

# Improvement of Plant layout using CRAFT

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**Abstract-** In the manufacturing plant consider different department with interconnected and interdependent to each other. Plant layout plays the significant role in the efficient working of the industries. Plant layout plays a vital role in process layout. Where the studied industries layout depends on process based that can be minimized modification problem of the plant. In this work the modification of process based plant layout is studied, and craft algorithm was used to minimize the travel route and transportation cost of inter-department activities. The study of plant layout is based on the DDBPL (Density and distance based process layout). The features provided by the craft when using add ins in craft, for problem solution approaches the best outcome is finding out. Craft algorithm suggests that you can design the plant layout on the basis of frequently manufacturing product and their process. It is suggested to the organization to interchange the few departments to minimize the cost and distance in the industries.

**Keywords-** CRAFT, Plant layout, Process layout, DDBPL

## I. INTRODUCTION

Today's The consumer of industrial goods is increasing exponentially while the growth of manufacturing unit is linear. Manufactured firm aimed to manufacture product at low cost and adequate quality to fulfil the need of consumers having high efficiency. It can be possible when the firms utilized their all resources and efficient techniques. Today Millions of small, medium and large scale industries Play a wider role to fulfil the world requirement. Among those industries maximum organization unstructured as compare to ideal facility layout. The distance-based facility layout state that the main problem with layout having an unequal area among departments, has been studied in different research, since last 30 years, it was addressed by Armour and Buffa. In today's scenario the lot of research work was focused on plant layout modification, and distance based facility layout. DDBPL is focused on reducing time and cost.

### A. Importance of Plant layout

- 1) Help in smooth functionality in operation and cost saving process
- 2) For functionality, better placed close important department and minimize working distance

- 3) Overall facility, improving including employee safety and communication

### B. Objective in Plant layout

- 1) Minimize investment in equipment
- 2) Minimize overall production time
- 3) Utilize existing space most effectively
- 4) Provide for employee convenience, safety and comfort
- 5) Maintain flexibility of arrangement
- 6) Minimize material handling cost
- 7) Minimize variation in type of material handling equipment
- 8) Facilitate the manufacturing process
- 9) Facilitate the organizational structure

## II. LITERATURE REVIEW

Castillo and Brett define the distance based facility layout problem, especially for process layout. In 1996 Yavuz A. Bozer and Russell D. Muller proposed an alternative distance measure, namely EDIST which is based on the expected distance between two departments. Yavuz A. Bozer and RUSSELL D. Muller again proposed QAP (Quadratic assignment problem) approach to facility layout to obtain the optimal solution of the problem.

In 2014 Hari Parsad. N, Rajyalakshmi. G, and Sreenivaslu Reddy. Develop a Java program to design the optimum plant layout as STEP file.

S. P. Singh and R. R. K. Sharma shows the usability of different software with comparing to other and optimize the facility layout software as well as algorithm trend.

Michael C. Georgiadis, Guillermo E. Rotstein, and Sandro Macchietto define in the work On the basis of three case study optimal no of required floor for facility layout.

## III. RESEARCH METHODOLOGY

An industry situated in Indore, Madhya Pradesh was chosen for the study. They manufactured variety of product. So that, it was very difficult task to modification of their existing plant layout the complexity of the work was increased due to a variety of products manufactured in the organization.

For reducing this complexity we took density based criteria to optimize overall performance of organization layout. Product those was contributing 75% of total production in a year choose as a dense product for the work. For this purpose the chart is drawn to analyze their manufacturing sequence and calculating the total distance travelled by the product in the manufacturing process. CRAFT algorithm is used to solve it on excel.

#### IV. ANALYSIS

The products which are frequently manufactured in the industries selected as a dense product for the work. These products manufactured above 75% of the total working days. This information was collected from an organization, manufacturing scheduled chart. The table Shown below is given the most detailed of the products which are frequently produced throughout year and the amount of production.

Table 1: Production of product 75% working days of year

S.No.	Product	Production per month
1	Bearing Cap	2400
2	Engine Mounting Bracket	600
3	Tube muffler	1200
4	Pin	300
5	Assembly return pin	900
6	Assembly return plate	900
7	Total assembly	900
8	Ring	1200

The table No. 2 defines the different sequence of the process through which the most dense product manufactured. It also shows the trolley load of the industries ,trolley load is useful to calculate travelling cost among the department.

Table 2: Process and load

S.No	Product	Process	Trolley load per month
1	Bearing Cap	1-14-9-5-6-11-12-13	48
2	Engine Mounting Bracket	1-2-4-5-6-7-11-12-13	150
3	Tube muffler	1-2-6-8-11-12-13	12
4	Pin	1-2-5-6-7-8-11-12-13	6
5	Assembly return pin	1-2-5-7-6-1	3
6	Assembly return plate	1-6-1	18
7	Total assembly	1-8-11-12-13	12
8	Ring	1-2-14-9-5-11-12-13	12

The figure shown below was generated using CRAFT that provides detailed information about the particular department with respect to the type of the department i.e. fixed department or variable department is shown by F/V. The fixed department shows constraint, that it could not be shifted as

compare to variable department. The Column cell shows no of occupied cell and the area of the cell. The area of one cell is taken as  $4m^2(2m \times 2m)$ .

### Department Information

	Name	F/V	Area	Cells
Dept. 1	D 1	V	320	80
Dept. 2	D 2	V	360	90
Dept. 3	D 3	V	288	72
Dept. 4	D 4	V	750	188
Dept. 5	D 5	V	280	70
Dept. 6	D 6	V	283.5	71
Dept. 7	D 7	V	280	70
Dept. 8	D 8	V	48	12
Dept. 9	D 9	V	276	69
Dept. 10	D 10	V	84	21
Dept. 11	D 11	V	112	28
Dept. 12	D 12	V	80	20
Dept. 13	D 13	V	80	20
Dept. 14	D 14	V	230	58

Figure 1: Department Area and Occupied Cell in Excel

The Figure No. 2 shown the existing plant layout .The plant has14 small and big departments. That is as follows, Raw Material, Cutting Machine, Scrap Yard, CNC Turning, Leth Machine-7ft ,Piller Drill, Cylindrical Drill, Surface Table, Leth Machine-17ft, Rejection-Rework, Quality

Inspection, Packing, Finish goods, and Hydraulic Machine Departments.

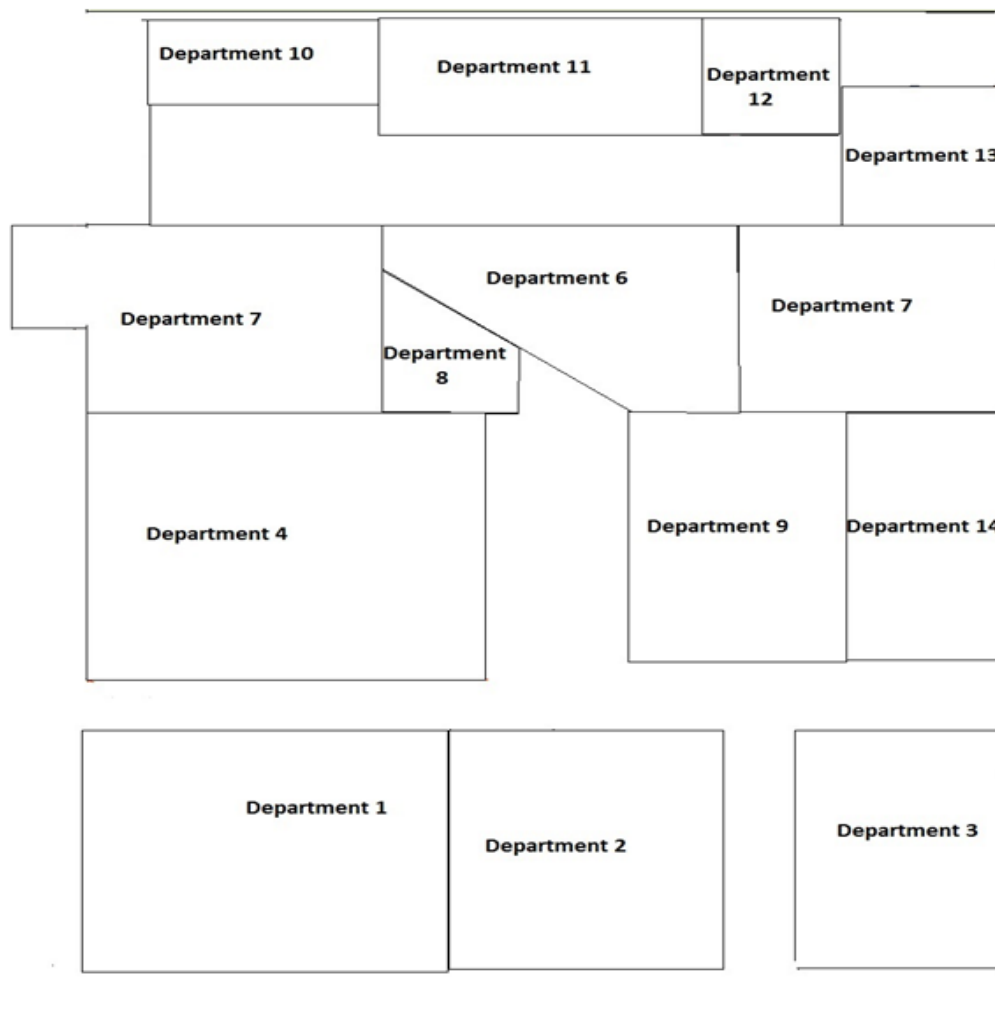


Figure 2: Existing plant layout and departmental arrangement

figure 2 given above shows the facility layout of existing plant. By applying the CRAFT it provides the details of the production unit that indicate that the total number of the department involved in the organizational manufacturing process the area of each department already exist and the required area of the department . This provides the initial cost

of the inter-department transportation. That suggests the required area and the present area of the department and centroid of the departments with respect to X and Y axis.

### Facility Layout

Problem Name:	Production
Number Depts.:	14
Length(cells):	41
Width(cells):	27
Area (cells):	1107
Cost:	31680

Method:	Sequence
Layout:	Aisle
Fill Departments:	Yes
Measure:	Euclidean
Number Aisles:	6
Dept. Width:	5

Department	Color	Area-require	Area-defined	x-centroid	y-centroid	Sequence
D 1	1	80	80	2.5	8	1
D 2	2	90	90	2.5	25	2
D 3	3	72	75	5.16666651	37.23333336	3
D 4	4	188	190	8.15789509	14.6578951	4
D 5	5	70	70	12.5	12	5
D 6	6	71	75	12.5	26.5	6
D 7	7	70	70	15	37.5	7
D 8	8	12	15	17.5	32.5	8
D 9	9	69	70	17.5	24	9
D 10	10	21	25	17.5	14.5	10
D 11	11	28	30	17.5	9	11
D 12	12	20	20	17.5	4	12
D 13	13	20	20	20	1	13
D 14	14	58	60	22.5	8	14

Figure 3: Initial layout and position with sequence

Applying CRAFT in the existing plant layout it gives the initial cost of the transportation of material in the various departments. As shown in above figure 3. The figure 4 given below shows the improved facility layout of existing plant. By applying the CRAFT it provides the details of the production unit that indicate that the total number of the department involved in the organization as a main part of the

manufacturing process. The area of each department already exist and the required area of the department was suggested. This provides the optimal cost of the inter-department transportation and centroid of the departments with respect to X and Y axis.

## Facility Layout

Problem Name:	Production	Method:	Sequence
Number Depts.:	14	Layout:	Aisle
Length(cells):	41	Fill Departments:	Yes
Width(cells):	27	Measure:	Euclidean
Area (cells):	1107	Number Aisles:	6
Cost:	22894	Dept. Width:	5

Department	Color	Area-require	Area-definer	x-centroid	y-centroid	Sequence
D 1	1	80	80	7.5	16	1
D 2	2	90	90	17.5	26	2
D 3	3	72	75	3.5	35.9000015	3
D 4	4	188	190	13.2894735	27.0526314	4
D 5	5	70	70	7.5	31	5
D 6	6	71	75	2.5	7.5	6
D 7	7	70	70	9.64285755	3.57142854	7
D 8	8	12	15	12.5	7.5	8
D 9	9	69	70	2.5	22	9
D 10	10	21	25	22.5	11.5	10
D 11	11	28	30	18.333334	2.16666675	11
D 12	12	20	20	22.5	3	12
D 13	13	20	20	22.5	7	13
D 14	14	58	60	17.5	11	14

Figure 4: Final layout and positioning with sequence

### V. RESULTS

The data collected from the industry as plant layout and used in the study by using excel add-ins tool, the algorithm CRAFT optimized the process layout. CRAFT gives the result that the total number of the department is 14 having length 41 cells and width 27 cells that is equal to 82M x 54M. the total area of the production plant is 1107 cells or

4428 Sq. Meter. In CRAFT sequential method was used that suggest the sequences of the department. The transportation cost among the department is also reduces the initial cost of the transportation among the department is Rs. 31680 that was reduced toward Rs.22894. This cost reduction gives the biggest impact on organization's profitability. The below figure shows the saving cost of various interchanging departments.

Iter.	Type	Action	Cost
1	Switch	8 and 4	25825
2	Switch	5 and 8	24756
3	Switch	14 and 10	24363
4	Switch	6 and 8	24113
5	Switch	6 and 1	23610
6	Switch	9 and 2	23011
7	Switch	7 and 8	22894

Figure 7: Switching Department

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## VI. CONCLUSIONS

In this work the process layout was studied. After the study it is concluded that the industry will interchange the some of the departments that reduced the inter-department material transportation cost. That direct impact to the industry profit and efficiency of the labor.

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