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A ZERO AND ONE MIXED MATHEMATICAL MODEL FOR DETERMINE THE OPTIMAL LAYOUT IN ADVANCED MOLD ASSEMBLY UNIT IN THE IRAN KHODRO FACTORY

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Abstract

The equipment layout is one of the most important issues in the manufacturing company, because with the proper alignment equipment can reduce material transportation costs significantly. This article presents a mathematical model to determine optimal facilities layout in advanced mold Iran Khodro factory's assembly unit. The model mentioned model is kind of zero and one mixed that is derived from Tompkins. The objective function of model is to minimize transportation costs. The model is solved by Lingo software and its output determines the best location of machines.

Keywords: Facilities, Facilities Layout, Zero and one modelling.

1. Introduction

One of the most important issues affecting the progress of work and reduce production costs is type of layout and layout issues. There are numerous articles on the problem the establishment of factories. Most of the Articles set of attitudes that by industrial engineers are provided in solving establishment of the plant used since the early 1900s. Before analytical approaches have recently been proposed, the traditional methods and solutions often were relying on empirical perspectives. However, some of the views that are already available are important. We examine the role of these two views in the layout design (Seyyed Hoseini, 1999). Poor handling equipment is one of the causes of inefficiency in production. For example, in one of the factories have moved production of raw materials to the warehouse and then transported to the warehouse and finally, preserved in another place. In a layout process based on raw materials during construction must be transferred between different units that Resulting is increases unnecessary cost form of inventory, production delays and etc, will happen. Suitable locating of facilities and work place design, the will increase of goods and services an organization. Some of the main objectives of locating facilities include reduced transportation costs, inventory carrying work in process, minimize the investment in equipment, better use of space and improve employee morale. (Seyyed Hoseini, 2005).

One of the definitions that have been proposed for locating states that purpose of locating is identifying, selecting and specifying the equipment necessary to perform various operations and specify the size, shape and dimensions and finally put them in the optimum location at the time the project is achieved. (Entezarkheir, 2008). Another definition states that the site layout locating reflects the relation between the workshop to their environment with respect to communication, access roads and equipment. (Shen, 2004). Elsewhere expressed that the workshop layout or equipment is operations, actions and Supply that should be implemented on a temporary basis for the period to initiate and perform the Subject of the contract, according to the documents. (Pour Moghaddam, 2010). The facility represents an exponential fit the specific physical facilities. The aim of facilities locating study is:

A). Minimize delays in material handling, flexibility, more efficient use of space and labor and increasing employee morale

When it is necessary to:

1. A new facility to be built
2. There is a general shift in production volume.
3. New product launch.
4. Various processes and equipment to be installed. (Seyyed Hoseini, 2005)

B). Locating types are mentioned below are six general categories:

1. Locating on the basis of a fixed place
2. Locating on the product
3. Locating on the process
4. Locating cell or group
5. Locating based on flexible manufacturing systems
6. Locating based on multiple assembly lines (Jaafar Nejad, 2006).

In articles and researches in the field of placement and arrangement of various mathematical methods, including statistical methods, methods of solving optimization and simulation models, heuristic methods such as genetic algorithms have been used.

In this regard, the results of which are:

Aryafar (2002) Importance of locating the facility in cellular manufacturing system aims to provide and develop a model for the facility's layout issues, that total cost of the between cellular and intercellular transport at the same time is considered. The superiority of this model than Wang's model uses two algorithms AS1 and AS2 to for solving model.

Ramezani (2002) to determine the optimal placement distribution substations genetic algorithm optimization method is used. In order to optimize the structure of the construction costs to be minimized and practical limits in urban areas. A new method has been used for coding the decision variables in which the chromosome structure is flat. To obtain the optimum capacity load factor of transformer substations selected a limited time, you can post. GA method is used to solve model.

Gholizadeh (2006) point out to the importance of civil equipping plan in workshops and the cost of the projects referred fate. The correct arrangement saves the high cost of projects. He used an harmony algorithms to achieve optimal arrangement. Layout View Figure priority would be nice to fix the problems with the current algorithms. With the introduction of several new operators can be quickly algorithms search engines increased harmony and to achieve optimal arrangement.

(Huijun, 2008) to solve the problem of locating distribution centers used of bi-level programming method. In this method, the interests of customers and distributors are considered together. He noted that the model to a numerical example shows the effectiveness of the models and variables are as 0 and 1.

(Yurdakul, 2005) Using the TOPSIS and AHP approach in the field of performance evaluation to identify the characteristics and these characteristics to be compared with the best company and also introduced abilities that help to company in the long-term.

(Schmidt, 19980) To find the optimal facility layout as the economy picks up and operational arrangements should be persuasive. The CAD software is for layout design used, but is not for optimized. Heuristic methods, statistical data and new algorithms are for layout.

(Wei Xie, 2008) stated that prototypes entered are not suitable for problems with inequality facilities. CFL models introduced for eliminate of limitations. He has provided a branch and bound algorithm for solving the problem of minimizing costs without limitation rectangular layout and its development.

2. Materials and Methods

Locating equipment, studying for determine M machine for N situation of machineries in manufacturing company. So that N≥M. During the process of making material flow will be diverted from one machine to another, until all the processes have to be completed. After solving issues for layout, to minimize total of material transportation in production. Systems.

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Assumptions of the model:

1. All facilities have a rectangular geometric shape and are fixed.
2. Each of the facilities in both horizontal and vertical deemed.
3. Linearly broken between manufacturing facilities and facility centers are measured.
4. Factory floor for is fixed size (width) in (long) that encompass all facilities, and there is no overlap between facilities.
5. All dimensions must be measured integer.
6. One type of facility can be up or down or left and right are each facility.
7. The shape and workshop space does not create any restrictions on issues.
8. The objective function based on the distance between the sectors.
9. Locating is in a continuous presentation space.
10. Process flow data is intended Static and deterministic.

Indexes:

i =Machineries and facilities No.
j = Machineries and facilities No.

The model parameters:

Bx= Building long
By= Building width
Ai= Machine area i
Li= Machine long i
Wi= Machine width i
M= big number

The decision variables of the model:

Ai= Coordinates X machine i gravity Center
Bi= Coordinates y machine i gravity Center
x'i= Coordinates X machine i left.
x"i= Coordinates X machine i right.
y'i= Coordinates y machine i down.
y"i= Coordinates y machine i up
zxij= Is equal to 1 if Machin I is completely right of machine j . Otherwise is 0.
zyij= Is equal to 1 if Machin I is completely up of machine j . Otherwise is 0.

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The objective function and constraints:

Minimize $Z = \Sigma i \Sigma j\ fc\ (|\alpha i - \alpha j|) + (|\beta i - \beta j|)$

Subject to:

$xi'' - xi' = Li$ for all i -1
$yi'' - yi' = Wi$ for all i -2
$0 \leq xi' \leq xi \leq BX$ for all i -3
$0 \leq yi' \leq yi'' \leq By$ for all i -4
$.5xi' + .5xi'' = \alpha i$ for all i -5
$.5yi' + .5yi'' = \beta i$ for all i -6
$xj'' \leq xi' + M\ (1 - zxij)$ for all i & j, $i \neq j$ -7
$yj'' \leq yi' + M\ (1 - zyij)$ for all i & j, $i \neq j$ -8
$zxij + zxji + zyij + zyji \geq 1$ for all i & j, $i < j$ -9
$\alpha i\ , \beta i \geq 0$ for all i -10
$xi', xi'', yi', yi'' \geq 0$ for all i -11
zxij, zyij 0/1 binery for all i & j, $i \neq j$ -12

3. Results and Discussion

The factory-assembled unit due to problems in this study is investigated. The dimensions of the hall are:

Hall length = 18 m (3.5 m because of the Gun machine use, is prohibited).

Hall width = 6/5 m.

The hall has 14 facilities, including 8 original Machines (1Drill machine, 1 F1 machine, 1 F2 machine, 1 F3 machine, 2 F4 machines, 1 F5 machine.). 6 pallets, semi-finished material storage racks. In modeling are studied.

To solve the model constants and parameters must be defined so as to be unknown variables.

Data collected of advanced mold Iran Khodro factory. Using Lingo software model which can be solved in a couple of facilities are coordinates

1 - (52/5, 77/5)	2 – (106/5, 57/5)	3 – (298, 65)
4 – (298, 195)	5 – (437 57/5)	6 – (556, 98/5)
7 – (675, 57/5)	8 – (824, 95)	9 – (815 419/5)
10 – (676 267)	11– (676 407)	12 (537, 419/5)
13 – (415/5 3890	14 – (273 402)	

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Optimal solution is:

Min z= 174960

Model validation:

For validity of the resulting of model answer to compare with the real situation.

Handling costs in the current layout assembly is as follows:

Min z=

80 (|a1-a2|+|β1-β2|) + 40 (|a2-a3|+|β2-β3|) + 40 (|a2-a4|+|β2-β4|) + 40 (|a3-a5|+|β3-β5|) + 40 (|a4-a5|+|β4-β5|) + 80 (|a5-a6|+|β5-β6|) + 56 (|a6-a7|+|β6-β7|) + 56 (|a7-a8|+|β7-β8|) + 56 (|a8-a9|+|β8-β9|) + 32 (|a9-a10|+|β9-β10|) + 32 (|a9-a11|+|β9-β11|) + 32 (|a10-a12|+|β10-β12|) + 32 (|a11-a12|+|β11-β12|) + 56 (|a12-a13|+|β12-β13|) + 56 (|a13-a14|+|β13-β14|)

Z=

80(|385 |+|0|) + 40 (|155|+|230|) + 40 (|170|+|230|) + 40 (|155|+|200|) + 40 (|170|+|200|) + 80 (|200|+|210|) + 56 (|115|+|170|) + 56 (|190|+|185|) + 56 (|150|+|200|) + 32 (|200|+|155|) + 32 (|190|+|170|) + 32 (|175|+|130|) + 32 (|200|+|115|) + 56 (|100|+|175|) + 56 (|305|+|300|)

Z= 272560 ⟹ Z= 272560 ≥ 174960

Given that the answer obtained from the model is less than the actual state, so model is a valid.

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Locating of model solution: After salving of model and obtained results, the layout of the model salving is as follows:

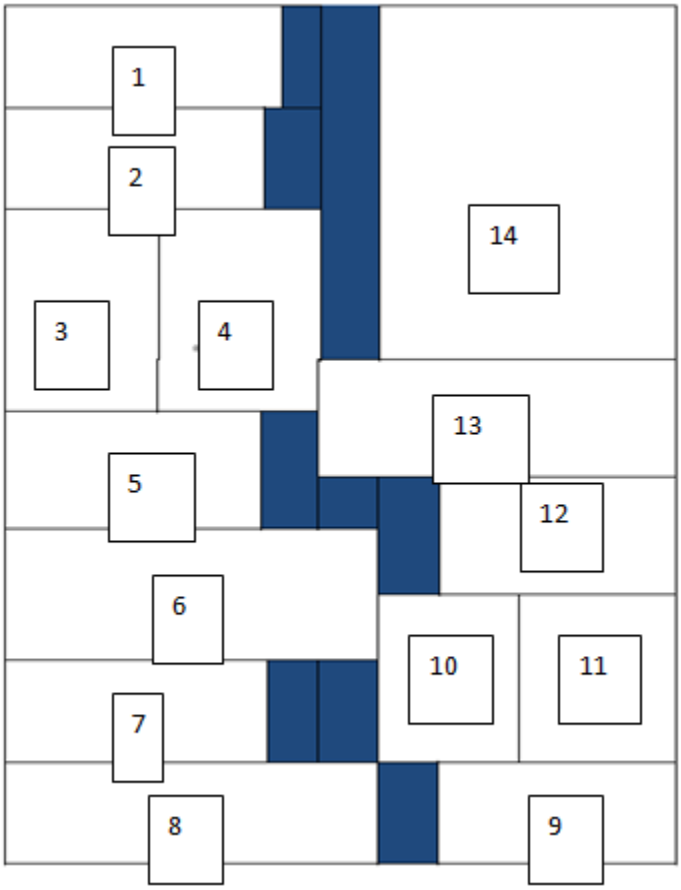

Fig 1. The layout of the model solution by Lingo

Locating importance of reducing costs and raising competitiveness of enterprises in production is no covered. Eventually leading to organizational efficiency, increasing information flow and the efficiency of staff. Each company should attend to conditions and restrictions in locating. In this regard, the answer obtained from the model 0 and 1 leads to an optimized layout was using mathematical programming. The mentioned company can be according obtained answers of model and respect to current situation to displace facilities layout. These changes as the optimal arrangement shown in Figure 1.

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