Proceedings of Symposium on Technology Management and Logistics (STMLGoGreen), 8-9 December 2015, Universiti Utara Malaysia

OPTIMAL SOLUTION OF ASSIGNMENT PROBLEM IN ROJAM MANUFACTURING COMPANY

Nor Fatihah bt Mohamad[1], Dr. Kamarul Irwan bin Abdul Rahim[2]
College of Business, Scholl of Technology Management and Logistic, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia
Email: [1]norfatihah_2510@yahoo.com, [2]mk.irwan@uum.edu.my

ABSTRACT

This research is about assignment problems consist to determine one of the special cases of transportation problems. The assignment problem is a of combinatorial optimization problems in the branch of optimization of or operation research in the mathematics. This research is trying to dig a lot of information by looking at the statistics of the management department with problems whose structure are identical with assignment problems in manufacturing company, which for separate jobs and the cost of assign each job to each person. This study comes out with two elements as an objective which is to minimize total cost of assignment problem in manufacturing company and to maximize the profit in manufacturing company. This study will conduct visit to a manufacturing company and the data will be collected from all employees in departments such as quality department, operation department, human resources department, marketing department and others. This study using quantitative methodology and the data will be analysed using the AMPL model to solve the assignment problem in the manufacturing company. The findings of this research are showing the vehicle assignment problem and the computational procedure, which lead to an optimal solution of the problem. It can reduce the total cost and increases the quality performance the workers.

Keyword: optimal solutions, assignment problem, manufacturing company, minimize cost, maximize profit

INTRODUCTION

The assignment problem is a of the fundamental combinatorial optimization problems in the branch of optimization or operations research in mathematics. This study will conduct a visit to manufacturing company, and use AMPL model for the assignment problem. Basically, in our real life we are facing with the problem of allocating different workers to the different jobs. In fact, not everyone has the ability to do and perform with the job that is given to them. Different persons have different abilities to execute the same task and these capabilities are expressed in term of cost, profit and time involved in executing a given job. According G.Monge (1784), the assignment problem is of the first studied combinatorial is an optimization problems. Furthermore, various methods are available to solve the assignment problem to obtain an optimal solution. . In additional, from the web operation research that found the formula had been developed by D.Konig assignment, a mathematician Hungary and therefore known as the Hungarian problem assignments. A time to minimize the assignment problem (TMPA) related to the allocation of the work is allocated to only one person. Therefore, everyone should do at least one job only to save time for a work performed. If one has to do more than one job, she did not them one by one in any order.

Therefore, the aim of this study was to find that the task is executed which reduces the amount of time to complete all the work by suggesting optimal assignment can be implemented to reduce costs and improve profitability within the company. Accordingly, from this research are to the vehicle assignment problem and the computational procedure, which leads to an optimal solution of the problem. According to Defersha and Chen (2006), was developed a comprehensive mathematical programming model with the objective of minimising machine investment cost, intercellular material handling cost, operating cost, subcontracting cost, tool consumption cost, set-up cost, and system reconfiguration cost in an integrated manner. Therefore, relate to this fact, this study trying to dig a lot of information by looking at the statistics of the management department with problems whose structure are identical with assignment problems in Rojam manufacturing company, which for separate jobs and the cost of assign each job to each person . Besides, these studies also want to solve either common and to know about the worker or person is an imaginary job but they cannot get the job. Next, the researcher also wants to know the person is incapable of doing certain job or specific job and the performed worker when they cannot get the job that they want. This point because nowadays, it is hard to find job that will match with our need, so they just have to accept whatever job that they been offered.

OBJECTIVE

The aim of this study is to determine the assignment problem in manufacturing company. These surveys have two objectives:

- To minimize the total cost and time of management the department in manufacturing company.
- To maximize the profit of the manufacturing company.

LITERATURE REVIEW

Definition of assignment problem

According G.Monge (1784), the assignment problem is of the first studied combinatorial is an optimization problems. These problems have many applications in VLSI design, economics, telecommunications, production planning and others. the basis of the assignment problem are classified into three higher-dimensional assignment problem, the problem of quadratic and linear problem issues and problems related to the assignment problem. Assignment problem can be solved in various ways including some basic features, algorithms and applications such as water supply and sanitation. However, the most successful method to solve the assignment problem is algorithm. According Koopmans and Beckam (1957), for model problems of location theory has been widely during the year and since then it has attracted hundreds of researchers to study the problem. Furthermore, many practical problems that change happen. Apart from that, to tackle this kind of problem often means that we have to evaluate a number of functions for each task of articles and journals that have been studied, there is a way that can be easily solved with some primitive methods of these two methods such as Hungary, as well as the rules and others which by taking into account the quadratic objective function however the problem is far more difficult than methods Hungary.

Time minimize assignment problem

According Cohen (2008), assumed learning depends on the worker who operated the task. Furthermore, the processing time which represents learning behaviour is set in different way. There is a method of task duties workers as workers' skill levels and learning abilities. The

processing time per employee varies depending on the production during the learning ability of employees. We focus on employee job duties where tasks are ordered in series and the number of tasks is greater than the number of workers to minimize time the assignment problem. Generally, workers would improve their performance by repeating the same operation or task. The worker will require less time to produce the succeeding unit or gain proficiency with the repetition of the same task.

Corominas et al. (2010), considers the problem of assigning and scheduling a set of tasks to a set of workers, when worker's performance on a task depends on the experience of the worker about this task and the other involved tasks. From that, the fact is the time to do the job or task can be shorted and it can save time and can minimize time in the assignment problem. Moreover, workers have different learning abilities i.e. the processing time of the succeeding item being shorter than the preceding item. In the problem, the processing time of each worker for each item is based on the skill level and learning of the worker in solving the assignment problem.

Benefit of assignment problem

Browne and yechiali (1990), introduced a scheduling problem with deteriorating jobs, in this problem processing time of a job is a linear nondecreasing start time dependent function. From this point, we will see the benefit of the assignment problem is to minimize the cost and time in manufacturing company. From that, it will help the manager to come out with the solutions to prevent and minimize this cost and time in a way to solve the problem effectively. As stated by cheng and wang (2000), used the volume dependent processing time function to the model learning effects, in which the learning effects on the processing time of a job depend on the number of jobs processed before the job. Apart from that, the assignment problem it can save time by the processing time of each worker for each item is based on the skill level and learning of the worker in solving the assignment problem. The importance and the relevance of the scheduling problems can improve time a work can be completed quickly. Conclusion, assignment problems arise in many different situations in which we need to know the optimal way to resolve in a more orderly manner.

METHODOLOGY

The approach used in this study was descriptive and form of data collection surveys based manufacturing company where the study involves the collection of data related relate to trying to dig a lot of information by looking at the statistics of the management department with problems whose structure are identical with assignment problems in Rojam manufacturing company, which for separate jobs and the cost of each job is assigned to each person.

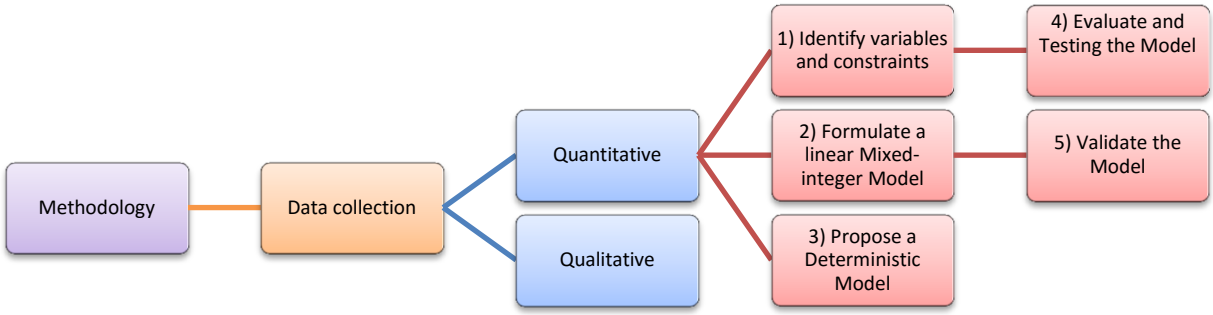

Figure 1: The step in methodology

Identify variables and constraints
The variable is the concept or construct investigated by gay and arasian (2000), which is a factor in any investigation or identity, is varied in terms of quantity or quality. Research involving the relationship between variables involved in an incident in which each of them has a different function.

Formulate a linear mixed-integer model
An integer programming problem is a mathematical optimization and the feasibility program in which some or all of the variables are restricted to be integers. In many settings the term refers to an integer linear programming (ILP), in which the objective function and the constraints (other than the integer constraints) are linear. A significant number of problems can be formulated as ILP. This includes the department and workers.

Propose a deterministic model
Deterministic models are simulation models which do not contain any components that are probabilistic (random) and the output can be determined so that the number of input and specific relationship entered. Output obtained will remain the same even if the input is reprocessed. Model deterministic focus their evaluation on the critical factors that are assumed to have a certain exact value at a specific time. Examples of deterministic model is the transportation problem, the assignment problem, the problem of transhipment, and the network model (one applications of graph theory that the material can be downloaded in discrete mathematics) this method is generally a development of the simplex method which is the basis of all methods of linear programming problem.

Evaluate and testing the model
The test is a mechanism to ensure the quality of products, systems or capabilities (for example, the right products, built right). To be effective, the test cannot occur only at the end of development. It needs to be addressed on a going basis throughout the entire life cycle. Testing and Evaluation involves assessing the product from component level, for stand-alone systems, integrated systems, and, if appropriate, system-of-systems and companies. Moreover, models are can be created to solve large real -world problems, but unfortunately some classes of the assignment. The model must be evaluate and testing to know the model can be used or not for solving this assignment problem. By building these models to not be problem specific, numerous different problem instances can be tested and evaluated.

Validate the model

The validation process can involve analysing the goodness of fit of the regression, analysing whether the regression residuals are random, and checking whether the model of predictive performance deteriorates substantially when applied to data that were not used in model estimation. In the context of verification of a computer simulation model of is the process of confirming it is correctly implemented with respect to the conceptual model of (it matches the specifications and assumptions deemed acceptable for the given purpose of application). During the verification model of is tested to find and fix errors in the implementation of the model of.

FINDING AND DATA ANALYSIS

The data is collected from all employees in departments such as quality department, operation department, human resources department, marketing department and other. Analysis of the data will be presented through quantitative methods, namely through the data of companies Rojam. The results obtained are indicated by assignment problem related to the election office by the company's employees. , This data analysis approaches use the AMPL model for the assignment problem to complete the data has been collected. AMPL is a modelling which can help us to formulate optimization problems to minimize the total cost and to maximize the profit in manufacturing and others.

Mathematical model of the problem

The analysed the problem is expressed in terms of multicriteria, non-linear, integer, combinatorial mathematical programming.

Parameters of the model

π_{ij}: The cost associated with assigned performing job to each person

a_{ij}: Assigned performing job

p_i : Amount for person

D_j: Amount for the job/department

MINIMIZE TOTAL COST

$$\sum_{i\in 0} \sum_{j\in D,} \pi_{ij} \, . \, a_{ij}$$

SUBJECT:

$$\sum_{i\in D} t_{ij} = p_i \quad (1)$$

$$\sum_{i\in 0} t_{ij} = D_j \quad (2)$$

Mathematical data

This is data assignment problem in Rojam manufacturing company about workers and department.

```
data;
set ORIG := Aisyah Akmal Atikah Azman Farhana Faris Fatin Firdaus Helmi Hidayah
            Kamarul Khairi Muhsin Nazri Siti Syafiq Syairah Syazwanie Yusma  ;

set DEST := D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18 D19 ;

param supply default 1 ;

param demand default 1 ;

param cost:
          D1    D2   D3   D4   D5   D6   D7   D8   D9   D10   D11  D12  D13  D14
Aisyah     1    18   12    5    8   13    2   10    4     7    19   14   17   11
Akmal      3     2    8   13   16   10   18    1   14     4    19   15    6    7
Atikah     1     4    7    9   10   13   15   17   19     2     5   12    8   14
Azman      1    18    5   11   16   12    3    8   14     6    10    7   13    2
Farhana    1    19   14    6    3   15    9   18   12     5    10    4   16    2
Faris     19     5   12    8   14    7   13    1   10    16     6    2   11   15
Fatin      5    19    6    9   17    8   13    4    3     7    12   10   15   11
Firdaus   19    11    5   17    4   18    6    1    7     8    16   12    2   15
Helmi      6    13   11   15   10   12    9   18    8    14     7   19    1   16
Hidayah    2    10   15   18   14    1    5    9    3    17    11    7   13    4
Kamarul    8     3   10   13    7   11    9    4   15    17    12   19    1   18
Khairi    11    19    8   10   17   15    1    7   13     2     3   12    4    5
Muhsin     2     6    1   13    7    9    3    8   12    16     5   15   14   11
Nazri     11    15    9   10   12    5   17    3   13     4    18    6    7   19
Siti      11     4    5    9    3   14   19    7   15     2    16    8   10   12
Syafiq     3     1   10    8   16    7   12    2   19     6    17   14    9    4
Syairah   11    16    9   14   10    8   13    6    5     7    15    3   18    4
Syazwanie 13     6    1    4   12   14    2   16    3     7    10   18    9   11
Yusma     14    11   18    9   16   19    8    4   12     6    17    5    3   10


          D15 D16  D17  D18  D19 :=
Aisyah      6   3   15    9   16
Akmal      12   5   11    9   17
Atikah     18   16   3    6   11
Azman       9   17   4   19   15
Farhana     7   17  11   13    8
Faris       4   18   9   17    3
Fatin      18    2   14   1   16
Firdaus    10   13   14   3    9
Helmi       2   17    5   4    3
Hidayah    19    6   12   8   16
Kamarul    16    5   14   2    6
Khairi     16    6   18   9   14
Muhsin     19   17   18   10   4
Nazri      14   16    8    1   2
Siti        1    6   13   18  17
Syafiq     11    5   15   11  13
Syairah    12    1    2   17  19
Syazwanie  19   17   15    5   8
Yusma      13   15    7    2   1 ;
```

This organization chart shows about the department in Rojam manufacturing have 5 departments include production department, technical department, human resources department, marketing department and customer service department, and every department there are several division of jobs.

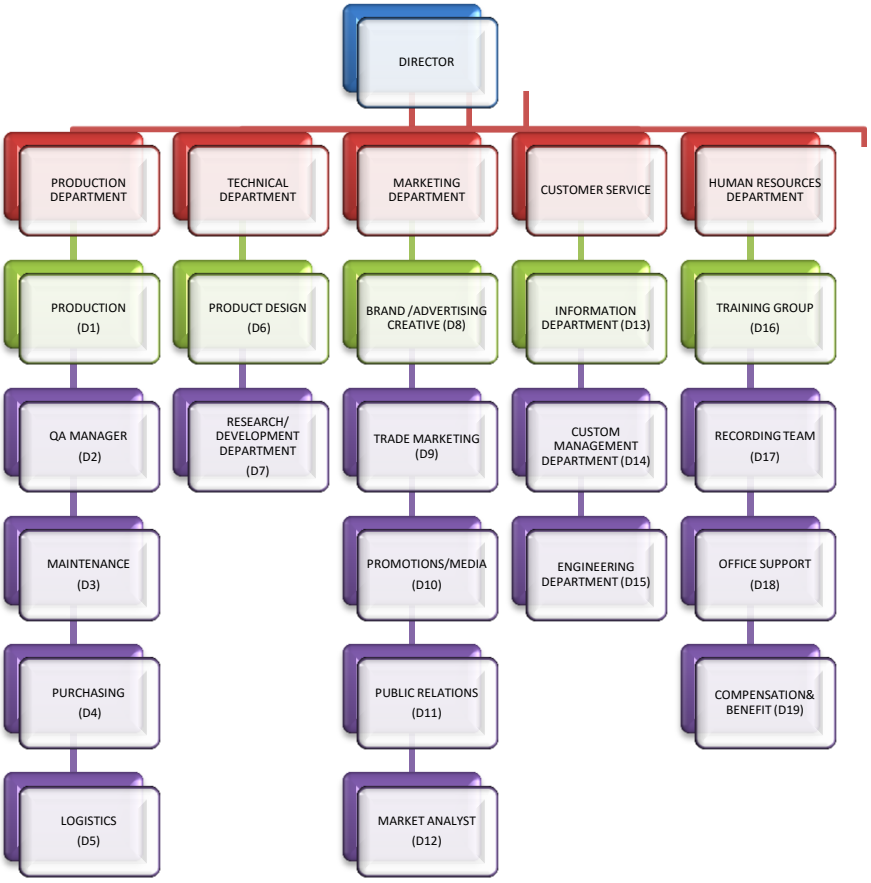

Figure 2: The organization chart in manufacturing company

4.4 THE AMPL RESULT

```
ampl: model assign.mod;
ampl: data assign.dat;
ampl: solve;
MINOS 5.51: optimal solution found.
123 iterations, objective 36
ampl: display Trans;
Trans [*,*]
:               D1          D2    D3            D4    D5              D6       :=
Aisyah      -5.25175e-17    0      0             0     0               0
Akmal        0              0      0             0     0               0
Atikah       0              0      0             0     0               0
Azman        1              0      0             0     0               0
Farhana      0              0      0             0     -2.48901e-17    0
Faris        0              0      0             0     0               0
Fatin        0              0      0             0     0               0
Firdaus      0              0      0             0     1               0
Helmi        0              0      0             0     0               0
Hidayah      0              0      0             0     0               1
Kamarul      0              0      0             0     0               0
Khairi       0              0      0             0     0               0
Muhsin       0              0      1             0     0               0
Nazri        0              0      0             0     0               8.47636e-17
Siti         0              0      0             0     0               0
Syafiq       0              1      0             0     0               0
Syairah      0              0      0             0     0               0
Syazwanie    0              0      5.85048e-17   1     0               0
Yusma        0              0      0             0     0               0
```

:	D7	D8	D9	D10	D11	:=
Aisyah	1	0	0	3.45554e-17	0	
Akmal	0	1	0	0	0	
Atikah	0	0	0	0	0	
Azman	0	0	0	0	0	
Farhana	0	0	0	0	0	
Faris	0	0	0	0	-7.74076e-17	
Fatin	0	0	1	0	0	
Firdaus	0	0	0	0	0	
Helmi	0	0	0	0	0	
Hidayah	0	0	0	0	0	
Kamarul	0	0	0	0	0	
Khairi	-7.97169e-17	0	0	0	1	
Muhsin	0	0	0	0	0	
Nazri	0	0	0	0	0	
Siti	0	0	0	1	0	
Syafiq	0	0	0	0	0	
Syairah	0	0	0	0	0	
Syazwanie	0	0	-1.56527e-17	0	0	
Yusma	0	0	0	0	0	

:	D12	D13	D14	D15	D16	D17	:=
Aisyah	0	0	0	0	1	0	
Akmal	0	0	0	0	0	0	
Atikah	0	0	0	0	0	1	
Azman	0	0	-2.48901e-17	0	0	2.22045e-16	
Farhana	0	0	1	0	0	0	
Faris	1	0	0	0	0	0	
Fatin	0	0	0	0	2.48901e-17	0	
Firdaus	0	0	0	0	0	0	
Helmi	0	0	0	1	0	0	
Hidayah	0	0	0	0	0	0	
Kamarul	0	1	0	0	-2.62587e-17	0	
Khairi	0	0	0	0	0	0	
Muhsin	0	0	0	0	0	0	
Nazri	0	0	0	0	0	0	
Siti	0	0	0	-5.25175e-17	0	0	
Syafiq	0	0	0	0	8.47636e-17	0	
Syairah	0	0	0	0	1	2.48901e-17	
Syazwanie	0	0	0	0	0	0	
Yusma	0	0	0	0	0	-1.37281e-16	

:	D18	D19	:=
Aisyah	0	0	
Akmal	0	0	
Atikah	0	0	
Azman	0	0	
Farhana	0	0	
Faris	0	0	
Fatin	1	0	
Firdaus	0	0	
Helmi	0	0	
Hidayah	0	0	
Kamarul	0	0	
Khairi	0	0	
Muhsin	0	0	
Nazri	1	0	
Siti	0	0	

```
Syafiq      0               0
Syairah     0               0
Syazwanie   0               0
Yusma       5.85048e-17     1
;

ampl:
```

Table 1: Result for assign job to each workers

NAME	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19
AISYAH	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AKMAL	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ATIKAH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
AZMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
FARHANA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FARIS	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
FATIN	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
FIRDAUS	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HELMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
HIDAYAH	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
KAMARUL	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
KHAIRI	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
MUHSIN	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NAZRI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
SITI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SYAFIQ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SYAIRAH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
SYAZWANIE	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YUSMA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

From the result, it shows that the minimum cost is 36. In response questions of this study is the first study to identify the assignment problem Rojam manufacturing company. The results are presented in the table above result shows that there are two categories of workers and the person or department.

Based on result solved in the AMPL software, it is found that every person have their own job preference based on their skill. The number one shown in this table indicated the department that workers a have been placed as example for Aisyah, refer to her job preference she has decide to place her in the department 7. Furthermore, Akmal has been placed in brand and advertising department, Atikah has been placed in recording team, Azman has been placed in custom management department. Moreover, Farhana in production department, Faris in market analyst, Fatin in trade marketing, Firdaus in logistics, Helmi in engineering department, Hidayah in product design, Kamarul in information department, Khairi in public relation, Muhsin has been placed in maintenance department, Nazri has been placed for office job, Siti has been placed in promotion and media, Syafiq in QA manager, Syairah in training group, Syazwanie in purchasing department, and the last worker Yusma has been placed in compensation and benefit department.

The data shows about every worker are divided into one department only. Moreover, the workers can get one job for department in manufacturing company. From that, assign one and only job to each person in department manufacturing company because that way the total cost of assignment is minimized.

CONCLUSION

In conclusion, the benefits of this research are to the vehicle assignment problem and the computational procedure, which leads to an optimal solution of the problem. Moreover, assignment problem has a positive relationship towards workers satisfaction. Besides that, it can reduce the total cost and increases the quality performance the workers. From that, the management of manufacturing company can be consider with the performed workers about their work and the management of the company will know the person is incapable of doing certain job or specific job. Furthermore, for me as researchers from the used the software AMPL, I can learn about new software to use can be used in many thing in the future. However, AMPL Model will reduce the complexity with a simple and a clear solution manner which is can be easily used on different area for optimization problems.

REFERENCES

Assignment problems. (2015). Retrieved 16 September, 2015, from operationsresearch.biz: http://www.operationsresearch.biz/index.php

Balinski, M. L., & Gomory, R. E. (1964). A primal method for the assignment and transportation problems. *Management Science*, *10*(3), 578-593.

Bowman, M., Briand, L. C., & Labiche, Y. (2010). Solving the class responsibility assignment problem in object-oriented analysis with multi-objective genetic algorithms. *Software Engineering, IEEE Transactions on*,*36*(6), 817-837.

Burkard, R. E., & Butkovič, P. (2003). Max algebra and the linear assignment problem. *Mathematical programming*, *98*(1-3), 415-429.

Celano, G., Costa, A., & Fichera, S. Makespan minimization in a flowshop sequence dependent group scheduling and worker assignment problem.

Chen, L., & Lu, Z. (2012). The storage location assignment problem for outbound containers in a maritime terminal. *International Journal of Production Economics*, *135*(1), 73-80.

Esturilho, C. G., & Estorilio, C. (2010). The deployment of manufacturing flexibility as a function of company strategy. *Journal of Manufacturing Technology Management*, *21*(8), 971-989.

Kuhn, H. W. (2010). The hungarian method for the assignment problem. In *50 Years of Integer Programming 1958-2008* (pp. 29-47). Springer Berlin Heidelberg.

Nagurney, A. (2010). Optimal supply chain network design and redesign at minimal total cost and with demand satisfaction. *International Journal of Production Economics*, *128*(1), 200-208.

Paendong, M., & Prang, J. D. (2011). Optimisasi Pembagian Tugas Karyawan Menggunakan Metode Hungarian. *Jurnal Ilmiah Sains*, *11*(1), 109-115.

Papaioannou, G., & Wilson, J. M. (2010). The evolution of cell formation problem methodologies based on recent studies (1997–2008): Review and directions for future research. *European journal of operational research*, *206*(3), 509-521.

Povh, J. (2008). Assignment problems in logistics. *Logistics & Sustainable Transport*, *1*(3).

Roy, R., & Rathore, R. (2014). Method of Finding an Optimal Solution of an Assignment Problem. *International Journal of Research in Engineering Technology and Management*, *2*(1), 1-4.

Thongsanit, K., Boondisakulchok, R., & Tharmmaphornphilas, W. (2010). Heuristic for Task-Worker Assignment with Varying Learning Slopes.*Engineering Journal*, *14*(2), 1-14.

Wang, J. B., & Guo, Q. (2010). A due-date assignment problem with learning effect and deteriorating jobs. *Applied Mathematical Modelling*, *34*(2), 309-313.

Zak, J., Jaszkiewicz, A., & Redmer, A. Multicriteria optimisation method for the vehicle assignment problem in the bus transportation company.

Zhang, B., & Peng, J. (2014). Expected value model for optimal assignment problem with uncertain profits.