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International Journal of Applied Business and Information Systems ISSN: 2597-8993 Vol 3, No. 2, September 2019 pp. 45-52 45 DOI: W: http://pubs.ascee.org/index.php/ijabis | E: info@ascee.org Transportation Problem Optimization Systems using The Algorithm of Allocation Table Method Wahyu Sri Utami 1, Saucha Diwandari 2, Aditya Hermawan 3 1,2,3 Department of Information System, Faculty of Information Technology and Electrical Engineering University of Technology Yogyakarta, Sleman Yogyakarta, Indonesia 1 wahyu.utami@staff.uty.ac.id; 2 saucha.diwandari@staff.uty.ac.id; 3 okeaditya988i@gmail.com 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 ARTICLE INFO ABST R ACT Article history: Received July 02, 2019 Revised on August 01, 2019 Accepted August 29, 2019 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. Copyright © 2019 Association for Scientific Computing Electronics and Engineering. All rights reserved. Keywords: System, optimization, transportation, allocation table method ISSN: 2597-8993 International Journal of Applied Business and Information Systems 46 Vol 3, No. 1, March 2018 pp. 45-52 Wahyu Sri Utami et.al (Transportation Problem Optimization System using The Algorithm of Allocation Table Method) Figure 1 shows that S1-Sm are the sources and D1-Dn are destinations.

Cij is the shipping cost, and Xij 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: (1) Constraints: (2) (3) Where Xij 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 Voel’s proa eth (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 Voel’s ppxim tion

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, ISSN: 2597-8993 International Journal of Applied Business and Information Systems 47 Vol 3, No. 2, September 2019 pp. 45-52 Wahyu Sri Utami et.al (Transportation Problem Optimization System using The Algorithm of Allocation Table Method) 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 Start Literature Review Testing Designing Prototyping Implementation Finish Defining Initial Need Decision Making Decision Making ISSN: 2597-8993 International Journal of Applied Business and Information Systems 48 Vol 3, No. 1, March 2018 pp. 45-52 Wahyu Sri Utami et.al (Transportation Problem Optimization System using The Algorithm of Allocation Table Method) 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 D1 D2 D3 D4 F1 3 1 7 4 300 F2 2 6 5 9 400 F3 8 3 3 2 500 Demand 250 350 400 200 Table 2. Result of Calculation for Case-1 Factories Showrooms Capacity D1 D2 D3 D4 F1 3 300 1 7 4 300 F2 250 2 6 150 5 9 400 F3 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 ISSN: 2597-8993 International Journal of Applied Business and Information Systems 49 Vol 3, No. 2, September 2019 pp. 45-52 Wahyu Sri Utami et.al (Transportation Problem Optimization System using The Algorithm of Allocation Table Method) 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 D1 D2 D3 D4 S1 50 60 100 50 20 S2 80 40 70 50 38 S3 90 70 30 50 16 Demand 10 18 22 24 ISSN: 2597-8993 International Journal of Applied Business and Information Systems 50 Vol 3, No. 1, March 2018 pp. 45-52 Wahyu Sri Utami et.al (Transportation Problem Optimization System using The Algorithm of Allocation Table Method) Table 4.

Result of Calculation for Case-2 Sources Destinations Supply D1 D2 D3 D4 S1 10 50 60 100 10 50 20 S2 80 18 40 6 70 14 50 38 S3 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 D1 D2 D3 O1 4 3 5 90 O2 6 5 4 80 O3 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. ISSN: 2597-8993 International Journal of Applied Business and Information Systems 51 Vol 3, No. 2, September 2019 pp. 45-52 Wahyu Sri Utami et.al (Transportation Problem Optimization System using The Algorithm of Allocation Table Method) 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. Koruko lu and S.

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