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Application of assignment Model and its Solution using QSB in Selecting among Offers

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Introduction:

The resource allocation process is a complex process that accompanies many projects that are referred to companies and primary and secondary contractors that face departments in government institutions in most countries of the world. This problem gets worse when scientific methods are not used in distribution and allocation, which complicates the completion of projects, delays the completion periods and the consequent certain responsibility and affects the fairness of the allocation and distribution process. In the current study, we seek to discuss the available and used scientific methods and methods within this framework and the methods that can be selected for application in Iraq in order to facilitate the completion of projects and reduce its cost and rapid achievement in addition to the introduction of modern methods and methods that enable Iraqi administrations to benefit from modern methods in scientific privatization processes.

The Quantitative System For Business (QSB) program has been chosen for its suitability for such cases and to encourage its use by government departments that refer different projects to contractors and different delivery agencies. The research also sought to apply the program to make the process of its application an opportunity for the concerned departments to train on the application process, which leads to improving the allocation process and keeping it away from randomness and avoiding the negative effects resulting from that.

Abstract :

The current research aims to study the possibility of applying the (QSB) program on how to allocate different resources to the works that require the assignment of various projects and contracting to business companies and primary and secondary contractors and the distribution of resources to the various bodies concerned with implementation according to fair methods that take into account the various factors and capabilities available to these bodies. Several scientific methods and methods for resource distribution methods were discussed, as well as the methods most consistent with the Iraqi reality and the selection of one of them. Therefore, the researcher came to the conclusion that there are ways that may harmonize with the Iraqi reality more than others, explaining the application requirements and techniques, explaining the application skills and its requirements.

Research structure:

The research consists of four sections, the first section includes the research methodology, diagnosis of the main problem, research objectives an

d hypotheses. The second topic includes the theoretical side and literature review. The third topic discusses the practical side and the associated applications. In the fourth topic, the research discusses the conclusions of the research and the necessary recommendations.

Part (1)Research Methodology

1. Research Problem:

Anwar Al-Bashaier Company, like other companies, is confronted with the problems of assigning resources or assigning secondary contractors to complete large projects referred to it by Basra Governorate. Despite the large amounts assigned for the completion of projects, planning methods for optimal assignment of resources, use, and selection of secondary contractors are still primitive methods that are no longer in line with the development and complexity of projects as well as increasing alternatives when making assignment decision.

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The project for the implementation of the heavy water sewerage system was forwarded to the company, a huge network amounting to 3 billion was assigned as a business cost only. The company has to make an important decision in selecting secondary contractors to implement a part of the project at the lowest possible costs.

2. Research Objectives:

The theoretical aspect of the research is aimed at presenting the method of using the assignment model and its solution using the Hungarian Method and resorting to Win QSB program to select secondary contractors in order to later popularize the use of this method in all the assignment decisions.

3. Research Hypothesis:

The adoption of the assignment model method in researching optimal decisions in solving assignment problems enables the company to reach the best decision in a short time and with easy effort, especially when using Win QSB.

4. Research Model:

The applied methodological research is based on a case study to apply a scientific method of resource assignment that relies on building a mathematical model and the use of a computer to achieve the optimal assignment.

In order to achieve the research objectives, a simplified presentation is made for the theoretical aspect of the assignment model and the other practical aspect included an application of secondary contractor assignment (identification) problems for the implementation of secondary contracting that is intended to be implemented by secondary contractors while ensuring that assignment is optimal within the use of Win QSB.

5. Research Importance:

The research's importance comes from the results of its application. A lot of effort and money can be saved using methods adapted in research, computer, and QSB program, solutions can be found with easy effort compared to random methods, or complete enumeration method, which became useless by a large number of alternatives available for the decision-maker. The optimal use of resources provided by this research method is a competitive advantage for any company in a competitive and scarce resources world.

Part (2)
Theoretical Aspect

The theoretical aspect of the research is aimed at presenting the method of using the assignment model and its solution using the Hungarian Method and resorting to Win QSB program to select secondary contractors in order to later popularize the use of this method in all the assignment decisions.

1-2 Assignment Model Concept:

The transporting model is a special case of the transportation models and is used by assigning resources for uses so that each resource has a single-use at the lowest cost or at the greatest profit where the assignment problem is represented by a square matrix (the number of rows is equal to the number of columns) and the matrix numbers represent the cost of using each resource for each use or profits of using each resource for each use.

2-2 General form and mathematical formulation:

Suppose the problem is assignment m (agent or job) to the number (n) machine were job assignment i (= 1, 2, …. m) on the machine j (= 1, 2 .... n) The cost cij and the goal is to assign jobs to machines and one job to a machine so as to achieve the lowest cost where the data are organized as the following table:

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Table (1) General form of assignment model

Machine

		1	2		n
	1	C11	C12	.....	C1n
Work	2	C21	C22		C2nWork
	. .	.		..	.
	.		.		
	m	Cm1	Cm2		Cmn

Mathematical the assigned model can be expressed as follows:

Let xij denote the assignment of facility i to job j such that

0 , if the i th facility is not assigned to j th job X i j

1 , if the i th facility is not assigned to j th job

Then the model is given by

Minimize=$\sum_{j=1}$ $\sum^{n}_{i=1}$ cij xij^{n}

= $\sum^{n}$ $\sum^{n}$ cij xij $_{i=1\ j=1}$

Subject to constraints:

$$\sum_{i=0}^{n} xij = 1, i = 1,2,3, \dots, n$$ (*one job is assigned to the i th Facility*)

Assigned to the i th facility

$$\sum_{i=0}^{n} xij = 1, j = 1,2,3, \dots, n$$ (*one Facility is assigned to the j th job and xij*

= 0 or 1 (or xij = xi^{2}j))

Is assigned to the j th job

And xij = 0 or 1 (or xij = xi^{2}j)

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1-3 Assignment problems solving methods

1. Complete Enumeration Method
2. Hungarian Method
3. Linear programming Method
4. Transportation Method

Our explanation will be limited to the first method for being common and the second method, which is the most appropriate for solving transport problems.

2-3-1 Complete Enumeration Method:

It is also called the Enumeration method, whereby all potential uses of available resources are calculated and the cost of each available alternative is found. The best option is to achieve the lowest cost when the goal is to minimize costs or maximize profits. This method is one of the easiest, but it isn't suitable to be used at present for being difficult to use due to many alternatives since the number of alternatives under this method is equal to (n!). If the problem consists of (6) resources and (6) uses, the number of alternatives will be 720, it's difficult to compare and choose optimally as resources and uses number increase, especially since there is a more appropriate and easier method that doesn't require special calculations by using a computer which is the Hungarian Method.

2-3-2 Hungarian Method:

This method is the best way to solve assignment models where the optimal solution is achieved according to the following steps:

1) Preparation of assignment table where resources are placed on one side of the table and uses on the other side. costs or profits are placed inside the cells of the table.
2) Achieve Balance: When the number of table rows is not equal to the number of columns then add a row or column, which is (depending on the need) to achieve balance (the number of rows is equal to the number of columns) the added row costs zero values.
3) Conversion of the matrix (table) to a cost table: When the table numbers represent profits, converted into costs by subtracting all values from the largest value in the table (to extract notional costs).
4) Subtract the lowest value in each row of all raw values.
5) Subtract the lowest value in each column of all column values.
6) Draw the lowest number of straight lines covering zero values. If the straight lines number is equal to the number of columns (which is equal to the number of rows), the solution is optimal. If the number of straight lines is not equal to the number of rows, then the smallest value is subtracted, not covered by straight lines, from all values not covered, then add the same value to the numbers located in the straight lines intersect. We repeat this step until straight lines number covering zero values are reached equal to columns number (optimal solution).
7) Assignment of resources to uses, it works by adopting the following steps:
   a) Start the assignment with a column or row that has zero value.
   b) Delete the zero values of the column or row whose resources have been assigned (so that it is not assigned again).
   c) Repeat steps (a) and (b) until the assignment is completed for all resources.
8) If resources are assigned to uses at a cost of zero values, then the assignment is optimal.
9) The assigned cost is the cost corresponding to the assigned in the last table in table I (cost table).

The following is a chart showing the steps:

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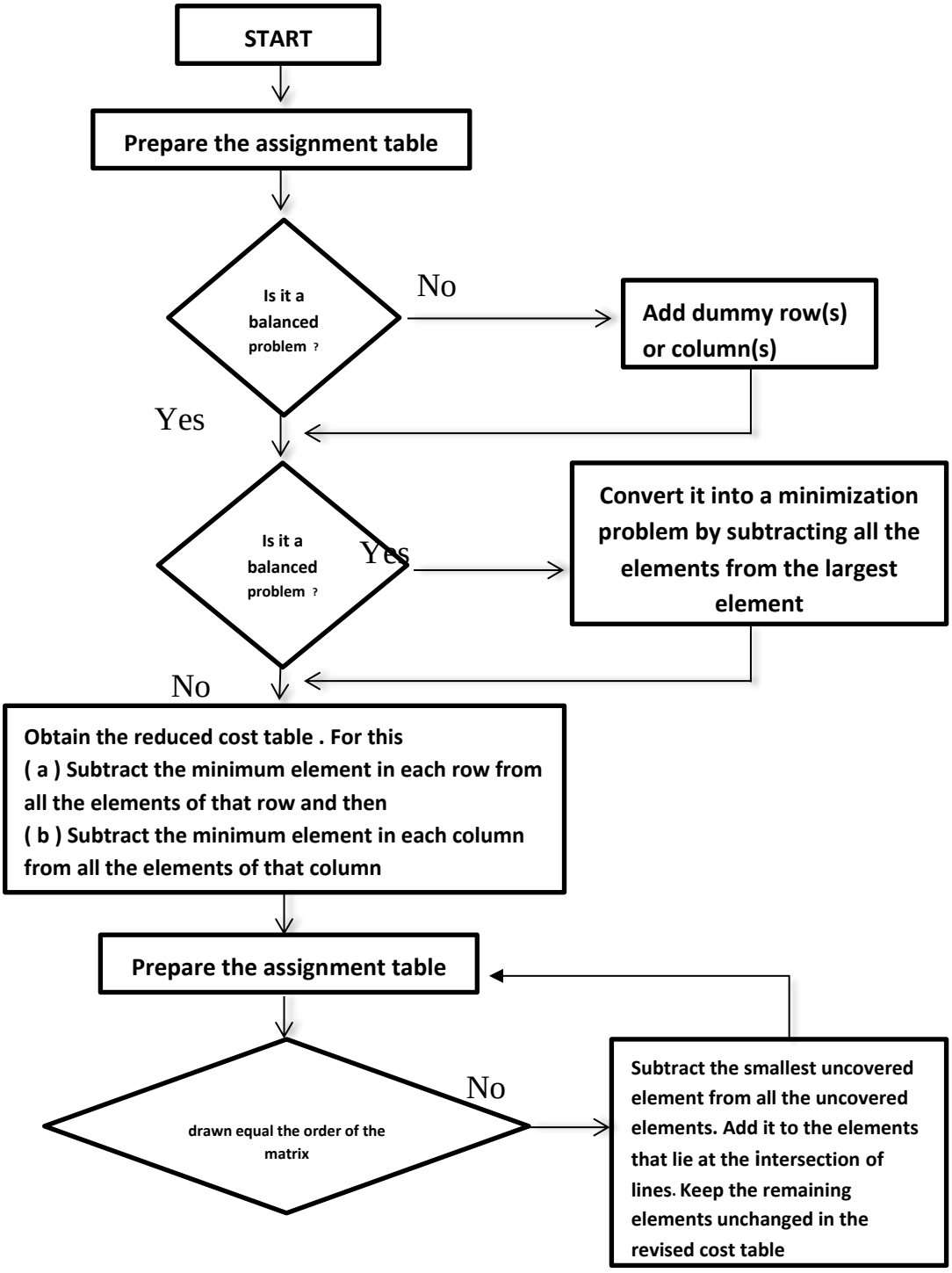
Flow chart of these steps is shown in Fig 4 1 below



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Dose the number of lines

Yes

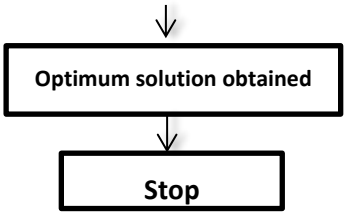

Fig . 4 . 1 Flow chart for Hungarian

2-4 Different cases of assignment model:

A. Maximization problems

The goal may not be to minimize costs. In some problems, the goal is to maximize profits. Then the profit matrix must be converted into a cost matrix (Notional costs), by subtracting all the values of the profit matrix from the largest values of the matrix and then following the steps referred to above. Profits are generated through the collection of profits corresponding to the assignment reached after the optimal solution is reached, i.e., adapt the profits contained in the first matrix and before converting them into the cost matrix.

B. Unbalanced problems:

When the given cost matrix is not a square matrix the assignment problem is called an unbalanced problem in such case a dummy row (s) or column (s) are added to the matrix (with Zeros as the cost elements) to make it square matrix. C.Multiple Solutions:

While making an assignment in the reduced assignment matrix, it is possible to have two or more ways to strike-off certain numbers of zero. Such a situation indicates multiple optimal solutions with the same optimal value of the objective
function.

D.Restrictions Assignment:

Sometimes it may happen that a particular resource (say man or machine) can't assign to perform a particular activity (say territory or job). In such a case, the cost of performing that particular activity by a particular resource is considered to be very large (written as m or ∞) so as to prohibit the entry of this pair of resource
activity into the final solution.

Part (3)
Practical Aspect

One of the projects referred by Basra Governorate is the Port Housing Sewage Project a part of the regional development projects. It includes a terminal, transport lines, and sewage networks. The company decided to transfer part of the project works to secondary contractors after ascertaining the availability of their expertise according to the following conditions:

1. Pipes are provided by the sewage department.
2. Manholes and their covers are provided by Anwar Al-Bashaier Company.
3. The secondary contractor handles pipe fitting, burying them with sup base, reburying them, and re-tiling the street.
4. The secondary contractor is subject to the guidance of the supervising engineer.

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5. The secondary contractor shall be charged (250) thousand dinars for each day of delay.

The part that the company decided to refer to secondary contractors consists of:

First four main transport lines.

Second, six sectors for secondary transport lines.

Lines and sectors have been assigned separately because the qualifications of contractors who are qualified to perform main lines differ from those who are implementing secondary lines.

First, assign main lines:

The main lines of transport consist of four lines, to be implemented by five contractors. Implementation of the lines has been approved according to meter price (per thousand) and as attached in the table. When checking prices, they turned out to be feasible and below the price of the governor's contract. Therefore, they have been adopted in a trade-off for assignment purposes and are included in (Table 1.), For a limited number of lines and contractors, the steps referred to in ( ) will be adopted. All contractors agreed to the terms of time adopted by the company and to the payment of Back interests (If delayed), after ensuring that they have the necessary experience and equipment to work, table (No. 1) represents the cost of loans for the implementation of the four main lines. **Table (1)**

(4)	(3)	(2)	(1)	Section / contractors
60	70	150	100	A
50	60	170	120	B
65	50	160	150	C
55	75	180	110	D
70	85	200	140	E

The model is unbalanced because the attorneys' number is more than the number of lines, so we add a column to ensure balance.

Table (2)

Dummy	(4)	(3)	(2)	(1)	Section / contractors
صفر	60	70	150	100	A
صفر	50	60	170	120	B
صفر	65	50	160	150	C
صفر	55	75	180	110	D
صفر	70	85	200	140	E

صففف 50 50 150 100 The smallest

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value
in each column

When subtracting the lowest values in each column table (3), which contains the lowest values in each zero-value row, the table remains the same and we draw the lowest number of straight lines covering the zero values.

Table (3)

Dummy	(4)	(3)	(2)	(1)	Section / contractors
صفر	10	20	صفر	صفر	A
صفر	صفر	10	20	20	B
صفر	15	صفر	10	50	C
صفر	5	25	30	10	D
صفر	20	35	50	40	E

The number of lines covering zero values is lower than the rows number, so we subtract the lowest uncovered values (5) from all uncovered values and add them to the values at the intersection of lines, producing a table number (4). **Table (4)**

Dummy	(4)	(3)	(2)	(1)	Section / contractors
5	10	20	صفر	صفر	A
5	صفر	10	20	20	B
5	15	صفر	10	50	C
صفر	صفر	20	25	5	D
صفر	15	30	45	35	E

We note in table (4) that the lowest number of straight lines covering zero values (4) is lower than the number of rows, so the lowest uncovered values (5) are repeatedly subtracted from all uncovered values and added to the values at the intersection of straight lines, producing the solution in table (5) below.

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Table (5)

Dummy	(4)	(3)	(2)	(1)	Section / contractors
10	15	20	صفر	صفر	A
5	صفر	5	15	15	B
10	20	صفر	10	50	C
صفر	صفر	15	20	صفر	D
صفر	15	25	40	30	E

The above table contains the optimal solution because the lowest number of straight lines covering the zero value is equal to the number of rows and the optimal assignment is indicated in circles, according to which the assignment is as follows.
Line number 1 is assigned to Contractor D at a cost of 110

Number 2 to Contractor A at a cost of 150

Number 3 to Contractor C at a cost of 50 Number 2 to Contractor B
at a cost of 50
Contractor E has been excluded for not being required.

Second: assign secondary lines:

Secondary transporting lines were divided into ten sectors. The company's staff completed four of them, and the other six sectors will be transferred to the contractors.A large number of contractors were submitted for implementation, a number of whom were excluded because they don't have the requested qualifications of expertise, staff, and machines to qualify them for implementation. the following table summarizes the submitted offers and the costs of implementing one meter (per thousand).

Table (6)

F	E	D	C	B	A	Section / contractors
36	33	41	40	30	35	(1)
60	58	50	42	40	46	(2)
26	27	28	30	33	20	(3)
54	50	56	57	52	50	(4)
40	43	44	41	40	42	(5)
60	63	59	58	60	62	(6)

By using QBS with the following steps:

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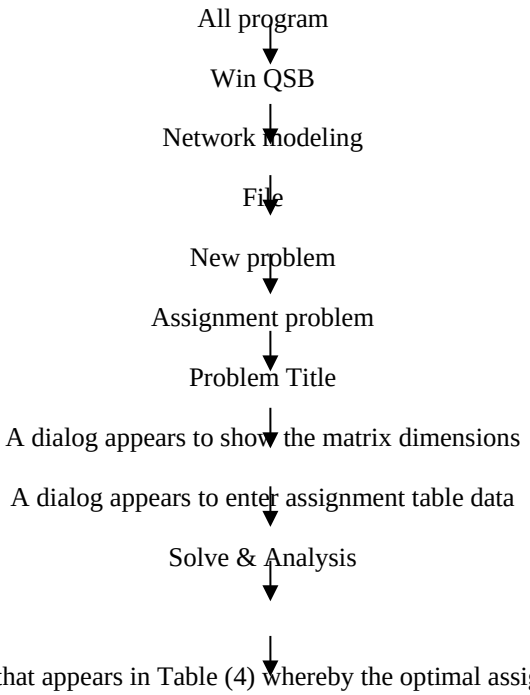

We get the optimal assignment that appears in Table (4) whereby the optimal assignment is as follows:

Sector 1 is assigned to Contractor B at a cost of 30 per meter

Sector 2 is assigned to Contractor C at a cost of 42

Sector 3 is assigned to Contractor A at a cost of 20

Sector 4 is assigned to Contractor E at a cost of 50

Sector 5 is assigned to Contractor F at a cost of 40 Sector 6 is assigned to Contractor D at a cost of 59 With a total cost of 141.

The assignment above is optimal, achieved in two steps, with easy effort and time. **Part (4)**

Conclusion and Recommendations *Conclusions and Recommendations:*

Using the assignment model to achieve the optimal assignment of the company's resources can save and utilize a lot of resources and create a competitive advantage for the company, especially after using the computer. Through the QSB application, the assignment has become a process that costs easy effort and time. This Technique avoids random company decision-making and limits personal effects on decision-makers.

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