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Transportation Problem Optimization Systems using The Algorithm of Allocation Table Method

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ABSTRACT

Transportation is the process of distributing products from source to destination. Transportation problems are special cases of network optimization method where the numbers of goods distributed from sources to destinations are optimized thereby minimizing transportation costs. The increasing number of sources and destinations results in complex calculations of the distribution process. The methods to find optimal solutions in determining the number of goods distributed with the aim of minimizing costs have been proposed. Comparative methods have been carried out and obtain optimal solutions. The result shows that the algorithm of the *Allocation Table Method* has shown better performance compared to previous methods such as *Least Cost Method, Vogel Approximation Method* dan *North West Corner Method*. Yet, a more complex transportation network needs a calculation method to seek for solutions. The aim of the study was to implement the algorithm of the Allocation *Table Method* as a method to seek solutions in a system designed to support problem-solving. The tryout conducted on several cases has shown that the Allocation Table Method is a leading method in finding optimal solutions for transportation problems involving multi-sources and multi destinations.

I. Introduction

Transportation problems are special cases in network optimization in a supply chain network consisting of production, transportation and inventory processes. Transportation models have very important roles in the logistics and supply network. [1]. The aim of the transportation model is to minimize the cost of shipping from source to destination so that required capacity data and supply data from the source and destination [2]. The transportation network model is presented in Figure 1 [3]. The solutions for transportation problems consist of three stages, namely decoding problems into linear programming, creating a transportation table and conducting an initial feasible solution, and finding a final feasible solution.

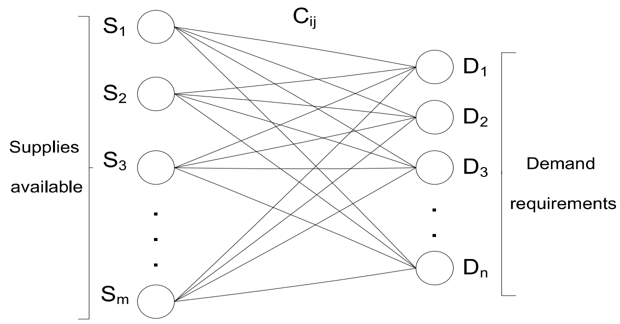

Fig 1: The network model of the transportation problem

Figure 1 shows that S_1-S_m are the sources and D_1-D_n are destinations. C_{ij} is the shipping cost, and X_{ij} is the number of goods shipped from the source i to the destination j. So, transportation problems are formulated in the following transportation model:

Objective:

$$\text{Min}\, Z = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij} X_{ij} \quad (1)$$

Constraints:

$$\sum_{j=1}^{n} X_{ij} = S_i \quad (2)$$

$$\sum_{i=1}^{m} X_{ij} = D_j \quad (3)$$

Where X_{ij} is the number of goods sent from *source* Duxbury to *destination* j, Cij is the transportation cost from *source* i to *destination* j, Si is the supplier to i and Dj is the demand to j [4].

The greater the number of sources and destinations results in the more complex supply chain network and the more difficult to do calculations in the search for solutions. There are several existing transportation methods that are used to minimize transportation costs, including *North West Corner Method* (NWCM) [5], *Least Cost Method* (LCM) [6] or *Vogel's Approximation Method* (VAM) [7]. These methods have been able to produce feasible initial value for transportation problems, but the search for new methods is growing and producing more optimal solutions or fewer iterations to obtain faster problem-solving. *Allocation Table Method* (ATM) is a new method that introduces the search for an initial solution [8]. A research conducted by Uddin et.al. suggests that the *Allocation Table Method* has provided effective solutions for transportation problems. To analyze the performance of ATM, five methods were used as comparison, namely: *North West Corner Method* (NWCM), *Least Cost Method* (LCM) or *Vogel's Approximation Method* (VAM), *Extremum Difference Method* and *Optimum Solution* by using four different cases [9] Previous researcher has conducted a research on several case studies and suggests that the calculation of minimizing the cost of distribution the algorithm of *Allocation Table Method* has shown lower cost compared to the result of the calculation using the algorithm of *Least Cost Method* [10]. Based on the performance of ATM in providing effective calculation, the author conducted a study to build a system to optimize transportation problems by using the algorithm of the *Allocation Table Method* in order to facilitate the implementation in the field.

II. Research Methodology

A. *Allocation Table Method*

The steps of the *Allocation Table Method* algorithm are as follows:

Step-1: Create Transportation Table from Linear Programming Model based on the problem

Step-2: Ensure that demand and supply are balanced. If not, then use the unbalanced transportation method table.

Step-3: Select the cost with the smallest odd number (MOC) in the table. If there are no odd costs in the table, then divide all costs by 2 until an odd value is found.

Step-4: After step 3 is completed, the values in the table are identified as the values of the allocation table (TA). Then subtract each odd cost in the table with the value of MOC. The values in the table are labeled cell allocation values (ACV).

Step-5: Start to fill cells. The first cell to be filled in the cell labeled as ACV at the smallest odd value. In the cell, allocate the least goods from capacity/request. If the rows of capacity/columns of requests have been fulfilled, close the row/column.

Step-6: Next, identify the next ACV having the second least value, then allocate it to the appointed cell having minimum request/supply. If there are several equal minimum values, then select the cell with the minimum allocation that can be selected from the demand / supply. If the case has same allocation,

select the cell with the lowest cost in the initial table in Step-1. Furthermore, if the cost and allocation cells are the same, select the cell closest to the minimum (demand / supply) then allocate.
Step-7: Repeat Step-6 until all rows and columns are fulfilled
Step-8: Move the solutions in each cell from the result of table allocation in Step-7 to the main table.
Step-9: Calculate the total transportation cost by adding up the multiplication results of the allocations in each cell with the transport costs. [10]

B. *Research Design*

The study was conducted in several steps as presented in Figure 2.

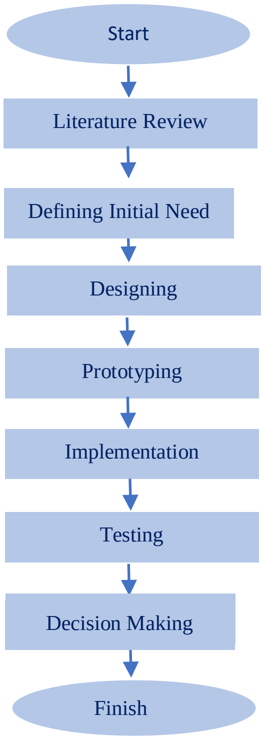

Fig 2: Research Design

The literature review was conducted to study the *Allocation Table Method* which was employed in designing a product distribution optimization system. Then, the next step was defining the initial requirements such as the theme or flow of the system as well as the process model. The final goals were represented using use case diagrams that show application functionality.

Low fidelity prototype is utilized to illustrate the system to be built, which is presented in Figure 3.

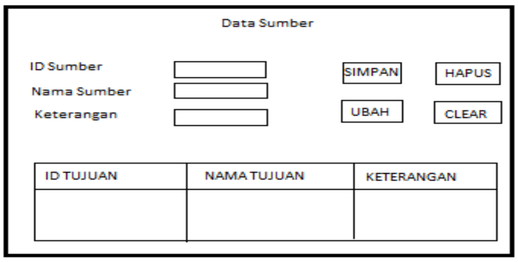

Fig 3. System Prototype

III. Result and Discussion

Interface implementation was based on the result of *low fidelity* prototyping. System implementation was conducted on three sample cases and ATM-based problem solving was presented on each page for each case [8].

Case-1

The data used in the first sample case is presented in Table 1.

Table 1. Sample Case-1

Factories	Showrooms				Production Capacity
	D_1	D_2	D_3	D_4	
F_1	3	1	7	4	300
F_2	2	6	5	9	400
F_3	8	3	3	2	500
Demand	250	350	400	200	

Table 2. Result of Calculation for Case-1

Factories	Showrooms								Capacity
	D_1		D_2		D_3		D_4		
F_1		3	300	1		7		4	300
F_2	250	2		6	150	5		9	400
F_3		8	50	3	250	3	200	2	500
Demand	250		350		400		200		

Total transportation cost is (300 x 1 + 250 x 2 + 150 x 5 + 50 x 3 + 250 x 3 + 200 x 2) = 2850.
The case implementation using Distribution Optimization System is presented as follows:

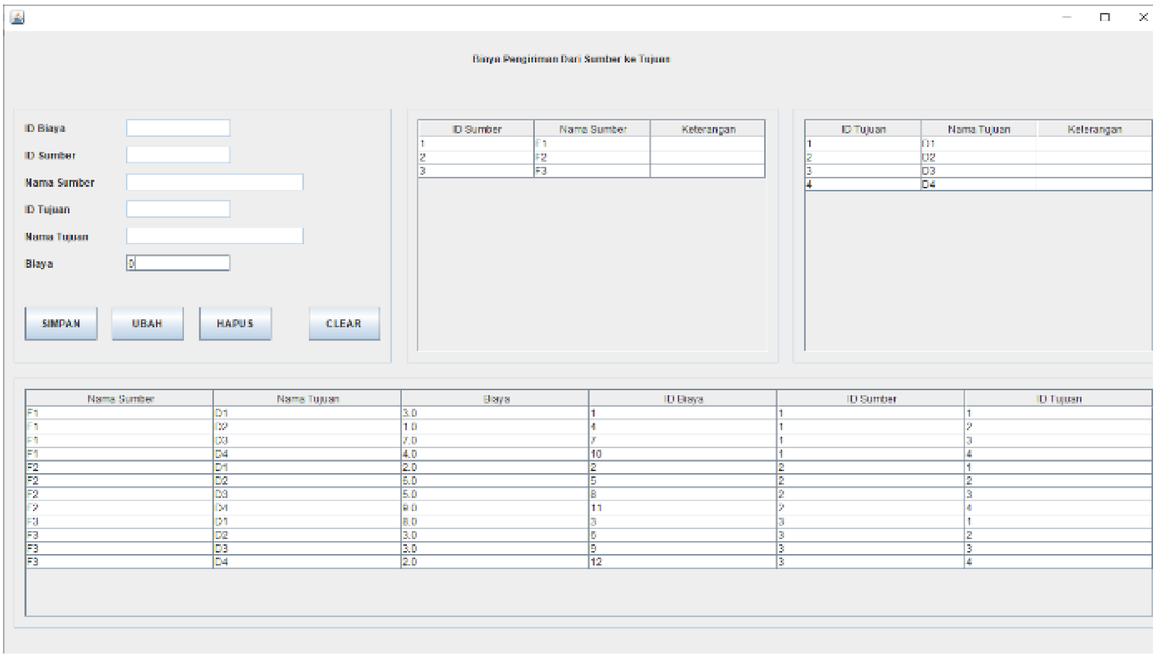

Fig 4. Page of Cost of Product Distribution Optimization Process using ATM algorithm for Case-1

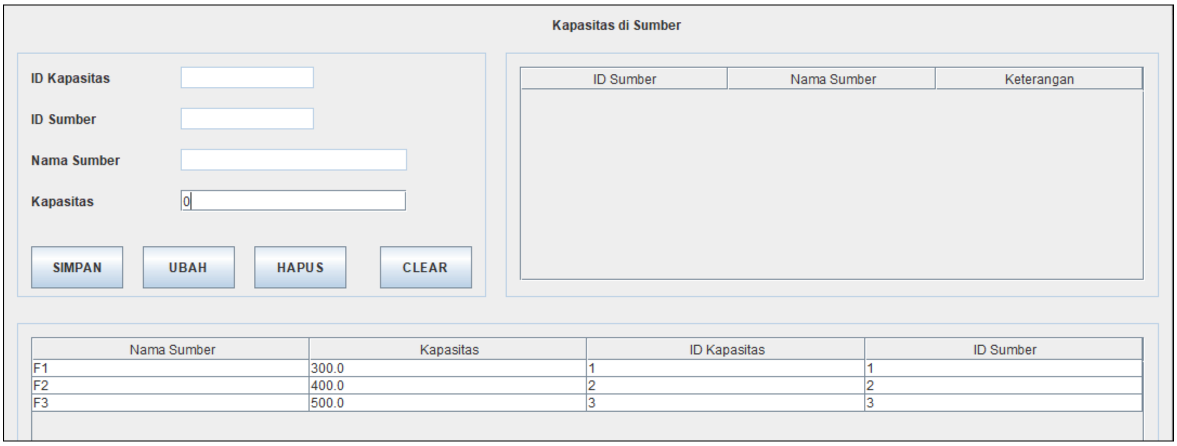

Fig 5. Page of Capacity and Source of Product Distribution Optimization Process using ATM algorithm for Case-1

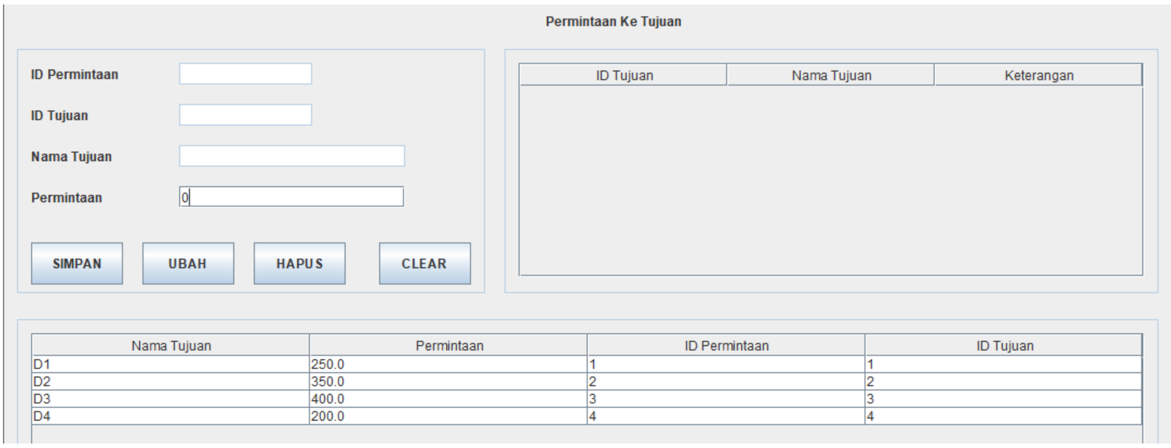

Fig 6. Page of Requests and Goals of Product Distribution Optimization Process using ATM algorithm for Case-1

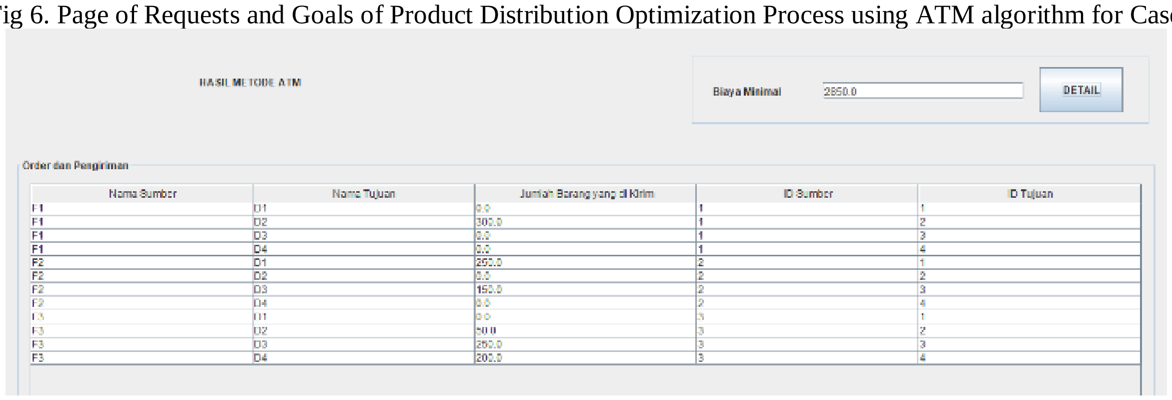

Fig 7. Page of Result of Product Distribution Optimization Process using ATM algorithm for Case-1

Case-2

The data used in the first sample case is presented in Table 3.

Table 3. Sample Case-2

Sources	Destinations				Supply
	D_1	D_2	D_3	D_4	
S_1	50	60	100	50	20
S_2	80	40	70	50	38
S_3	90	70	30	50	16
Demand	10	18	22	24	

Table 4. Result of Calculation for Case-2

Sources	Destinations								Supply
	D_1		D_2		D_3		D_4		
S_1	10	50		60		100	10	50	20
S_2		80	18	40	6	70	14	50	38
S_3		90		70	16	30		50	16
Demand	10		18		22		24		

Total transportation cost is (10 x 50 + 10 x 50 + 18 x 40 + 6 x 70 + 14 x 50 + 16 x 30) = 3320. The case implementation using Distribution Optimization System is presented as follows:

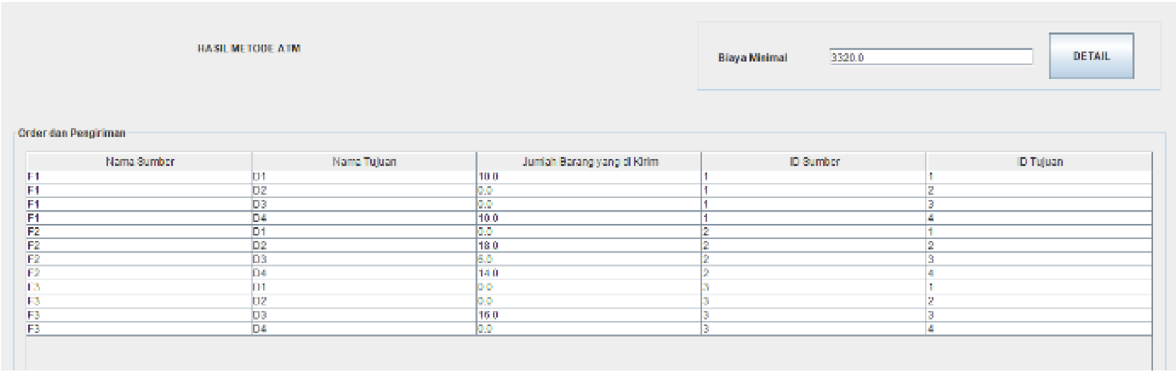

Fig 15: Page of Result of Product Distribution Optimization Process using ATM algorithm for Case-2.

Case-3

Table 5. Sample Case-3

Origins	Destinations			Supply
	D_1	D_2	D_3	
O_1	4	3	5	90
O_2	6	5	4	80
O_3	8	10	7	100
Demand	70	120	80	

Table 6. Result of Calculation for Case-3

Origins	Destinations						Supply
	D1		D2		D3		
O1		4	90	3		5	90
O2		6	30	5	50	4	80
O3	70	8		10	30	7	100
Demand	70		120		80		

Total transportation cost is (90 x 3 + 30 x 5 + 50 x 4 + 70 x 8 + 30 x 7) = 1390.
The case implementation using Distribution Optimization System is presented as follows:

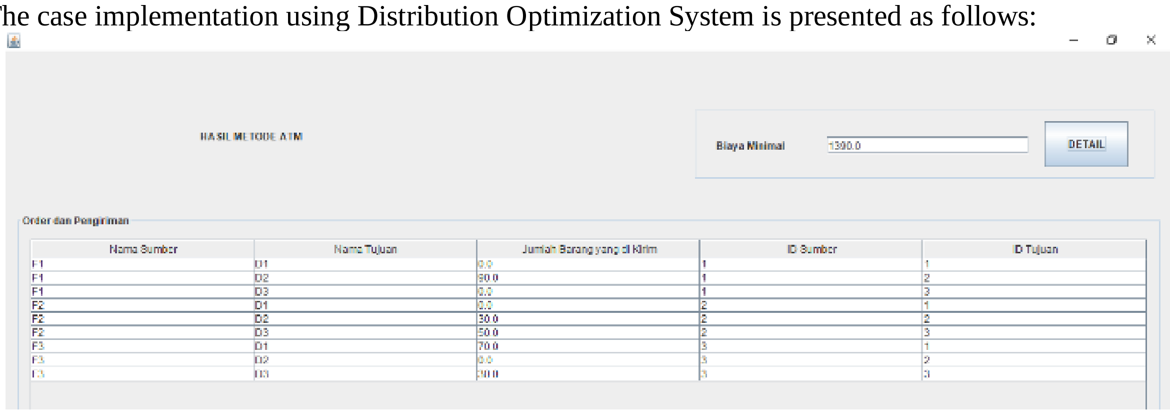

Fig 16. Page of Result of Product Distribution Optimization Process using ATM algorithm for Case-3.

D. Validation Test

Validation test was conducted using *Blackbox* method. The test was conducted by matching the result of implementation to initial demand which was defined before.

Table 7 . Validation Test

No	Tested Case	Status of Validity
1	Login	Valid
2	Adding Source Data	Valid
3	Editing Source Data	Valid
4	Deleting Source Data	Valid
5	Viewing Source Data	Valid
6	Adding Destination Data	Valid
7	Editing Destination Data	Valid
8	Deleting Destination Data	Valid
9	Viewing Destination Data	Valid
10	Adding Request Data	Valid
11	Editing Request Data	Valid
12	Deleting Request Data	Valid
13	Viewing Request Data	Valid
14	Viewing Capacity Data	Valid
15	Adding Capacity Data	Valid
16	Deleting Capacity Data	Valid
17	Editing Capacity Data	Valid
18	Adding Cost Data	Valid
19	Editing Cost Data	Valid
20	Deleting Cost Data	Valid
21	Viewing Cost Data	Valid
22	Conducting ATM Process	Valid
23	Viewing Hasil Proses	Valid
24	Viewing Detail Proses	Valid
25	Logout	Valid

IV. Conclusions

Based on the results of design, implementation, and testing, it can be concluded that the product distribution optimization system using the Allocation Table Method was successfully implemented. The system can be used as a decision-making tool for companies regarding the number of products that must be distributed from source to destination to minimize transportation costs.

V. Recommendation

1. The weakness of the Allocation Table Method is that the cost of transportation from each source to the destination cannot be reduced to a decimal number because it cannot be determined whether the decimal number goes to odd or even numbers in step 3 of ATM algorithm.
2. The system has been able to show the performance of the ATM algorithm yet the interface looks simple so further development of the system is needed to be more user-friendly and interesting.

References

[1] S. Korukoğlu and S. Balli, "An Improved Voegel's Approximation Method For The Transportation Problem," *Mathematical and Computational Applications*, vol.16, no.02, pp.370-381, 2011.
[2] J.E. Reeb, and S. Leavengood, "Transportation problem: A special case for linear programming," Oregon: Oregon State University Extension Service Publications EM 8779, 2002.
[3] H. Wagner, *Principles of Operations Research*, New Jersey: Prentice-Hall, Englewood Cliffs, 1969.
[4] J. Yurkiewicz, "Operations research: Applications and algorithms," by Wayne L. Winston, duxbury Press, Boston, 1987, 1025 pages, *Networks*, vol. 19, no.05, pp. 616–618, 1989.
[5] G.B. Dantzig, *Linear Programming and Extensions*, New Jersey: Princeton University Press, 1963.
[6] H.A. Taha, *Operations Research: An Introduction. 8th Edition*, Pearson Prentice Hall, Upper Saddle River, 2007.

[7] N.V. Reinfeld and W.R. Vogel, *Mathematical Programming*, New Jersey: Prentice-Hall, Englewood Cliffs, 1958.
[8] M.M Ahmed, A.R. Khan, M.S. Uddin and F. Ahmed, “A New Approach to Solve Transportation Problems”, *Open Journal of Optimization*, vol. 5 no. 1, p.9, 2016.
[9] M.S. Uddin, M.N. Islam, dan I. Raeva, “Efficiency of Allocation Table Method For Solving Transportation Maximization Problem,” *Processing of The Union of Scientists – Ruse*, 13, p.40, 2016.
[10] W.S. Utami, dan S. Diwandari, “Implementasi Algoritma Allocation Table Method untuk Optimalisasi Pendistribusian Produk Multi Sources dan Multi Destinations, “ *Seminar Nasional Aplikasi Teknologi Informasi (SNATi) Yogyakarta*, pp. A52-A56, 2019.