Production & Operations Management INFO 335-01

Facility Layout

Chapter 10

Warehouse Layouts

Warehouse Layout Considerations:

- Primary decision is where to locate each department relative to the dock
- Departments can be organized to minimize "Id" totals
- Departments of unequal size require modification of the typical Id calculations to include a calculation of the "ratio of trips to area needed"

Warehouse Layout

Warehous	e (Storage Area of	Equal Sizes)	
Dept.	Category Trips from-to Do		ock
A	Canned Goods	50	
B	Cereal	63	
С	Condiments	35	
D	Baby Products	55	
E	Cookies	48	
F	Grocery	60	
	В	A	с
DOCK		AISLE	
	F	D	E

Warehouse Layout

Warehous	e (Storage Area of	Unequal Sizes)		
Dept.	Category	Block Area	From-To	Trips/Area	
A	Canned Goods	2	50	25	
В	Cereal	3	63	21	
С	Condiments	1	35	35	
D	Baby Products	1	55	55	
E	Cookies	1	48	48	
F	Grocery	2	60	30	
	D	с	F	A	в
DOCK	AISLE				
	E	F	A	в	в

Load-Distance Model

Calculate the Id	d iscore for eac	h layout using	the load-factor	model given th	e from-to data m	natrix.
BLOCK DIAGE	AM (Step 2 - A	Alternatives)				
Layout1 (L1)		,		Layout2 (L2)		
D	E	С		C	D	В
A	В			A	E	
FROM-TO MAT	TRIX (Step 1 -	Data Gatherii	ng)			
			Trips between	departments		
Department	<u>.</u>	A	В	С	D	E
A			18	8	3	4
В	0			16	22	5
С	24				50	20
D	55					90
E						
ANALYSIS (St	ep 3)					
	Trips (Load)	Distance (L1)	F-L Score (L1)	Distance (L2)	F-L Score (L2)	
A-B	18	1	18	3	54	
A-C	8	3	24	1	8	
A-D	3	1	3	2	6	
A-E	4	2	8	1	4	
B-C	16	2	32	2	32	
B-D	22	2	44	1	22	
B-E	5	1	5	2	10	
C-D	50	2	100	1	50	
C-E	20	1	20	2	40	
D-E	90	1	90	1	90	
Id Score			344	1	316	

Designing Product Layouts

- Designing product layouts requires consideration of:
 - Sequence of tasks to be performed by each workstation
 - Logical order
 - Speed considerations line balancing

Designing Product Layouts – cont'd

- Step 1: Identify tasks & immediate predecessors
- Step 2: Determine output rate
- Step 3: Determine cycle time
- **Step 4**: Compute the Theoretical Minimum number of Stations
- Step 5: Assign tasks to workstations (balance the line)
- Step 6: Compute efficiency, idle time & balance delay

Step 1: Identify Tasks & Immediate Predecessors

Example 10.4 Vicki's Pizzeria and the Precedence Diagram							
		Task Time					
Work Element	Task Description	Predecessor	(seconds				
А	Roll dough	None	50				
В	Place on cardboard backing	А	5				
С	Sprinkle cheese	В	25				
D	Spread Sauce	С	15				
Ш	Add pepperoni	D	12				
F	Add sausage	D	10				
G	Add mushrooms	D	15				
Н	Shrinkwrap pizza	E,F,G	18				
	Pack in box	Н	15				
		Total task time	165				



Step 2: Determine Output Rate

- Output Rate is the number of units to be produced over a specific period of time
 - Vicki needs to produce 60 pizzas per hour

- Vicki will need to divide the work among a number of people simultaneously at workstations
- The goal is to design a product layout that can produce the desired number of units with the least amount of work centers and a balance of workload

Step 3: Determine Cycle Time

Determine cycle time calculations

 The amount of time each workstation is allowed to complete its tasks

Cycle time (sec./unit) = $\frac{\text{available time (sec./day)}}{\text{desired output (units/hr)}} = \frac{60 \text{ min/hr x 60 sec/min}}{60 \text{ units/hr}} = 60 \text{ sec./unit}$

- Minimum cycle time = bottleneck
- Limited by the bottleneck task (the longest task) -which is in this case 50 seconds. So maximum output rate in this case would be 72 pizzas per hour.

Step 4: Theoretical Minimum Number of Stations

- Computing the theoretical minimum (TM) number of stations
 - TM = number of stations needed to achieve 100% efficiency (every second is used)

 $TM = \frac{\sum (\text{task times})}{\text{cycle time}} = \frac{165 \text{ seconds}}{60 \text{ sec/station}} = 2.75, \text{ or } 3 \text{ stations}$

- Always round up (no partial workstations)
- Serves as a lower bound for our analysis

Step 5: Assign Tasks to Workstations

• Assigning tasks to workstations (Balance the Line)

- Start at the first station & choose the longest eligible task following precedence relationships
- Continue adding the longest eligible task that fits without going over the desired cycle time

•	When no	additional	tasks of	can be	added	within	the	desired	cycle	time,
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Workstation	Eligible task	Task Selected	Task time	Idle time
1	А	А	50	10
	В	В	5	5
	С	С	25	35
2	D	D	15	20
	E, F, G	G	15	5
	E, F	E	12	48
2	F	F	10	38
3	н	н	18	20
	1	I. I.	15	5

Step 6: Efficiency and Balance Delay

- Computing efficiency and balance delay
 - Efficiency (%) is the ratio of total productive time divided by total time

Efficiency (%) = $\frac{\sum t}{NC} = \frac{165 \text{ sec.}}{3 \text{ stations x 60 sec.}} (100) = 91.7\%$

 Balance delay (%) is the amount by which the line falls short of 100%

Balance delay = 100% - 91.7% = 8.3%