95 + 0.049 I_2$$

$$5556 = 0.999 I_2$$

$$\boxed{I_2 = 5562 \text{ units}}$$

$$I_1 = \frac{O_1}{1-d_1}$$

$$\frac{5562}{1-0.05} = 5854.74 \text{ units}$$

$$\simeq 5855 \text{ units}$$

Ch3

Saturday, November 23, 2024 4:36 PM

three charactsistics of process flow
- item or subject
- resources
- communication/procedures.

Flow types

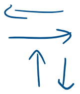
- Flow into facility (Material management system)
- Flow within facility (Material flow system)
  - Flow within workstations
  - Flow within departments
    - Product department
      - end to end
      - back to back
      - front to front
      - circular
    - Process department
      - parallel
      - perpindicular
      - diagonal
  - Flow between departments
    - flow
      - straight line
      - S-shaped
      - u-shaped
      - w-shaped.
    - entrance - exit placements
      - same location
      - adjacent sides
      - same side opposite ends.
      - opposite ends.
- Flow out of facility (Physical distribution system)

Flow pattern or structure:

1. line flow
   - straight line, S-shape, W-shape, u-shape
2. spine flow
3. tree flow
4. loop
   - inner loop
   - outer loop

Facilities layout

- Production line
- Fixed
- Family/Group technology
  - manufacturing cells
    - decoupled cells
    - integrated cells
      - POK Production cards
      - WLK withdrawal cards
    - clustering techniques
      - direct clustering algorithm
      - clustering identification algorithm.
      - rank order clustering
- Process
- Hybrid



2^{m-j}

2^{p-i}

5 types of Activity Relationships

- organizational (ODC)
- Flow (Facilities)
  - measured by
    - Quantitative
      - mileage chart (distance)
      - from-to chart (flow)
    - Qualitative
      - relationship c
        (A E I
- control (control+Automation)
- Environmen (human)

from-to chart → frequency → relationship tal other process.

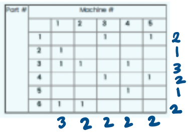
hart
ou x)

chart

Problems

Saturday, November 30, 2024 10:01 PM

Question 1: Create manufacturing cells based on the machine-part matrix below. If conflicts or exceptional parts exist, propose alternative approaches. Use Direct order clustering algorithm.



Part #	Machine #					
	1	2	3	4	5	
1			1		1	2
2	1					1
3	1	1		1		3
4			1		1	2
5				1		1
6	1	1				2
	3	2	2	2	2	

	2	3	4	5	1
3	1		1		1
6	1				1
4		1		1	
1		1		1	
5		1		1	
2					1

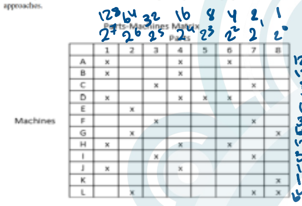
	2	4	1	3	5
3	1	1	1		
6	1		1		
4				1	1
1				1	1
5				1	1
2			1		

	2	4	1	3	5
3	1	1	1		
6	1		1		
2			1		
4				1	1
1				1	1
5				1	1

machine 2,4,1 produce 3,6,2

machine 3,5 produce 4,1,5

Question 2: Use the Rank Order Clustering algorithm to create manufacturing cells based on the machine-part matrix below. If conflicts or exceptional parts exist, propose alternative approaches.



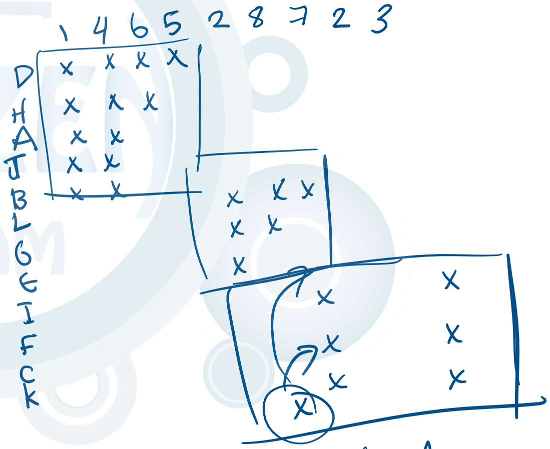
Parts-Machines Matrix

Parts

Machines

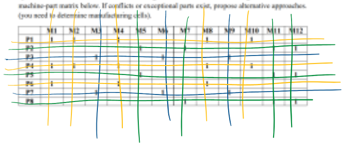
	128	64	32	16	8	4	2	1	
	2^7	2^6	2^5	2^4	2^3	2^2	2	2^0	
	1	2	3	4	5	6	7	8	
A	x			x		x			128 + 16 + 4 = 148 ✓
B	x			x					128 + 16 = 144 ✓
C			x				x		32 + 2 = 34 ✓
D	x			x	x	x			128 + 16 + 8 + 4 = 156 ✓
E		x							64 ✓
F			x				x		32 + 2 = 34 ✓
G		x						x	64 + 1 = 65 ✓
H	x			x		x			128 + 16 + 4 = 148 ✓
I			x				x		32 + 2 = 34 ✓
J	x			x					128 + 16 = 144 ✓
K								x	1
L		x					x	x	64 + 2 + 1 = 67 ✓

		3968	112	14	3968	2048	3072	78	97	
		1	2	3	4	5	6	7	8	
1	D	x			x	x	x			2048
2	H	x			x		x			1024
3	A	x			x					512
4	J	x			x					256
5	B	x			x					128
6	L		x					x	x	64
7	G		x						x	32
8	E		x							16
9	I			x				x		8
10	F			x				x		4
11	C			x				x		2
12	K								x	1



duplicate or at boundary
or outsource

Question 3: Use the cluster identification algorithm to create manufacturing cells based on the machine-part matrix below. If conflicts or exceptional parts exist, propose alternative approaches. (you need to determine manufacturing cells).



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
P1	1	1		1				1		1		
P2					1		1				1	1
P3			1			1			1			
P4	1	1		1				1		1		
P5					1						1	1
P6	1			1				1				
P7			1			1			1			
P8							1				1	1

$M_1, M_2, M_4, M_8, M_{10}$
make: P_1, P_4, P_6

M_5, M_7, M_{11}, M_{12}
make: P_2, P_5, P_8

M_3, M_6, M_9
make: P_3, P_7

Ch4 parking

Monday, December 23, 2024 4:40 PM

Steps for solving parking spaces:

① Employees to spaces ratio, if given do ضرب تبادلي

if not given make 1.25 employees → 1 parking (no transportation)
3 employees → 1 parking (with transportation)

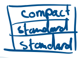
② Is it pepindicular or angular?
what kinds of cars will be parking?
what SW will I use (should be given or choose first option)
what is W? (W_1, W_2, W_3, W_4)
→ جدول.

③ Know that → ($\underset{\text{width}}{\underline{180}} \times \underset{\text{depth}}{\underline{200}}$ ft)

If perpindicular:

See for any car is the أفضلية and test using module width taken from جدول. which combination is the best having it fit in depth given.

for ex:
2 modules for standard + 1 module for compact



② x 66" + ① x 57.2" = $\underline{189}$"

الأفضلية

مابوسع أكثر.

اذا كان نوع واحد مثلا بدون
بس بخط compact

$\frac{200}{66} = 3$

3 modules

④ Σ module numbers of each kind x 2 rows for each module (or 2 x num of modules)

2 standard module x 2 rows + 1 compact module x 2 rows = 6 rows

⑤ Handicapped + turning aisles

Handicapped percent for handicap x total spaces (100 here) = spaces for them
(usually 2%)

how much depth or (module width) will be taken by them?

spaces x 12" (Handicap module width)

turning aisles 15" turning width, if there is جزيرتين for turning x2

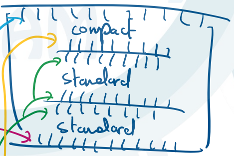
⑥ # of spaces for each car: (using width not depth)

\# for standard: 180 / 8.6" = for a single row
width / stall width

\# " 180 − (15" x 2) / 8.6" = for turning rows
(width − turning width) / stall width

\# for compact: 180 / 8" = for single row

" : 180 − (15" x 2) / 8" = for turning rows



\# for handicapped: 180 / num = put it in standard rows.

⑦ add: spaces for standard + spaces for compact ...
and see if they almost equal num of spaces calculated at the beginning.

always round down in parking

③

If angular: θ = 60 with stall depth 16.

num of modules: 42.4" x 2 + 51.8" x 2 = 187"

4 modules

④ num of rows: 2 x 4 = 8 rows.

⑤ same thing or number of handicapped u

⑥ We are going to use PW not SW so we

$\sin\theta = \frac{SW}{PW} = \frac{8.6"}{PW} = \sin 60$ $\boxed{PW = 9.8"}$ standa

$\sin\theta = \frac{SW}{PW} = \frac{8"}{PW} = \sin 60$ $\boxed{PW = 9.23"}$ comp

* — * what about y?

$\cos 60 = \frac{y}{SD = 16} = 8$
(stall depth)

\# of spaces for standard cars : $\frac{180 - \textcircled{8}}{\textcircled{9.8}}$
PW

\# of spaces for standard cars (with turni

\# " " : compact cars : $\frac{180 - 8}{9.23}$

\# " " " " " (with turning)

\# Handicapped: $\sin 60 = \frac{SW_{(HC)}}{PW_{(HC)}}$

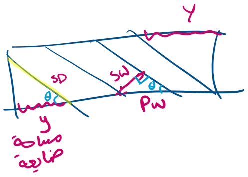
< 200"

will be given.

need it:

ard

act.



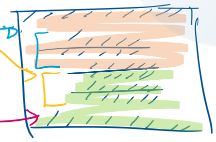
a single module
كتلة المعرض .

$= 17.55 \simeq 17$ for a single module. (هيدا المعرض ١٩ أكثر)

g) : $\frac{180-(15\times2)-8}{9.8} = 14$.

$= 18.63 \simeq 18$
3

: $\frac{180-(15\times2)-8}{9.23}$



$\leadsto$ $\sin 60 = \frac{12}{PW}$ $PW_{(Hg)} = 13''$

Food service

Sunday, January 19, 2025 8:24 PM

① num of employees / shift = num of employees per shift

②

*<u>Cafeteria</u> + vending:

$12\,ft^2 \times$ num of employees per shift $+ 1\,ft^2 \times$ "

*Cafeteria + <u>service line</u>:

can have 70 employees / shift only ⟶ so $\frac{\text{employees}}{70}$ = num of lines

$12\,ft^2 \times$ " + num of lines × $300\,ft^2$

* cafeteria + full kitchen

(sum of cafeteria + service line) + $\frac{\text{area from table}}{\text{num of meals}}$ بالساعة كده

Ch4 numbers

Sunday, January 19, 2025 4:36 PM

1 → 1.25 employees (no transportation)

1 → 3 employees (tranportation available)

2/100 handicapped stalls, 12" module

no walking more than 300-400 feet

33% for compact cars if not given.

16" for turning aisle

6 ft² locker for each person.

200 ft close bathroom for each work station.

bathroom numbers.

Food service within 1000 feet

water fountain within 200 feet

Health services: 250 ft² for each nurse

75 ft² + 25 ft² only for additional nurse

150 ft² for each doctor.

Ch5

Sunday, January 19, 2025 10:25 PM

Determine the following:
1. Container space utilization.
2. Container nesting ratio.
3. Trailer space utilization (if all containers stacked vertically in only one orientation).
4. Trailer return ratio.

① Container Space utilization $= \frac{\text{inside dimension}}{\text{outside dimension}} = \frac{18 \times 11 \times 11}{20 \times 12 \times 12} = 75.625 \approx \boxed{76\%}$

② Container nesting Ratio $= \frac{\text{container outside hieght}}{\text{nesting height}} = \frac{12}{2} = \boxed{6}$

← كل ما كانت
أقل كل ما
كان أفضل

(نهتم فقط بال Height)

⟹ so (6) nested container use the Same space as one closed container

③ Trailer Space Utilization =

→ ※ of Loaded containers that the trailer can take

(we need to determine how much container are in the Length and width and height

Length → $\frac{240}{20} = \underline{12}$ containers along the Length

width → $\frac{120}{12} = \underline{10}$ containers along the width

height → $\frac{120}{12} = \underline{12}$ containers along the height

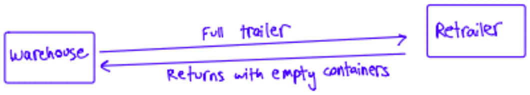
※ so Total number of containers $= 12 \times 10 \times 10 = 1200$ full containers

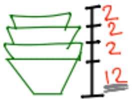
and now the trailer Utilization $= \frac{\text{※ of container} \times \text{container inside dimension}}{\text{Trailer inside dimension}}$

$$= \frac{1200 \times (18 \times 11 \times 11)}{240 \times 120 \times 120} = \boxed{76\%}$$

④ Trailer Retail Ratio $= \dfrac{\text{\# of empty containers fit in the trailer}}{\text{(\# of full containers fit in the trailer)}}$

من الفرع اللي قبل
1200





so number of containers stacked vertically $= \underset{\text{ثابت}}{1} + \dfrac{(\overset{\substack{\text{the height}\\ \text{of the}\\ \text{trailer}}}{120} - \overset{\substack{\text{the first}\\ \text{height}}}{12})}{\underset{\substack{\text{the nested}\\ \text{height}}}{2}} = 1 + \dfrac{108}{2} = \boxed{55}$ empty containers vertically

*so total # of empty containers $= 55 \times 12 \times 10 = 6600$ empty container

* Trailer Return Ratio $= \dfrac{\text{\# of empty containers fits in the trailer}}{\text{\# of full containers fits in the trailer}}$

$$= \frac{6600}{1200}$$

$$= \boxed{5.5}$$

we want this number to be as high as possible