

References

- Cannibal\Classes\GARCIA\INEN416\
Components of Decision Support
System\Section Descriptions\Section III

Section V- Layout Planning

Objective

To generate an initial plant layout and choose material handling equipments to facilitate the overall manufacturing operations.

Section V Points Distribution

1. Preliminary work station design: **5**
2. Material flow analysis: **5**
3. Department relationship chart: **10**
4. Material Handling Requirement & Costs : **30**
5. CRAFT-m outputs & block diagrams: **25**
6. Layout Planning Chart: **5**
7. Sample Calculations: **10**
(Dept. distances, Std times, Material handling manfraction, Crew fractions, equipment cost/year)
8. Report writing/appendix: **10**

Analysis methodology

1. Preliminary work station design

- o Tabulate the space requirements for each dept.

2. Material flow analysis

- o Create the From-To chart in matrix form by summing the number of trips taken from one station to another
- o Use the route sheets to gather this data
- o Choose any of Pieces/hr, moves/day, pounds/week as a flow measure
- o Create Departmental distance matrix

Material flow From-to matrix

TGI

Rectangular Accent Table

FROM-TO CHART

No. Department

- 1 Shipping
- 2 Warehouse/Receiving
- 3 Table Saw
- 4 Radial Arm Saw
- 5 Band Saw
- 6 Planer
- 7 Edge Sander
- 8 Disc Sander
- 9 Drill Press
- 10 Sprayer
- 11 Oven
- 12 Assembly

RECTANGULAR ACCENT TABLE Units: Number of pieces through workstation

From\To	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	1295.94	458.23	103.39	579.12	285.08	0.00	93.31	0.00	0.00	0.00
3	0.00	0.00	0.00	1448.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	398.30	98.22	435.32	0.00	294.66	0.00	983.48	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	98.22	0.00	413.55	0.00	0.00	0.00
6	0.00	0.00	229.12	321.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1399.62	0.00	168.42
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	421.05
9	0.00	0.00	0.00	0.00	0.00	0.00	972.61	443.21	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1329.64	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1263.16
12	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* This table is important for calculating the daily production of the factory.

RECTANGULAR ACCENT TABLE Weight: 10.349 lbs

From\To	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	814.06	435.32	413.55	96.25	158.14	0.00	38.26	0.00	0.00	0.00
3	0.00	0.00	0.00	797.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	206.73	27.99	413.55	0.00	352.12	0.00	260.13	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	392.88	0.00	392.88	0.00	0.00	0.00
6	0.00	0.00	24.97	66.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1294.46	0.00	69.05
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	118.32
9	0.00	0.00	0.00	0.00	0.00	0.00	532.15	124.54	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1229.74	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1168.25
12	827.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

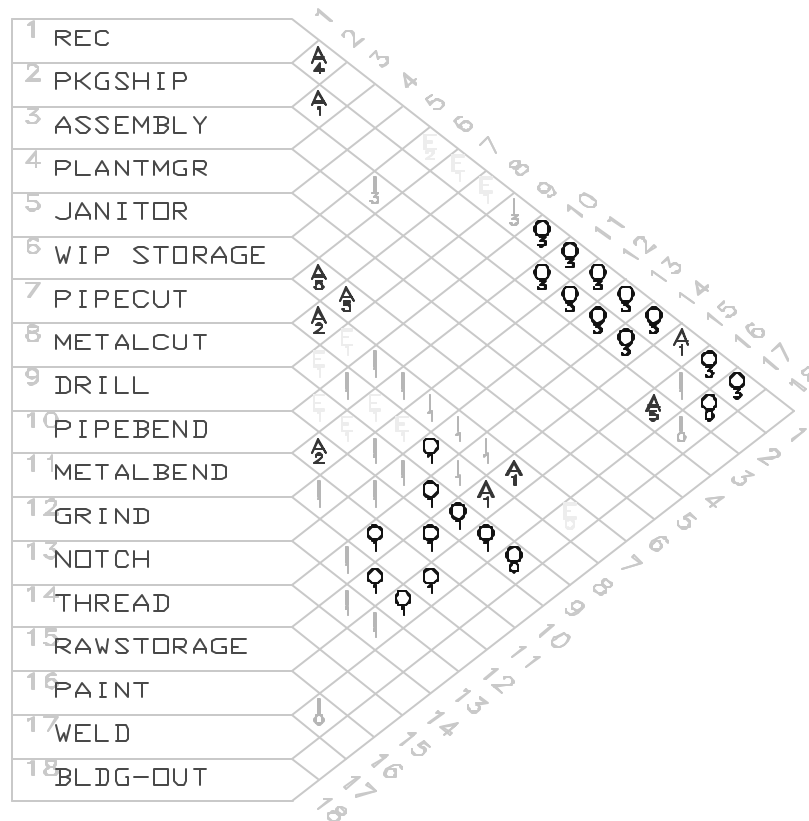
* This table is important for calculating the material handling requirements.

Note: The top table was derived by dividing each cell in the bottom table by the weight listed.

Department relationship chart

3. Department relationship chart

ACTIVITY RELATIONSHIP CHART: PROCESS LAYOUT



VALUE	CLOSENESS
A	ABSOLUTELY NECESSARY
E	EXPECIALLY IMPORTANT
I	IMPORTANT
O	ORDINARY CLOSENESS
U	UNIMPORTANT

#	REASON
1	FLOW OF MATERIAL
2	COMMON PERSONNEL
3	CLEANLINESS
4	SAME DECK
5	NECESSARY CONTACT

Material Handling Alternatives

4. Material Handling Requirement & Costs

- o How is Material Moved? If manual estimate manpower
- o What is the type of container?
- o What is the load size?
- o Discuss the methodology you used to decide the type of material handling equipment . Describe any assumptions that were made about the costs of the system.
- o For each selected equipment- Type, Model, Sizes, Capacity, Quantity
- You can make use of
 - o Garcia/Programs/ Material Handling Decision support system)
User Password: 416
 - o Class Discussions

Manual Material Handling Manpower Calculations

MAN FRACTION CALCULATION

$$N = \frac{T \times \frac{d}{[t \times (1 + a)]} + b}{H \times e}$$

Where:

- N = Man fraction for material handling
- T = Number of lots transferred per day
- d = Centroidal distance moved (ft/trip)
- t = * Average speed of material handling method (ft/sec)
- a = Time allowance factor
- b = Material load/unload time allowance
- H = Worker hours per day (sec/day)
- e = Worker efficiency factor

Calculation of Material Handling Man Fraction From Warehouse to Table Saw for RT-02

$$N = \frac{8 \times \frac{15.12}{[2.7887 \times (1 + 0.10)]} + 10}{28800 \times 0.85}$$
$$= 0.0049$$

* t is from:

http://hal.lamar.edu/~ie_dept/underdown/work_design/WD05_Standard_Data_files/WD05_Standard_Data.htm

MH manpower table (to be send in mail)


Material Handling Manpower Requirements										
Route	Route #	From Station	To Station	Parts transported	Parts Required	Batch Size	Standard Times (sec)	Fractional manpower	Sub total per Route	Crew Fraction
B	1	GRINDING	DRILLING	A007	1	200	13.976	0.004	0.008	0.110
				A008	1	200	13.976	0.004		0.110
Total manpower requirement for these routes								0.008		
A	2	PIPE CUTTING	WELDING	B126	4	200	16.645	0.010	0.010	0.026
A	3		DRILLING	C126	4	200	16.629	0.026		0.070
				A006	1	200	16.629	0.026	0.070	
				B127	4	200	16.629	0.026	0.070	
				B125	2	200	16.629	0.026	0.070	
A	4		PIPE BENDING	C123	2	200	19.824	0.006	0.006	0.016
Total manpower requirement for these routes								0.120		
A	5	DRILLING	PIPE BENDING	B125	2	200	12.454	0.003	0.003	0.009
A	6		METAL CUTTING	A006	1	200	22.350	0.004	0.004	0.010
A	7		PAINTING	C126	4	200	25.002	0.016	0.016	0.043
A	8		WELDING	B127	4	200	27.615	0.018	0.018	0.048
A	9		THREADING	A008	1	200	11.499	0.002	0.002	0.004
A	10		METAL BENDING	A007	1	200	16.706	0.003	0.003	0.007
Total manpower requirement for these routes								0.045		

EACH ROUTE CONSISTS OF MANPOWER COMBINATIONS FOR THE SAME OVERALL ROUTE

RA	ROUTE A	ROUTES 2, 3, 4, 5, 6, 7, 8, 9, 10, 19, 20
RB	ROUTE B	ROUTES 1, 11, 14, 15, 16
RC	ROUTE C	ROUTES 12, 13, 17, 18
RD	ROUTE D	ROUTES 21, 22

Material Handling Requirement & Costs Table

(Garcia/forms & checklists/ forms/S3MHT)

		Total Tool				
MATERIAL HANDLING REQUIREMENTS AND COSTS TABLE						
EQUIPMENT TYPE	DESCRIPTION	DISTANCE (ft)	CAPACITY	NO REQ'D	COST/UNIT	TOTAL COST
Forklift	Komatsu cushion tire forklift		3,500 lbs.	1	\$15,300.00	\$15,300.00
Bin Floor Rack	Double sided rail bin carts with 48 bins		250 lbs.	2	\$459.79	\$919.58
Polyethylene Cart	Polyethylene Cart (30" x 20" x 21")		44 gallons	2	\$165.30	\$330.60
Aluminum Mobil Rack	Aluminum Rack with 18 Tray slots (28" x 20" x 64")	266.7 (max)		9	\$368.25	\$3,314.25
Aluminum Trays	Aluminum Trays (26" x 18" x 1")	266.7 (max)	16.67 lbs.	162	\$16.13	\$2,613.06
					TOTAL ANNUAL COST	\$22,477.59
					COST PER PART	\$0.014

NOTE:

- 1) Salvage value is 10%.
- 2) There is a 10 year life expectancy for all material handling equipment.
- 3) The cost per part was solved by using the annual cost / 145,000 parts produced per year.
- 4) Bin Floor Rack is stationary between the assembly stations.
- 5) Mobile Rack does not add extra capacity; its purpose is to move more than one tray.
- 6) See Appendix II for pictures and more information about the material handling equipment.

Material Handling Requirements & Costs Table Explained

- **Equipment type** – Type of equipment used from the layout planning charts
- **Description** – Details about the equipment
- **Length** – Length of the equipment, if applicable.
- **Capacity** – The amount of weight the equipment can hold
- **No Req'd** – The number of equipment pieces needed for production, if applicable
- **Cost/Unit** – The cost per unit of equipment or the cost per unit of length
- **Total Cost** – $(\text{No Req'd}) * (\text{Cost/Unit})$
- **Annual Cost** – $(\text{Total Cost} - 10\% * \text{Total Cost}) \div (\text{Service Life})$

Web resources for MH selection

- www.mhia.org
- www.yaleflorida.com
- www.handlingconcepts.com
- www.cisco-eagleonline.com
- www.grossassociates.com
- www.forktrucks.com
- www.usroads.com/journals/rej/9704/re970404.htm
- www.integratedstorage.com
- www.raymondcorp.com
- www.asapauto.com
- www.king-way.com
- www.fkilogistex.com

CRAFT-m

5. CRAFT-m outputs & block diagrams

- o Use CRAFT to create proposed layout
- o Change constraints of fixed departments and valuable relationships to transcribe the most desirable plant layout (2 solutions)

Preliminary Layout Analysis step 2

Facility Layout A

Problem Name:	Production
Number Depts.:	12
Length(cells):	30
Width(cells):	25
Area (cells):	750
Cost:	155904

Method:	Traditional
Layout:	Blank
Fill Departments:	Yes
Measure:	Rectilinear
Number Aisles:	6
Dept. Width:	5

Department	Color	Area-required	Area-defined	x-centroid	y-centroid	Sequence
D 1	1	225	225	4.16666651	17.5	1
D 2	2	225	225	10.8333333	12.5	2
D 3	3	25	25	17.5	20.5	6
D 4	4	42	45	21.9444447	3.61111116	11
D 5	5	5	5	17.5	23.5	5
D 6	6	7	10	17.5	25	4
D 7	7	21	25	17.5	3.5	10
D 8	8	16	20	17.5	28	3
D 9	9	5	5	22.5	8.5	12
D 10	10	11	15	17.5	7.5	9
D 11	11	20	20	17.5	11	8
D 12	12	25	25	17.5	15.5	7

No. Department

- 1 Shipping
- 2 Warehouse/Receiving
- 3 Table Saw
- 4 Radial Arm Saw
- 5 Band Saw
- 6 Planer
- 7 Edge Sander
- 8 Disc Sander
- 9 Drill Press
- 10 Sprayer
- 11 Oven
- 12 Assembly

Random Layout Evaluate Show Flows

Solve Switch Change Facility

The last move increased the cost.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4
2	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	7	7	7	7	7	7	4	4	4	4
3	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	7	7	7	7	7	7	4	4	4	4
4	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	7	7	7	7	7	7	4	4	4	4
5	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	7	7	7	7	7	7	4	4	4	4
6	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	7	7	7	7	7	7	4	4	4	4
7	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	10	10	10	10	10	10	4	4	4	4
8	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	10	10	10	10	10	10	4	4	4	4
9	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	10	10	10	10	10	10	4	4	4	4
10	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	11	11	11	11	11	11	0	0	0	0
11	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	11	11	11	11	11	11	0	0	0	0
12	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	11	11	11	11	11	11	0	0	0	0
13	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	11	11	11	11	11	11	0	0	0	0
14	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	12	12	12	12	12	12	0	0	0	0
15	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	12	12	12	12	12	12	0	0	0	0
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
29	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	13	13	13	13	13	0	0	0	0

Preliminary Layout Analysis step 3

Facility Layout B

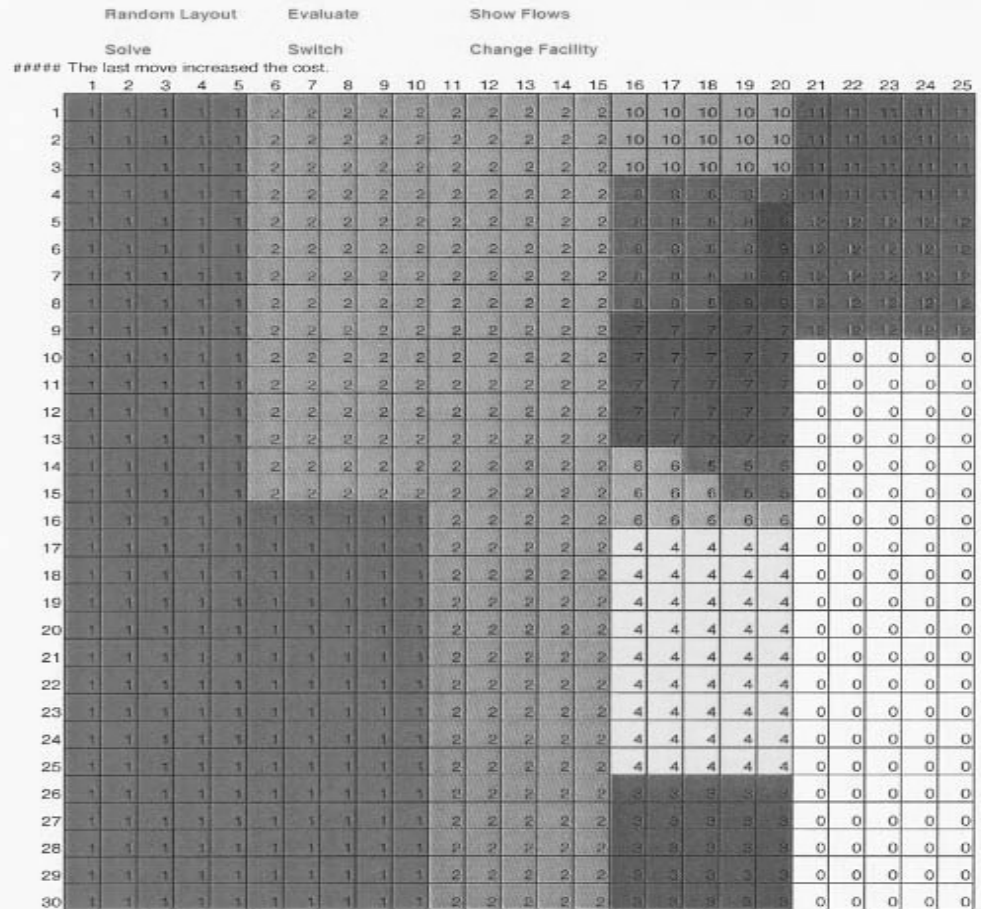
Problem Name:	Production
Number Depts.:	12
Length(cells):	30
Width(cells):	25
Area (cells):	750
Cost:	137851

Method:	Traditional
Layout:	Blank
Fill Departments:	Yes
Measure:	Rectilinear
Number Aisles:	5
Dept. Width:	5

Department	Color	Area-required	Area-defined	x-centroid	y-centroid	Sequence
D 1	1	225	225	4.16666651	17.5	1
D 2	2	225	225	10.8333333	12.5	2
D 3	3	25	25	17.5	27.5	3
D 4	4	42	45	17.5	20.5	4
D 5	5	5	5	18.7000008	13.8999996	5
D 6	6	7	10	16.8999996	14.8000002	6
D 7	7	21	25	17.5	10.5	7
D 8	8	16	20	17.0499992	5.30000019	8
D 9	9	5	5	19.2999992	6.30000019	9
D 10	10	11	15	17.5	1.5	10
D 11	11	20	20	22.5	2	11
D 12	12	25	25	22.5	6.5	12

No. Department

- 1 Shipping
- 2 Warehouse/Receiving
- 3 Table Saw
- 4 Radial Arm Saw
- 5 Band Saw
- 6 Planer
- 7 Edge Sander
- 8 Disc Sander
- 9 Drill Press
- 10 Sprayer
- 11 Oven
- 12 Assembly



Preliminary Layout Analysis step 4

Layout Selected

Name:	Production	Method:	Traditional
Depts.:	12	Layout:	Blank
n(cells):	30	Fill Departments:	Yes
n(cells):	25	Measure:	Rectilinear
n(cells):	750	Number Aisles:	5
Cost:	120649	Dept. Width:	5

Department	Color	Area-required	Area-defined	x-centroid	y-centroid	Sequence
1	1	225	225	4.16666651	17.5	1
2	2	225	225	11.3888893	9.72222233	2
3	3	25	25	17.5	7.5	3
4	4	42	45	17.5	14.5	4
5	5	5	5	18.7000008	21.1000004	5
6	6	7	10	16.8999996	20.2000006	6
7	7	21	25	17.5	24.5	7
8	8	16	20	22.1000004	20.5499992	8
9	9	5	5	20.2999992	26.2999992	9
10	10	11	27	23.1296291	25.7222214	10
11	11	20	20	18.6000004	28.7000006	11
12	12	25	25	12.5	27.5	12

- No. Department**
- 1 Shipping
 - 2 Warehouse/Receiving
 - 3 Table Saw
 - 4 Radial Arm Saw
 - 5 Band Saw
 - 6 Planer
 - 7 Edge Sander
 - 8 Disc Sander
 - 9 Drill Press
 - 10 Sprayer
 - 11 Oven
 - 12 Assembly

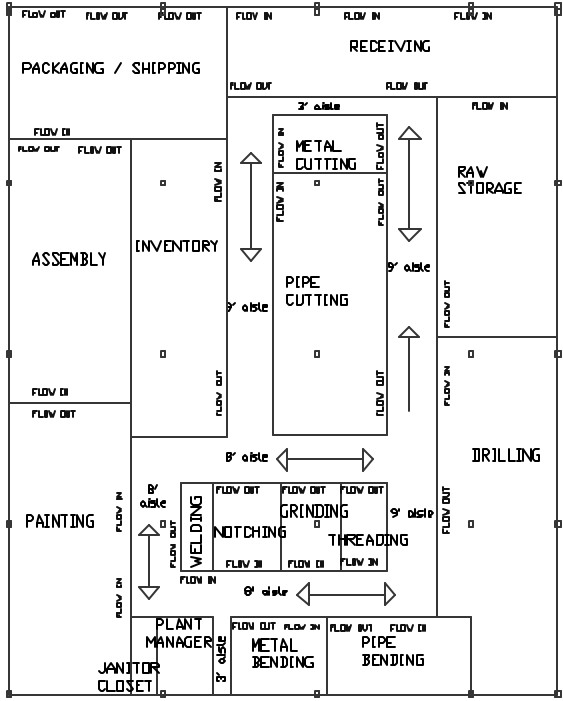
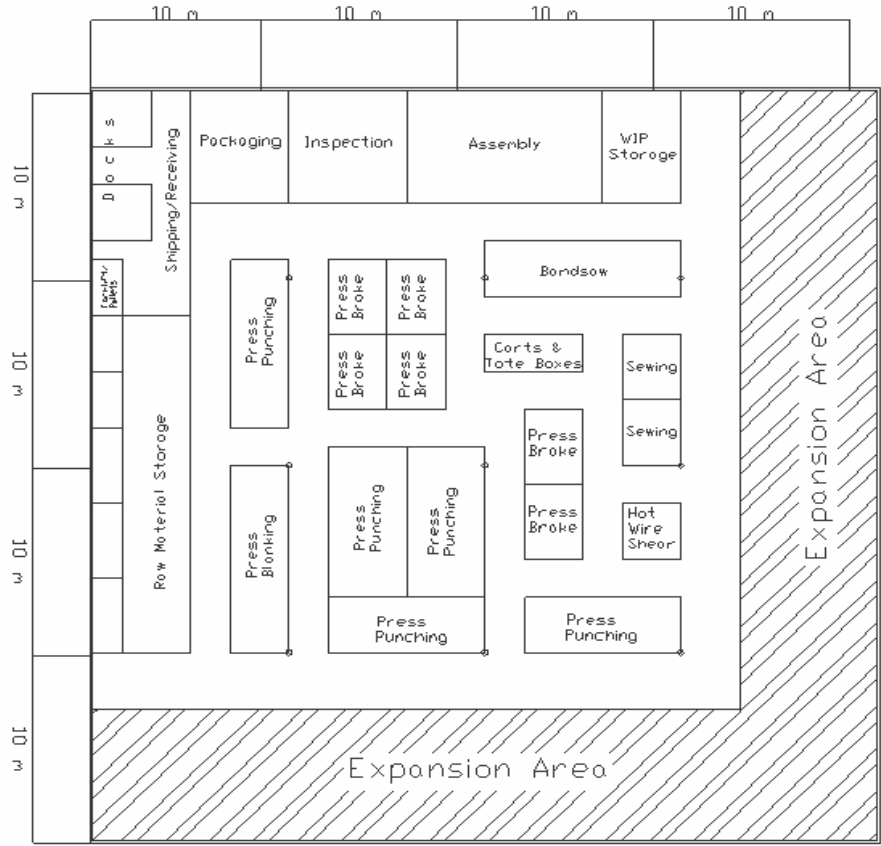
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
2	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
3	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
4	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
5	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
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7	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
8	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
9	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
10	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0
11	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
12	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
13	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
14	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
15	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
16	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
17	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
18	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
19	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	4	4	4	4	4	0	0	0	0	0
20	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	6	6	6	6	6	0	0	0	0	0
21	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	6	6	6	6	6	0	0	0	0	0
22	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	6	6	5	5	5	0	0	0	0	0
23	1	1	1	1	1	1	1	1	1	2	2	2	2	2	7	7	7	7	7	0	0	0	0	0	
24	1	1	1	1	1	1	1	1	1	2	2	2	2	2	7	7	7	7	7	10	10	10	10	10	
25	1	1	1	1	1	1	1	1	1	2	2	2	2	2	7	7	7	7	7	10	10	10	10	10	
26	1	1	1	1	1	1	1	1	1	12	12	12	12	12	7	7	7	7	7	0	10	10	10	10	
27	1	1	1	1	1	1	1	1	1	12	12	12	12	12	7	7	7	7	7	0	10	10	10	10	
28	1	1	1	1	1	1	1	1	1	12	12	12	12	12	11	11	11	11	11	0	10	10	10	10	
29	1	1	1	1	1	1	1	1	1	12	12	12	12	12	11	11	11	11	11	11	11	11	11	10	10
30	1	1	1	1	1	1	1	1	1	10	10	10	10	10	11	11	11	11	11	11	11	11	11	10	10

The last move increased the cost.

Proposed Layout drawing

- AutoCAD Drawing of Proposed Layout
 - From the proposed plant layout (CRAFT output), use AutoCAD to create a block layout.
 - Label all stations
 - Dimension each departments and perimeter of the proposed layout
 - Indicate the material flow lines
 - Include company name, Team Member who completed the drawing, date, Scale, and the title of the drawing

Examples: Block Layout



Departmental distance matrix

TGI

**Rectangular
Accent
Table**

CENTROIDAL DISTANCE BETWEEN DEPARTMENTS

Department	x-centroid	y-centroid
1. Shipping	4.1667	17.5000
2. Warehouse/Receiving	11.3889	9.7222
3. Table Saw	17.5000	7.5000
4. Radial Arm Saw	17.5000	14.5000
5. Band Saw	18.7000	21.1000
6. Planer	16.9000	20.2000
7. Edge Sander	17.5000	24.5000
8. Disc Sander	22.1000	20.5500
9. Drill Press	20.3000	26.3000
10. Sprayer	23.1296	25.7222
11. Oven	18.6000	28.7000
12. Assembly	12.5000	27.5000

n: 2

Calculated Distance from Department 1 to Department 2

$$\begin{aligned}
 D &= n \times [|x_2 - x_1| + |y_2 - y_1|] \\
 &= 2 \times [|11.3889 - 4.1667| + |9.7222 - 17.5000|] \\
 &= 30 \text{ feet}
 \end{aligned}$$

Where:

- D = Distance between departments
- n = Scale factor of CRAFT
- x_1 = x centroid of the department traveled from
- y_1 = y centroid of the department traveled from
- x_2 = x centroid of the department traveled to
- y_2 = y centroid of the department traveled to

From\To	1	2	3	4	5	6	7	8	9	10	11	12
1	0.00	30.00	46.67	32.67	36.27	30.87	40.67	41.97	49.87	54.37	51.27	36.67
2	30.00	0.00	16.67	21.78	37.38	31.98	41.78	43.08	50.98	55.48	52.38	37.78
3	46.67	16.67	0.00	14.00	29.60	26.60	34.00	35.30	43.20	47.70	44.60	50.00
4	32.67	21.78	14.00	0.00	15.60	12.60	20.00	21.30	29.20	33.70	30.60	36.00
5	36.27	37.38	29.60	15.60	0.00	5.40	9.20	7.90	13.60	18.10	15.40	25.20
6	30.87	31.98	26.60	12.60	5.40	0.00	9.80	11.10	19.00	23.50	20.40	23.40
7	40.67	41.78	34.00	20.00	9.20	9.80	0.00	17.10	9.20	13.70	10.60	16.00
8	41.97	43.08	35.30	21.30	7.90	11.10	17.10	0.00	15.10	12.40	23.30	33.10
9	49.87	50.98	43.20	29.20	13.60	19.00	9.20	15.10	0.00	6.81	8.20	18.00
10	54.37	55.48	47.70	33.70	18.10	23.50	13.70	12.40	6.81	0.00	15.01	24.81
11	51.27	52.38	44.60	30.60	15.40	20.40	10.60	23.30	8.20	15.01	0.00	14.60
12	36.67	37.78	50.00	36.00	25.20	23.40	16.00	33.10	18.00	24.81	14.60	0.00

Note: Values above and below the diagonal line are symmetric.
The shaded values were listed to cross-reference and double-check the calculated distances.

Layout Planning Charts (LPC)

- A detailed description of the sequence of operations (largely based on route sheets) for each part to aid layout planning process.
- Allows the planner to visualize combinations of operations, manpower, & machines.
- Notation
 - Fabrication - F - ?
 - Move - M - ?
 - Storage - S - ?
 - Inspection - I - □
- **For each M the Layout Planning Chart documents**
 - Frequency (# of moves per part)
 - Origin & destination of moves
 - Quantity being moved
 - Time per move

Format for Layout Plang. Chart (Garcia/forms & checklists/ forms/S3LPC or tamcam)



Total Tool

LAYOUT PLANNING CHART

PART NO	04PLRB	PCS/ASSY	1	PCS REQD/HR	75.5
PART NAME	Plier Part B	ASSY/PRODUCT	1	Prod HRS/DAY	8
ASSY NO	SA2	PCS/DAY	604	LOT SIZE	50
MATERIAL	304 Stainless Steel	SIZE	0.0422 lbs	PAGE	1 OF 2
		PREPARED BY	Lisa Clegg	DATE	2/25/2003

ST NO	F M S I	DESCRIPTION	TIME PER PIECE (hrs)	MACHINE OR EQUIPMENT	MACH. REQD			TOTAL MANPOWER				HANDLING REQUIREMENTS				REMARKS
					MACH FRAC	COMB WITH	MACH REQD	CREW FRAC	MAN FRAC	COMB WITH	ME N REQD	HOW MOVED	CONT TYPE	LOAD SIZE (lbs)	DIST MOVED (ft)	
1	◇○△□	From scrap cart														
2	◇●△□	To Casting Machine	0.00810					0.01731		1(3)		manual	poly-ethylene carts	2.11 (scrap)	83.33	
3	●○△□	Cast to mold general shape	0.05080	Casting Machine	5.46353	3(3)		5.46353		3(3)						
4	◇●△□	To CNC Workcenter	0.00869					0.01857		3(3)		manual	trays & rack	2.11	91.67	
5	●○△□	Drill hole for pin	0.00180	CNC Workcenter	0.19359	3(5)		0.19359		3(5)						
6	●○△□	Drill hole for fastener	0.00180	CNC Workcenter	0.19359	3(5)		0.19359		3(5)						
7	●○△□	Counterbore	0.00560	CNC Workcenter	0.60228	3(5)		0.60228		3(5)						
8	●○△□	Countersink for fastener	0.00330	CNC Workcenter	0.35491	3(5)		0.35491		3(5)						
9	◇●△□	To Deburring Machine	0.00928					0.01982		3(5)		manual	trays & rack	2.11	100	
10	◇○△□	Deburr	0.00250	Deburring Machine	0.26887	1(5)		0.26887		1(5)						

Layout Planning Charts

Explained

- **St No.** – Serial number of the step in the Layout Planning Chart
- **F M S I** – **Shade the type of operation** that is occurring during the current step
- **Description** – Description of the operation **including material handling operations**
- **Time per piece** – Standard time, from the route sheet (**only for F type of operation**)
- **Machine or Equipment** – Machine or equipment from the route sheet (**only for F type of operation**)
- **Mach. Frac.** – Fractional number of machines required, from the **machine requirements table**
- **Combine with-** Use the machine fraction calculations table of Section II and denote m/c codes
- **Mach Reqd** – Machine Fraction rounded up, notice that the machines can be shared with other operations
- **Crew Frac** – Summation of men fractions/ total men required

Layout Planning Charts Explained

- **Men Frac** – Fractional number of men required, (Crew Frac) *
(number of operators required to operate the machine)
- **Men Req'd** – Men required for the operation, i.e., rounded up
men frac, notice that the crew can be shared with other
operations
- **How Moved** – How the material is moved from one operation to
the next (only for M type of operations)
- **Cont Type** – Type of container used to move the material (only
for M type of operation)
- **Lot Size** – Quantity moved per trip (only for M type of
operation)
- **Dist. Moved** – Distance traveled (only for M type of operation),
you may need layout sketch to come out with these distances
- **Remarks** – Any comments about the operation

Appendix to Section V can Include..

- Photos, sketches of equipments, bins, racks, pallets selected
- Material Handling Annual Cost=
(total cost-0.1X total cost)/ 10 years
Note: Assumed 10% salvage value and 10 year service life
- Pounds Required
- Pounds per day
- Cost per unit
- Cost per year
- Material Requirements & Costs Excel Spreadsheet