ISSN: 2278-4632
Vol-11 Issue-02 2021

FUZZY APPLICATION FOR INDUSTRIAL ROBOT

Mir Naseer Hussain[1],Lucy Mohapatra
[1](*Mechanical Engineering, Gandhi Engineering College, Bhubaneswar)*
[2](*Mechanical Engineering, Gandhi Engineering College, Bhubaneswar)*

Abstract

Production industry continuously needs betterment of the layout/facility design. So as to get better results with minimum uses of resources. Thus giving rise to theneedoffacilityplanning.Toassignagivenfacilityoneneedadefinedpieceofland with proper material handling effort. Keeping in mind these given feature, facility distribution works by preparing its structural plan, layout plan & the subject arrangement plan. Thereby producing a organized facility plan many researchers had underwent in the past so as to get a optimized facility representation. Every research published in the earlier could not meet the required scheme as something is always lacking. So the main purpose is to get optimization of facility plan including every part of it.This paper is primarily focusing on detailed analysis of methodology of optimization of facility planning by applying different formulas on the representation and its aspects. The results are shown using mathematical equation in a computerised technique.

Keywords: Facility Planning; Plant Layout; Optimization Methods

I. INTRODUCTION

The concept of facilities planning is vast and at the same time this concept is complicated as well. It is a broad subject and it covers several fields of engineering that is, it covers several disciplines. It includes various engineering fields such as- civil engineering, electrical engineering, mechanical engineering, industrial engineering, architectural engineering and therefore, architects, consulting managers and urban area planners .So looking at the involvementofvariedaspectsofengineering,itisobvious,thattheconceptoffacilityplanning is not only vast, broad or extremely large but also of complex nature[3]. The concept of facility planning is about the location of the facilities and the design of the facilities. The concept of facilities planning is related to achieving the activity's best possible result through activity's tangible fixed assets. That is – what is the objective of the facility and how the objective is achieved?Thereare twocomponentsoffacilitiesplanning[4].Thefirstcomponentofthefacilities planning is the location of the facilities and the second component of the facilities planning is the design of the facilities[5]. To define the first component of the facilities planning, that is, the facilities location, it can be said that the facilities location means the placement or the placing of the facility on a particular plot of land, or it can be said that the placement of the facility on a specific piece, or plot of land, with respect to other facilities and also with respect to the customers and suppliers[6]. So in facilities planning, the location of facilities relates to the placementofthefacilitiesaccordingtothesuppliersandotherfacilities.Thesecondcomponent offacilitiesplanningisfacilitiesdesign[7].Nowthissecondcomponentoffacilitiesplanningthat is the facilities design is divided in to three parts. The first part of the facilities design is the designofthesystemofthefacility[8].Thesecondpartofthefacilitiesdesignisthedesignofthe layout. The last part of the facilities design is the design of the handling system. So in all, the second component of the facilities planning that is the facilities design consists of the facility system design, the layout design and the systems handlingdesign[9].

II. FACILITY-DESIGN

The term Facilities Layout is also known as Plant Layout in manufacturing units or industries. Plant Layout is the most crucial part of the entire facilities planning, because more than halfof theentireoutputdependsuponthesuccessfullayoutoftheplant.PlantLayoutismostimportant in a manufacturing unit because it directly affects the financial aspect of the manufacturing unit[10].

The financial aspect is the base of any production or manufacturing unit. Maximum profit by minimum cost spent or minimum expenditure is the basic mantra and this is what today's industrial system has truly adopted. The material handling costs and the cost of transportation arethetwocostswhichdirectlyaffectsthefinanciallayoutofmanufacturingunits.Fluctuation inanyoftheseresultsinlessprofitandthehurdlestheachievementofthefacility'sobjectives. So the Plant Layout, as mentioned earlier does affect the overall production system and its effectivenessinachievingthefacility'sactualobjectives.Theproblemsordifficultiesthatarise in facilities layout or the plant layout decrease the overall effectiveness of the production system. Many countries such as United States spends more than 8% of their Gross National Product annually upon employing new facilities so that the cost reduction can e done most effectively specially the cost oftransportations[11].

ISSN: 2278-4632
Vol-11 Issue-02 2021

129

If new facilities are employed in a proper duration of time, then the effectiveness of the facilities planning will be the maximum because new facilities will reduce the cost of material handling and the cost of transportation by 10% to 30%.Since facilities planning has major role in the productivity and the effectiveness of the entire production system, so the investment it requiresishuge.Now,facilitiesplanningrequirehugeamountofinvestment,itisthisfact,that thefacilitiesplanningisthetopicforsearch.Thatis,mostoftheindustrieshavethesamesearch topic, how facilities planning can be made more effective'? Because huge investment is involved the importance of facilities planning is obviously raised. Facilities Planner considers thefacilityasadynamicentity.Thereforecontinuousimprovementisanintegralelementof FP cycle[12].

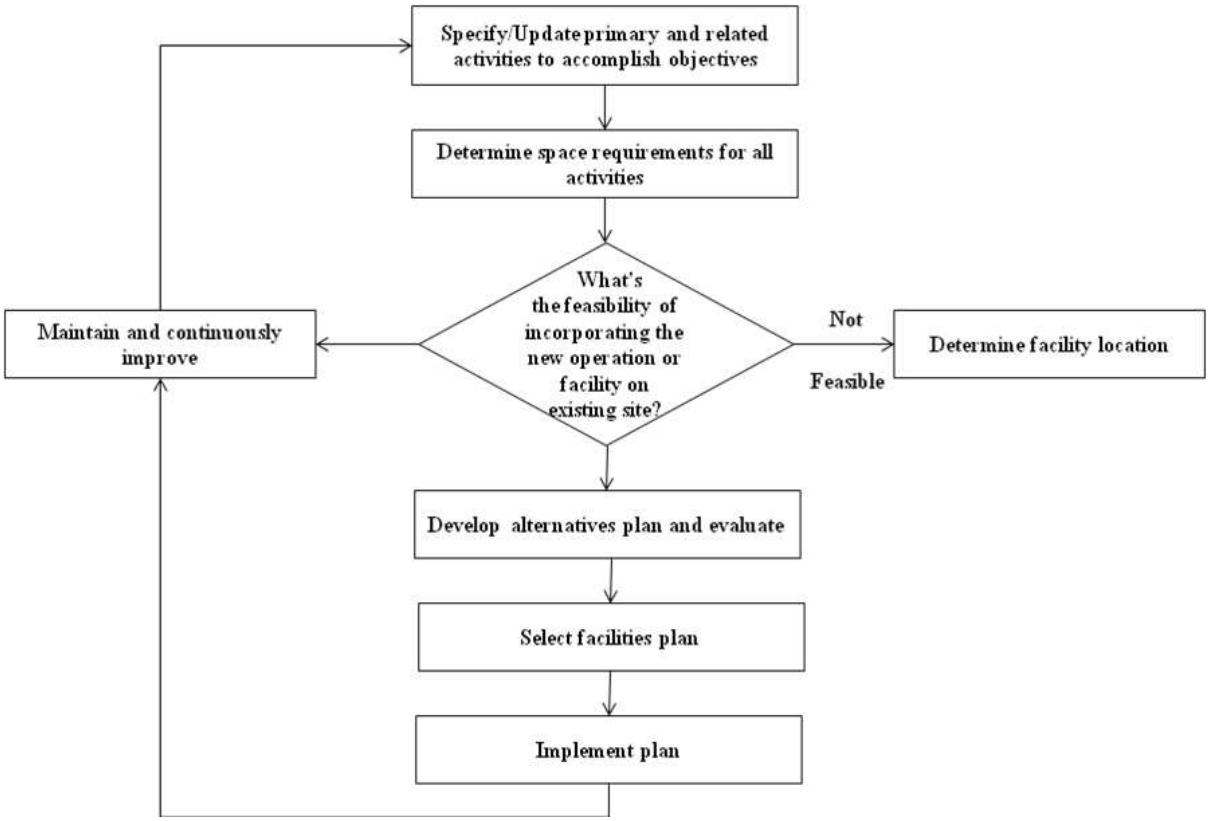

Figure 1 Continuous improvement facilities planning cycle

III. ALGORITHM FOR FLEXIBILITY IN LAYOUT DESIGN

Algorithm for flexibility in layout design is detailed in this section. This algorithm considers the material flow as input data then channelizes the layout and reschedule the flows[14]. This is done so that the transportation cost is reduced. So the main function of algorithm is to reduce the transportation costs there by reducing the total material flow. If there is any unexpected material flow, it can be kept in check by this algorithm. This algorithm thus provides various profits-channelizingthelayoutwillprovideforre-structureorre-scheduleandre-schedulewill further provide for reduction in total handling cost of the material[13,15].

Problem Statement and Modelling

Now the difficulty arising in the process plant for optimizing the total material handling cost gives many possible future material flows. The material flows can have the different cost per unit distance[16,17].

The final equation is as follows:

$$\text{Minimum } T = \sum_{i=1}^{n} \sum_{j=1}^{n} fijdijcij$$

ISSN: 2278-4632
Vol-11 Issue-02 2021

Where:

f_{ij}=frequency/quantity of flow

c_{ij}=cost to flow one unit load per unit distance between two machines

d_{ij}=distance amid machine *i* and *j*

Considering the cost c_{ij} remain steady, the aim would be reduced to minimizing the total distance travelled for the parts.

Example of three machine layout:

There are six possibilities for three machine layout that is given below in Table-1:

Table 1 Three machine layout

1	2	3
1	3	2
2	1	3
2	3	1
3	1	2
3	2	1

Table-2 Material handling cost calculation for three machine layout

1	2	3	*f12*d12+f13*d13+f21*d12+f23*d23+f31*d13+f32*d23*
1	3	2	*f13*d12+f12*d13+f31*d12+f32*d23+f21*d13+f23*d23*
2	1	3	*f21*d12+f23*d13+f12*d12+f13*d23+f32*d13+f31*d23*
2	3	1	*f23*d12+f21*d13+f32*d12+f31*d23+f12*d13+f13*d23*
3	1	2	*f31*d12+f32*d13+f13*d12+f12*d23+f23*d13+f21*d23*
3	2	1	*f32*d12+f31*d13+f23*d12+f21*d23+f13*d13+f12*d23*

Below is flow matrix and distance matrix considering “c” as a unit cost in table 2:

Table 3 Flow and Distance Matrix of three machine layout

fij	1	2	3	dij	1	2	3
1	-	2	4	1	-	1	3
2	6	-	3	2	1	-	2
3	5	1	-	3	3	2	-

$$Minimum\ T = \sum_{i=1}^{n}\sum_{j=1}^{n} f_{ij}d_{ij}c_{ij}$$

Table 4 Transportation cost for three machine layout

`Layout			T
1	2	3	38
1	**3**	**2**	**37**
2	1	3	43
2	3	1	43
3	1	2	47
3	2	1	46

ISSN: 2278-4632
Vol-11 Issue-02 2021

Here we can see that the layout 1-3-2 is most optimum layout.

Example of four machine layout

There are 24 possibilities for four machine layout that is given below in Table-5:

Table 5 Material handling cost calculation for four machine layout

1-2-3-4	f12*d12+f13*d13+f14*d14+f21*d12+f23*d23+f24*d24+f31*d13+f32*d23+f34*d34+f41*d14+f42*d24+f43*d34
1-2-4-3	f12*d12+f14*d13+f13*d14+f21*d12+f24*d23+f23*d24+f41*d13+f42*d23+f43*d34+f31*d14+f32*d24+f34*d34
1-3-2-4	f13*d12+f12*d13+f14*d14+f31*d12+f32*d23+f34*d24+f21*d13+f23*d23+f24*d34+f41*d14+f43*d24+f42*d34
1-3-4-2	f13*d12+f14*d13+f12*d14+f31*d12+f34*d23+f32*d24+f41*d13+f43*d23+f42*d34+f21*d14+f23*d24+f24*d34
1-4-2-3	f14*d12+f12*d13+f13*d14+f41*d12+f42*d23+f43*d24+f21*d13+f24*d23+f23*d34+f31*d14+f34*d24+f32*d34
1-4-3-2	f14*d12+f13*d13+f12*d14+f41*d12+f43*d23+f42*d24+f31*d13+f34*d23+f32*d34+f21*d14+f24*d24+f23*d34
2-1-3-4	f21*d12+f23*d13+f24*d14+f12*d12+f13*d23+f14*d24+f32*d13+f31*d23+f34*d34+f42*d14+f41*d24+f43*d34
2-1-4-3	f21*d12+f24*d13+f23*d14+f12*d12+f14*d23+f13*d24+f42*d13+f41*d23+f43*d34+f32*d14+f31*d24+f34*d34
2-3-1-4	f23*d12+f21*d13+f24*d14+f32*d12+f31*d23+f34*d24+f12*d13+f13*d23+f14*d34+f42*d14+f43*d24+f41*d34
2-3-4-1	f23*d12+f24*d13+f21*d14+f32*d12+f34*d23+f31*d24+f42*d13+f43*d23+f41*d34+f12*d14+f13*d24+f14*d34
2-4-1-3	f24*d12+f21*d13+f23*d14+f42*d12+f41*d23+f43*d24+f12*d13+f14*d23+f13*d34+f32*d14+f34*d24+f31*d34
2-4-3-1	f24*d12+f23*d13+f21*d14+f42*d12+f43*d23+f41*d24+f32*d13+f34*d23+f31*d34+f12*d14+f14*d24+f13*d34
3-	f31*d12+f32*d13+f34*d14+f13*d12+f12*d23+f14*d24+f23*d13+f21*d23+f24*d34+f43*d14+f41*d24+f42*d3

ISSN: 2278-4632
Vol-11 Issue-02 2021

1-2-4	4
3-1-4-2	f31*d12+f34*d13+f32*d14+f13*d12+f14*d23+f12*d24+f43*d13+f41*d23+f42*d34+f23*d14+f21*d24+f24*d34
3-2-1-4	f32*d12+f31*d13+f34*d14+f23*d12+f21*d23+f24*d24+f13*d13+f12*d23+f14*d34+f43*d14+f42*d24+f41*d34
3-2-4-1	f32*d12+f34*d13+f31*d14+f23*d12+f24*d23+f21*d24+f43*d13+f42*d23+f41*d34+f13*d14+f12*d24+f14*d34
3-4-1-2	f34*d12+f31*d13+f32*d14+f43*d12+f41*d23+f42*d24+f13*d13+f14*d23+f12*d34+f23*d14+f24*d24+f21*d34 132
3-4-2-1	f34*d12+f32*d13+f31*d14+f43*d12+f42*d23+f41*d24+f23*d13+f24*d23+f21*d34+f13*d14+f14*d24+f12*d34
4-1-2-3	f41*d12+f42*d13+f43*d14+f14*d12+f12*d23+f13*d24+f24*d13+f21*d23+f23*d34+f34*d14+f31*d24+f32*d34
4-1-3-2	f41*d12+f43*d13+f42*d14+f14*d12+f13*d23+f12*d24+f34*d13+f31*d23+f32*d34+f24*d14+f21*d24+f23*d34
4-2-1-3	f42*d12+f41*d13+f43*d14+f24*d12+f21*d23+f23*d24+f14*d13+f12*d23+f13*d34+f34*d14+f32*d24+f31*d34
4-2-3-1	f42*d12+f43*d13+f41*d14+f24*d12+f23*d23+f21*d24+f34*d13+f32*d23+f31*d34+f14*d14+f12*d24+f13*d34
4-3-1-2	f43*d12+f41*d13+f42*d14+f34*d12+f31*d23+f32*d24+f14*d13+f13*d23+f12*d34+f24*d14+f23*d24+f21*d34
4-3-2-1	f43*d12+f42*d13+f41*d14+f34*d12+f32*d23+f31*d24+f24*d13+f23*d23+f21*d34+f14*d14+f13*d24+f12*d34

Table 6 Flow and Distance Matrix of four machine layout

fij	1	2	3	4	dij	1	2	3	4
1	-	5	6	2	1	-	3	5	7
2	3	-	6	5	2	3	-	2	4

ISSN: 2278-4632
Vol-11 Issue-02 2021

3	4	6	-	2	3	5	2	-	3
4	2	5	8	-	4	7	4	3	-

n n

Minimum T = ∑ ∑ fijdijcij

i=1 j=1

Table 7 Transportation cost for four machine layout

`Layout				T
1	2	3	4	196
1	2	4	3	212
1	**3**	**2**	**4**	**192**
1	3	4	2	204
1	4	2	3	218
1	4	3	2	214
2	1	3	4	220
2	1	4	3	236
2	3	1	4	218
2	3	4	1	214
2	4	1	3	232
2	4	3	1	212
3	1	2	4	222
3	1	4	2	234
3	2	1	4	224
3	2	4	1	220
3	4	1	2	236
3	4	2	1	220
4	1	2	3	224
4	1	3	2	220
4	2	1	3	214
4	2	3	1	194
4	3	1	2	212
4	3	2	1	196

Here we can see that the layout 1-3-2-4 is most optimum layout.

IV. RESULT & CONCLUSIONS

A. Initialization

Input data: Flow matrix and Distance matrix.

B. Calculation of TransportingCost

It is found that arrangement 1-3-2(For three machine layout), 1-3-2-4 (For four machine layout) is optimum flow path.

V. CONCLUSION

The explicated attributes of algorithms and computer based system explained in this study, exemplify the importance of the flexibility for the layout design. The study performed in this

ISSN: 2278-4632
Vol-11 Issue-02 2021

researchwithalltypeofillustrationsalongwiththehighly-developedcomputerbasedprogram is not only highly useful for the researchers and designers but also exceptionally sort after for flexible layoutdesign.

This approach is method based. In a functioning plant many factors are required to be considered. Like aisle-arrangement, office requirements, personnel requirements- such as-lockers,restrooms,foodservices,healthservicesetc.Thisincludesthematerialhandlingcosts aswell.

REFERENCES

[1] McLean,C.Kibira,D.2002.Virtualrealitysimulationofamechanicalassemblyproduction line. Proceeding of the 2002 Winter Simulation Conference. Page1130-1137.
[2] Taha, Z. Tahriri, F. 2008. A classification of different type of facility layout design. Proceeding of Asia pacific conference on management of technology and technology entrepreneurship. Page1-5.
[3] Balakrishnan.J,Cheng,C.H.;2007.Multi-periodplanninganduncertaintyissuesincellular manufacturing: A review and future directions, European Journal of Operational Research. Ed.177. page281–309.
[4] Chang-sik, Seong-Hoon, 2015, Deciding the Optimal Operation Patterns of Steelmaking FacilitiesusingaNetworkDiagram,IndianJournalofScienceandTechnology,Vol8(S1), 346-352, January2015
[5] Huang, H. 2003. Facility layout using layout modules, Ph.D. Thesis, The Ohio State University.
[6] Jungdae Suh, Material Flow Control Procedure Considering the Status Information of Transporters, Indian Journal of Science and Technology, Vol 8(25), DOI: 10.17485/ijst/2015/v8i25/80224, October 2015
[7] Tompkins, J. A., 2003. Facilities planning. New York: John Willey andSon.
[8] Hassan.M,1994.Layoutdesigningrouptechnologymanufacturing.ElsevierInternational journal of Production Economics. Revised 1 July 1994. Pp173-188.
[9] Jang J, Suh J, Ferreira P. An AGV routing policy reflecting the current and future state of semiconductor and LCD bproduction lines. International Journal of Production Research. 2001; 39(17):3901–21.
[10] Jang J, Suh J, Liu CR. A look-ahead routing procedure for machine selection in a highly informative manufacturing system. InternationalJournal
[11] Zuhdi, A, Taha, Z. 2008. Simulation Model of Assembly System Design. Proceeding Asia Pacific conference on management of technology and technologyentrepreneurship.
[12] Rieth, D. Gerlach, S., 1996. Planning and controlling of fexible assembly systems for automotive industry. Proceeding of the IEEE International Symposium onComputer-aided Control System Design, Dearborn, September 1996,15-1
[13] Abhishek Kumar Jain, Dr. P M Mishra, "Dynamic approach of facility layout considering replacement analysis", International Journal of Science and Research Vol. 4 Issue 5, ISSN (online):2319-7064,2015
[14] Abhishek Kumar Jain, Dr. P.M.Mishra "Optimum Facility Design Considering Flow Obstruction"InternationalJournalofAdvancedMechanicalEngineering,ISSN2250-3234,
[15] Vol.4, No.7, 2014
[16] Abhishek Kumar Jain, Dr. P.M.Mishra Dr. V.K.Khare "Facility Planning and associate problem : A Review" Innovative Systems Design and Engineering, ISSN 2222-1727 (Paper) ISSN 2222-2871 (Online), Vol.4, No.6,2013
[17] Burra Karuna Kumar, Dega Nagaraju, S. Narayanan "Supply Chain Coordination Models: ALiteratureReview"IndianJournalofScienceandTechnology,Vol9(38),ISSN(Online)
[18] : 0974-5645
[19] Prabhat Kumar Sinha, Vijay Kumar Yadav*, Saurabha Kumar, Rajneesh Pandey, Static Analysis of Complex Structure of Beams by Interpolation Method Approach To Matlab. International Journal of Electrical Engineering & Technology, 5(5), 2014, pp.28-44.
[20] Dr. B. H. Jain, Mr. M.M. Ansari and Vikas Pralhad Patil, Evaluate PV Panel Performance Enhancement with Matlab. International Journal of Electrical Engineering & Technology, 6(7), 2015, pp.23-37
[21] Abhishek Kumar Jain, Dr. P.M.Mishra "Integration And Optimization Of Facility Design Considering Replacement Analysis" Indian Journal of Science and Technology, *Vol 9(S1), December 2016, ISSN (Print) :0974-6846.*