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The Way of Establishing a Relative Position for Some Production Units

The CRAFT Method was at the basis of the development of the heuristic commuting models, in which one starts from an initial emplacement of units that is successively improved, through the successive commuting of units among them on the basis of some criteria. In the present paper we have resolved to the Facility Location and Layout module of the WinQSB program that uses the CRAFT Method in solving problems of the Functional Layout type.

***Keywords**: initial emplacement, efficiency, relative position, rectilinear model.*

1. Introduction.

The methods used for establishing the relative position of units can be grouped according to their methodological content in: heuristic methods and mathematical methods.

The heuristic methods are based on methodological guidance through which rational search criteria is applied to some placement variants.

These methods are classified, according to the search way of the rational variant of placement, in constructive and commuting methods.

Within the heuristic constructive methods, the placement variant is iteratively carried out, at each utterance a unit being placed, whose position is determined in respect to the others already emplace, on the basis of a criterion.

Within the heuristic commuting methods, one starts from an initial emplacement of the units, that is later on improved, also on the basis of some criteria, through the successive commuting of the units among them. The CRAFT Method is at the basis of the development of these types of methods.

2. The problem data.

One must establish the relative position of 6 production units, whose surfaces are given in table 1 and in the „de la-la" diagram (figure 1) are given the existing fluxes among them. In figure 2 the actual emplacement of these production units is presented.

The manager wishes the change of the emplacement for the production units, in order to make the institution more efficient.

Table 1.

Unit	Surface (elementary squares)
A	16
B	8
C	10
D	6
E	2
F	6

De la \ la	A	B	C	D	E	F	Total
A		10	5	20	0	10	45
B	5		15	0	10	5	35
C	10	0		10	5	5	30
D	0	5	10		15	5	35
E	15	10	5	0		10	40
F	10	20	0	5	10		45
Total	40	45	35	35	40	35	230

Figure 1. The De la-la diagram

The centres of the units are: A: (4; 3), B: (10; 3), C: (2.5; 1), D: (6.5; 1), E: (8.5; 1), F: (10.5; 1).

In order to solve this problem we must firstly establish the way in which to compute the distance between two locations i and j, whose coordinates are: (x_i, y_i) and (y_j, y_j). The distance between these can be computed by using one of the models: rectilinear, Euclidian and square Euclidian.

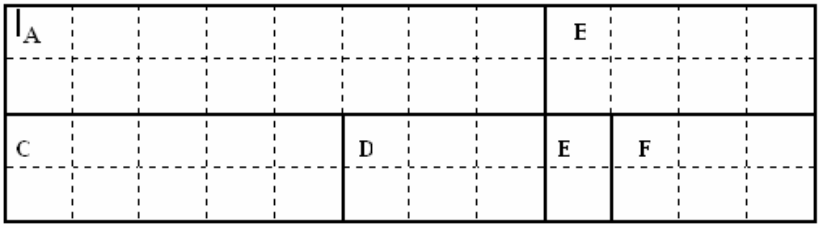


Figure 2. The actual emplacement of the production units

In such problem on uses the rectilinear model, generally when the emplacement is done after a grid of rectangular figures.

The distance between production units in the case of the initial emplacement is thus computed:

$$A - B = |4 - 10| + |3 - 3| = 6 \quad (1)$$
$$A - C = |4 - 2.5| + |3 - 1| = 3.5 \quad (2)$$
$$A - D = |4 - 6.5| + |3 - 1| = 4.5 \quad (3)$$
$$\vdots$$
$$E - F = |8.5 - 10.5| + |1 - 1| = 2 \quad (4)$$

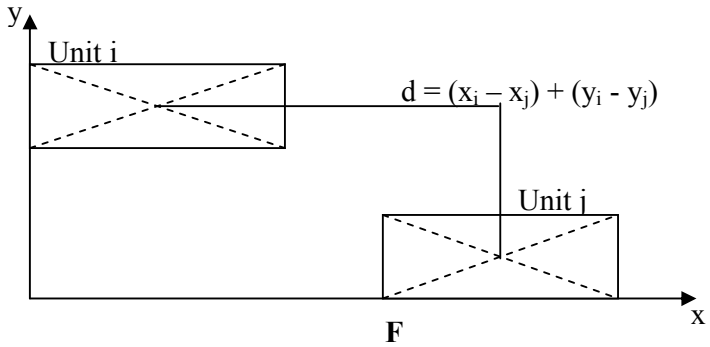


Figure 3. The computing of the distance between units i and j

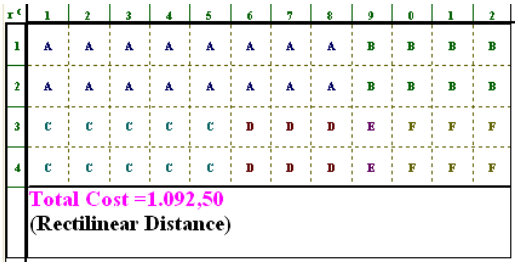
The change of the emplacement of production units must take into account the fact that the whole surface of the institution cannot be modified, but the way to emplace one towards another can be modified, as well as the form of the different units.

In order to place more efficiently the production units' one must know the fluxes between them (materials fluxes, human resources fluxes, informational fluxes). If the interaction of some fluxes in greater, these ones will be placed as close as possible one from another.

3. The solving of the problem by using WinQSB.

The problem, previously presented can be solved by using the program WinQSB and the module Facility Location and Layout.

After introducing the entrance data we obtain the initial emplacement (fig.4) of the production units, previously depicted in figure 2.



x	1	2	3	4	5	6	7	8	9	0	1	2
1	A	A	A	A	A	A	A	A	B	B	B	B
2	A	A	A	A	A	A	A	A	B	B	B	B
3	C	C	C	C	C	D	D	D	E	F	F	F
4	C	C	C	C	C	D	D	D	E	F	F	F

Total Cost =1.092,50
(Rectilinear Distance)

Figure 4. The initial emplacement of the units

The distances between production units, according to the initial emplacement are presented in figure 5.

10-10-2010 21:12:21	To A	To B	To C	To D	To E	To F	Sub Total
From A	0	6	3,50	4,50	6,50	8,50	29
From B	6	0	9,50	5,50	3,50	2,50	27
From C	3,50	9,50	0	4	6	8	31
From D	4,50	5,50	4	0	2	4	20
From E	6,50	3,50	6	2	0	2	20
From F	8,50	2,50	8	4	2	0	25
Sub-Total	29	27	31	20	20	25	152

Figure 5. The distance between the production units

The solving key for the given problem, offered by WinQSB are the following (fig.6):

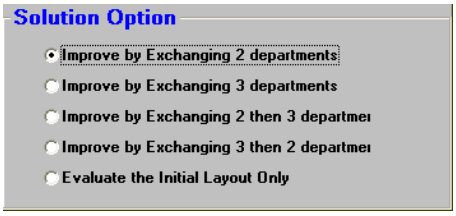


Figure 6. The dialogue box Functional Layout Solution

We choose as a first option for solving the problem the simultaneous change of the emplacement of two production units. After changing location A with C, we obtain the emplacement presented in figure 7, with a cost of 1079.13 u.m., 13.37 u.m. lower than the initial cost.

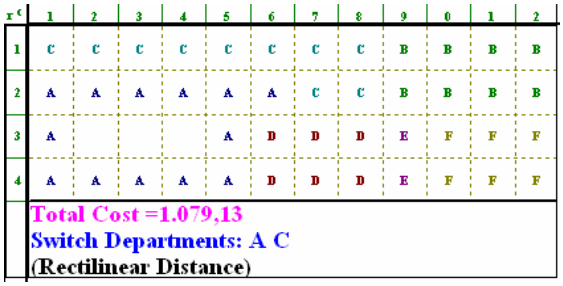


Figure 7. The change of the emplacement of units A with C

Then changing units A with D we obtain a new emplacement proposed by WinQSB, with a lower cost.

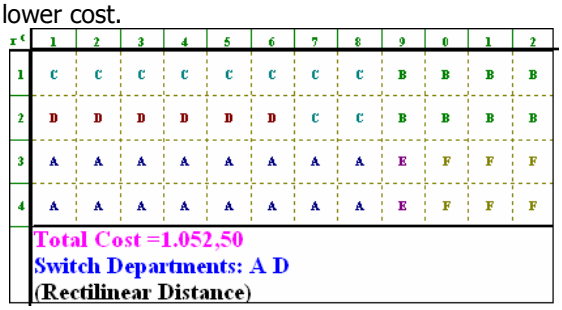


Figure 8. The change of the emplacement of units A with D

In figure 9 one may notice the computed centres for each of the compartments.

10-10-2010 23:34:55	Department Name	Center Row	Center Column	Flow To All Departments	Cost To All Departments
1	A	3,50	4,50	45	209,50
2	B	1,50	10,50	35	173
3	C	1,20	5,10	30	125,00
4	D	2	3,50	35	211,50
5	E	3,50	9	40	153,50
6	F	3,50	11	45	180
	Total			230	1.052,50
	Distance	Measure:	Rectilinear		

Figure 9. Results → Show Layout Analysis

We choose in turn the other options for solving, presented in figure 6 and we try to obtain a better solution to the problem if it is possible. All variants are tried and the optimal one is chose, which improves the objective function the most through the change of the position for the three compartments; the change of 2 and then 3 compartments and lastly the change of 3 and then 2 compartments.

4. Conclusion

We have started from an initial variant represented in figure 4, with a cost of 1092.5 u.m. All solving solutions offered by WinQSB were used, and they have given the following results:

- The optimal emplacement of the production units is the one represented in fig. 6, offered by three of the four problem solving solutions.
- The production units B, E and F remain exactly on the initial positions, the only units being commuted were A with C and D.
- The cost dropped to 1052.2 u.m., by 40 u.m. in respect to the initial variant.

References

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