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COST OPTIMIZATION ANALYSIS USING NORTH WEST CORNER AND VOGEL'S APPROXIMATION METHODS AT CV MITRA VISI PERSADA

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ABSTRACT

Background: The success of cost optimization in distribution logistics largely depends on the choice of effective methods to minimize expenses while maintaining service quality.
Purpose: This research aims to optimize shipping costs at CV Mitra Visi Persada by applying the North West Corner and Vogel's Approximation methods, focusing on identifying the most efficient solution.
Design/methodology/approach: The study employs a quantitative descriptive approach, analyzing shipping data from 2022 and 2023 using QM for Windows V5 software. Transportation optimization models were constructed, and cost calculations were conducted using both methods, North West Corner (NWC) Method and Vogel's Approximation Method (VAM)
Findings/Result: The results show that by applying these optimization methods, shipping costs were reduced from IDR307,016,000 to IDR197,120,600, achieving potential annual savings of IDR109,895,400. The verification indicates that both North West Corner and Vogel's Approximation methods provide feasible and effective solutions for cost minimization.
Conclusion: This study's findings support the feasibility of implementing quantitative optimization strategies to enhance distribution efficiency at CV Mitra Visi Persada.
Originality/value: This research is original in its practical application of two classical transportation methods within the operational context of a medium-scale logistics company, demonstrating clear financial impact.

Keywords: cost optimization, distribution, north west corner, transportation method, vogel's approximation

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INTRODUCTION

The Internet is a global network that connects thousands or even millions of computer networks (local/wide areal network) and personal computers (stand alone), allowing each computer connected to it to contact many computers at any time and from anywhere in this hemisphere to send news, obtain information, or transfer data (Warsita, 2008). Currently, the Internet is widely used by all circles, and according to the Indonesian Internet Service Providers Association (APJII, 2023), the number of Internet users in 2023 will reach 78.19% of the total population of 215 million people, an increase of about 1.17% compared to 2022 of around 210 million people. This increase is driven by the use of the internet, which has become a necessity for society. From the information on Internet development, the author wishes to conduct research on a company based on Wi-Fi installation service providers and the distribution of Wi-Fi equipment that the author will research for this research. CV Mitra Visi Persada is the company that the author chose for research because it was only established in 2020. Despite its growth, the company faces increasing distribution costs, prompting the need for optimized shipping strategies.

CV Mitra Visi Persada, which was founded in 2020 and is located in Durenjaya, Bekasi City, this company distributes products such as Wi-Fi equipment, CCTV equipment, handles requests from companies that need services to procure laptops/computers and their equipment, serves Wi-Fi installation, CCTV, and also installs laptop/computer software supported by professional human resources. The company distributes Wi-Fi and CCTV equipment to consumers, such as electronic stores in Jabodetabek, and is also used to meet the needs of Wi-Fi and CCTV installation. The company has several types of products including optical cables, xframe closure, pigtail, rosette, patch cord, lan cables, CCTV, and laptops of various brands. Shipping goods is an activity of distributing goods from producers to consumers and is an important part of a company's operational cost spending activity to meet consumer needs (Rahmawati, 2022). The right decision to distribute goods can reduce costs and affect the smooth operation to achieve maximum profit (Ramadhani, 2017). As in economic principles, the maximum profit is achieved by spending the minimum possible cost. To optimize transportation costs, a transportation method that can solve and optimize transportation performance with the aim of saving costs and distances is needed. The transportation method is a technique used to distribute goods from origin to destination which is designed in such a way as to produce optimal costs (Lestari & Christy, 2018).

The company distributes its products to the Jabodetabek area using three units of its own Daihatsu Gran Max. In 2023, there is a problem in the Jabodetabek area because the distribution for the Jabodetabek area is experiencing a decrease compared to the previous year, but the costs incurred increased.

Figure 1 shows the average total shipments and shipping costs incurred for the Jabodetabek area using self-owned vehicles in 2022 and 2023, respectively. From the data above, in 2023, the total shipments decreased from 110,069 shipments to 108,228 shipments. However, the decrease in the average total shipments was not followed by a decrease in shipping costs; in contrast, there was an increase in shipping costs from IDR 305,793,000.00, in 2022, to IDR 307,016,000.00, in 2023. Shipping is crucial in operational cost structures (Rahmawati, 2022). Efficient shipping decisions can reduce costs and enhance operational performance (Ramadhani, 2017). Therefore, it is essential to adopt appropriate transportation methods.

Previous studies have examined the effectiveness of transportation methods such as the Northwest Corner (NWC) and Vogel's Approximation Method (VAM) in optimizing logistics operations (Lestari & Christy, 2018; Hermanto et al., 2017). However, few studies have specifically applied these methods to medium-sized enterprises in Indonesia's technology-distribution sector. This study offers a novel contribution by implementing and validating these classical methods in the real operational setting of CV Mitra Visi Persada.

This study employed a quantitative descriptive approach. The shipping cost data from 2022 and 2023 were analyzed using QM for Windows V5 software. Transportation models were developed using the Northwest Corner and Vogel's approximation methods, with the optimum solution verified using the Modified Distribution Method (MODI).

Figure 1. Total shipments and shipping costs in 2022 and 2023

The purpose of this study is to formulate an optimized distribution strategy by applying transportation methods to reduce the total shipping costs incurred by CV Mitra Visi Persada and to determine whether the North West Corner or Vogel's approximation method provides the most cost-effective solution.

METHODS

Quantitative data were used in this study are quantitative data. The source of the data comes from secondary data, namely shipping data (volume of shipments and shipping costs) from CV Mitra Visi Persada for the periods 2022 and 2023. Data were obtained from internal company records on shipping activities and associated costs.

The technique of data collection used is documentation study, in which researchers collect historical shipping data recorded by the company, including the number of deliveries, types of destinations, vehicle capacity, and shipping costs for each delivery route.

Table 1 represents the transportation problem in atrix form, which is used to determine the optimal distribution from a number of sources to a number of destinations, with the objective of minimizing the total shipping cost.

- Rows represent sources (e.g. factories or warehouses), with the total supply of each denoted a1,a2,...,am.
- Columns represent destinations (e.g., stores or consumers), with their respective total demand denoted as b1, b2,...,bn.
- Cij denotes the transportation cost per unit from source-i to destination-j
- Xij denotes the number of units of goods shipped from source-i to destination

The analysis methods used are: North West Corner (NWC) and Vogel's Approximation Method (VAM):

North West Corner (NWC)

As the name implies, this method starts by allocating the maximum amount of load in the upper-left corner using the following steps: Allocate the demand value according to the existing supply value, and put it in row 1 and column 1; Cross out the row or column with zero demand or supply value (because the row or column is no longer used). If there are two or more zero inventory and demand values, choose one of the rows or columns to cross out arbitrarily; Allocate the inventory value adjusted to the demand value under the column or to the right of the row that is not crossed; Repeat steps b and c until all demand and inventory values have been allocated; Find the minimum cost value by summing all allocations and multiplying the allocations with the total profit.

Vogel's Approximation Method (VAM)

We create a matrix that shows the demand for each source and transportation cost per unit; Find the difference between the two smallest costs in each row column; Choose the largest difference among the differences calculated in the first step; Adjust the supply and demand to show the allocations that have been made. Eliminate all rows and columns in which supply and demand have been exhausted; If not all offers and demands have been satisfied, go back to step 1 if all the offers and demands of the initial solution are satisfied.

Table 1. Transportation Table

Form	To	Destination				Offer
		1	2	3	n	
Source	1	C11 X11	C12 X12	C13 X13	C1n X1n	a1
	2	C21 X21	C22 X22	C23 X23	C2n X2n	a2
	3	C31 X31	C32 X32	C33 X33	C3n X3n	a3
	m	Cm1 Xm1	Cm2 Xm2	Cm3 Xm3	Cmn Xmn	am
Demand		b1	b2	b3	bn	

Source: Heizer & Render (2016)

Table 2. Shipping Cost per Unit

To Form	Jakarta	Bogor	Depok	Tangerang	Bekasi
Car 1 (IDR)	1.800	1.895	1.775	1.950	1.720
Car 2 (IDR)	1.800	1.895	1.775	1.950	1.720
Car 3 (IDR)	1.800	1.895	1.775	1.950	1.720

The framework of this study begins by identifying the problem of inefficient shipping costs at CV Mitra Visi Persada. Shipping and cost data for 2022 and 2023 were then collected. Subsequently, the Northwest Corner and Vogel's approximation methods were applied to find initial feasible solutions. The optimized results were compared with the company's existing shipping costs to determine the best cost-saving strategy.

RESULTS

This calculation uses the transportation method with QM for windows V5 software application. In using the software, there are three transportation methods, namely the North West Corner (NWC) method and the Vogel's Approximation (VAM) method. Calculations were made based on existing data. Here, is the shipping cost provided by the company.

Table 2, Shipping Cost per Unit" presents the unit transportation costs from three different cars (Car 1, Car 2, and Car 3) to five destination cities: Jakarta, Bogor, Depok, Tangerang, and Bekasi. Each value in the table indicates the shipping cost (in Indonesian Rupiah - IDR) required to transport one unit of goods from a specific car to a specific city. Interestingly, the shipping costs are consistent across all cars for each respective city. For instance, the cost from any of the cars to Jakarta is IDR 1,800 per unit, while shipments to Bogor cost IDR 1,895 per unit, to Depok IDR 1,775 per unit, to Tangerang IDR 1,950 per unit, and to Bekasi IDR 1,720 per unit.

This uniformity suggests that the shipping cost is likely determined by the destination alone rather than the vehicle used for transport. This table is essential for planning optimal logistics and cost-effective distribution strategies, especially when integrating supply and demand data to minimize total transportation expenses.

Table 3 presents the shipping cost from the source destination per unit from three sources (labeled Car 1, Car 2, and Car 3) to five destination cities (Jakarta, Bogor, Depok, Tangerang, and Bekasi) for the year 2023. The costs per unit are displayed in Indonesian Rupiah (IDR).

Each car incurs identical shipping costs to each destination: Jakarta: IDR 1,800; Bogor: IDR 1,895; Depok: IDR 1,775; Tangerang: IDR 1,950; Bekasi: IDR 1,720. The supply available from each car is 36.076 units, summing up to a total supply of 108.228 units across all three cars. Demand from each destination is also provided: Jakarta: 30.523 units; Bogor: 17.627 units; Depok: 18.494 units; Tangerang: 19.238 units; Bekasi: 22.346 units. The total demand also amounts to 108.228 units, indicating that the transportation model is balanced, meaning that the total supply equals the total demand. This table forms the basis for solving a transportation optimization problem, where the objective is typically to minimize the total shipping cost while satisfying both supply and demand constraints.

Analyzing Shipping Costs Using the North West Corner (NWC) Method

From the transportation table above, and then processed using QM for Windows V5 Software, the following results were obtained:

Based on Figure 2, the North West Corner (NWC) method using QM for Windows V5 software, the most optimal result is IDR 197,120,600, - in the box that says "Optimal solution value" in Figure 2.

Table 3. Shipping Cost From Source Destination 2023

To / Form	Jakarta	Bogor	Depok	Tangerang	Bekasi	Supply (shipping)
Car 1	IDR 1.800	IDR 1.895	IDR 1.775	IDR 1.950	IDR 1.720	36.076
Car 2	IDR 1.800	IDR 1.895	IDR 1.775	IDR 1.950	IDR 1.720	36.076
Car 3	IDR 1.800	IDR 1.895	IDR 1.775	IDR 1.950	IDR 1.720	36.076
Demand	30.523 shipping	17.627 shipping	18.494 shipping	19.238 shipping	22.346 shipping	108.228 / 108.228

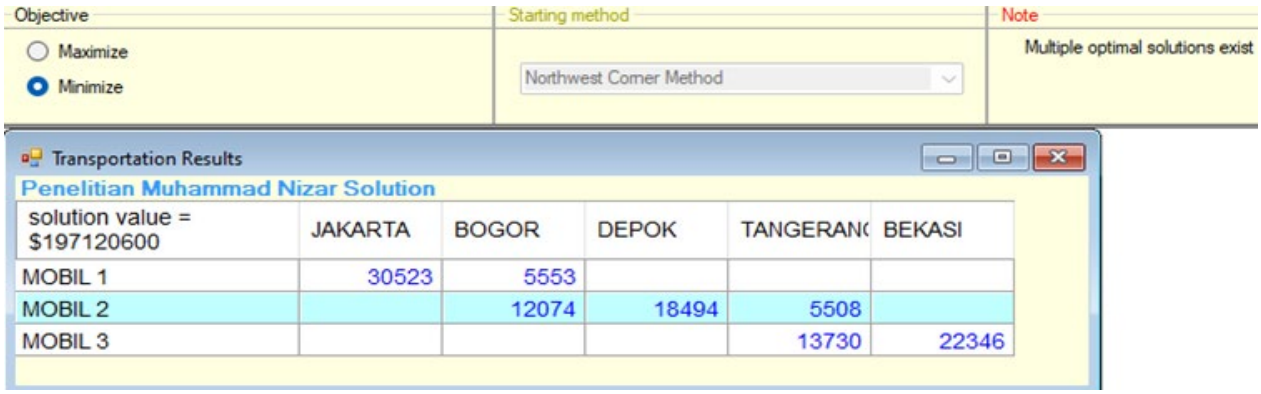


Figure 2. Optimal Results Using the North West Corner (NWC) Method

In Figure 3, there is one iteration: iteration occurs if the optimal result is not found, and the iteration stops if there is an optimal result. In the above figure, the iteration only occurs once and obtains the optimal result. The optimal cost results for each vehicle are as follows:

The Jakarta area uses one vehicle, namely, car 1, to deliver 30,523 units at a cost of IDR1,800/unit. Thus, the total shipping costs for the Jakarta area were IDR 54,941,400. This cost was calculated by multiplying the number of items to be shipped by the shipping cost per unit, which was 30,523 × IDR1,800 = IDR54,941,400.

The Bogor area uses two vehicles, namely car 1 to deliver 5,553 units at a cost of IDR1,895/unit and car 2 to deliver 12,074 units at a cost of IDR1,895/unit. Thus, the total shipping cost for the Bogor area is IDR 33,403,165. This cost is calculated by multiplying the number of items to be shipped by the shipping cost per unit, namely, (5,553 × IDR1,895) + (12,074 × IDR1,895) = IDR33,403,165.

The Depok region uses one vehicle, namely, car 2, to deliver 18,494 units at a cost of IDR1,775/unit. Thus, the total shipping cost for the Depok area was IDR 32,826,850. This cost was calculated by multiplying the number of items to be shipped by the shipping cost per unit, which was 18,494 × IDR1,775 = IDR32,826,850.

The Tangerang region uses two vehicles, namely car 2 to deliver 5,508 units at a cost of IDR1,950/unit and car 3 to deliver 13,730 units at a cost of IDR1,950/unit. Thus, the total shipping cost for the Tangerang area was IDR 37,514,100. This cost is calculated by multiplying the number of items to be shipped by the shipping cost per unit, namely, (5,508 × IDR1,950) + (13,730 × IDR1,950) = IDR37,514,100.

The Bekasi area uses one vehicle, namely, car 3, to deliver 22,346 units at a cost of IDR1,720/unit. Thus, the total shipping cost for the Bekasi area was IDR 38,435,120. This cost was calculated by multiplying the number of items to be shipped by the shipping cost per unit, which was 22,346 × IDR1,720 = IDR38,435,120.

Analyze Cost Shipping Using the Method Vogel's Approximation (VAM) Method

From the transportation table, and then processed using QM for Windows V5 Software, the following results were obtained:

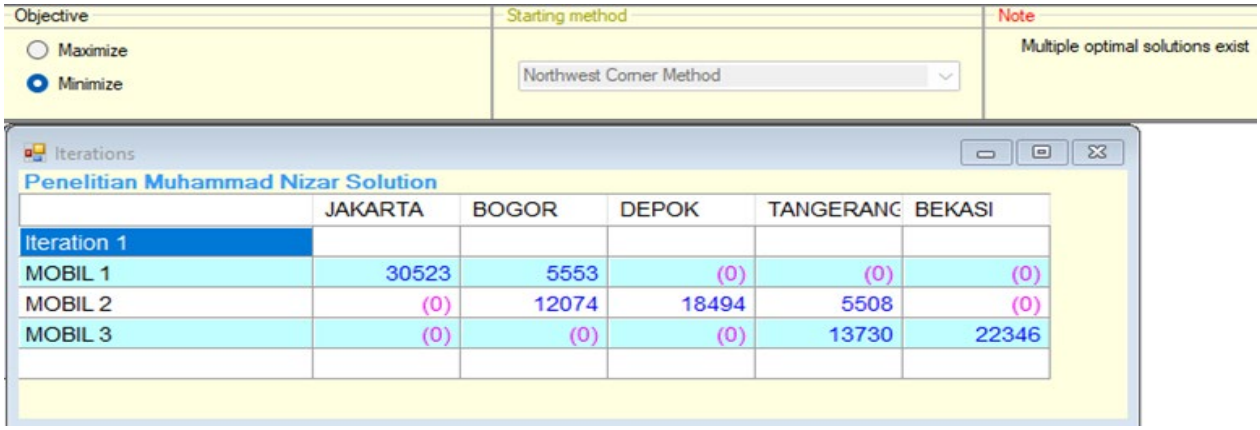
Based on Figure 4, the Vogel's Approximation (VAM) method using QM for Windows V5 software, the most optimal result is IDR 197,120,600, - in the box that says "Optimal solution value" in Figure 4.

In Figure 5, there is one iteration: iteration occurs if the optimal result is not found, and the iteration stops if there is an optimal result. In the above figure, the iteration only occurs once and obtains the optimal result. The optimal cost results for each vehicle are as follows:

The Jakarta area uses one vehicle, namely, car 2, to deliver 30,523 units at a cost of IDR1,800/unit. Thus, the total shipping costs for the Jakarta area were IDR 54,941,400. This cost was calculated by multiplying the number of items to be shipped by the shipping cost per unit, which was 30,523 × IDR1,800 = IDR54,941,400

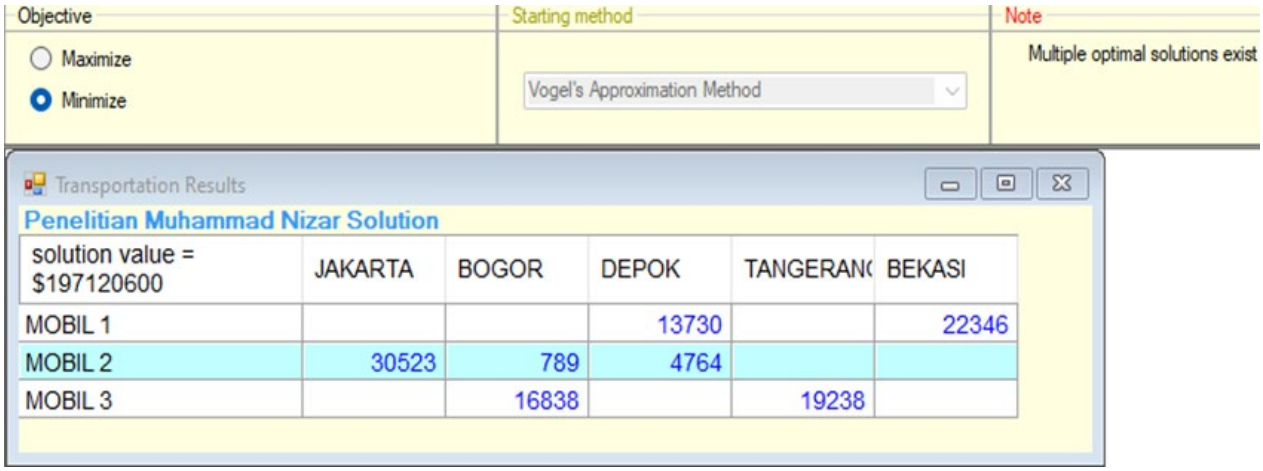
The Bogor area uses two vehicles, namely car 2 to deliver 789 units at a cost of IDR1,895/unit and car 3 to deliver 16,838 units at a cost of IDR1,895/unit. Thus, the total shipping cost for the Bogor area is IDR 33,403,165. This cost is calculated by multiplying the number of items to be shipped by the cost of shipping goods per unit, namely, (789 × IDR1,895) + (16,838 × IDR1,895) = IDR33,403,165.

The deposit area uses two vehicles, namely car 1 to deliver 13,730 units at a cost of IDR1,775/unit and car 2 to deliver 4,764 units at a cost of IDR1,775/ unit. Therefore, The total shipping cost for the Depok area was IDR 32,826,850. This cost is calculated by multiplying the number of items to be shipped by the cost of shipping goods per unit, namely, (13,730 × IDR1,775) + (4,764 × IDR1,775) = IDR 32,826,850.



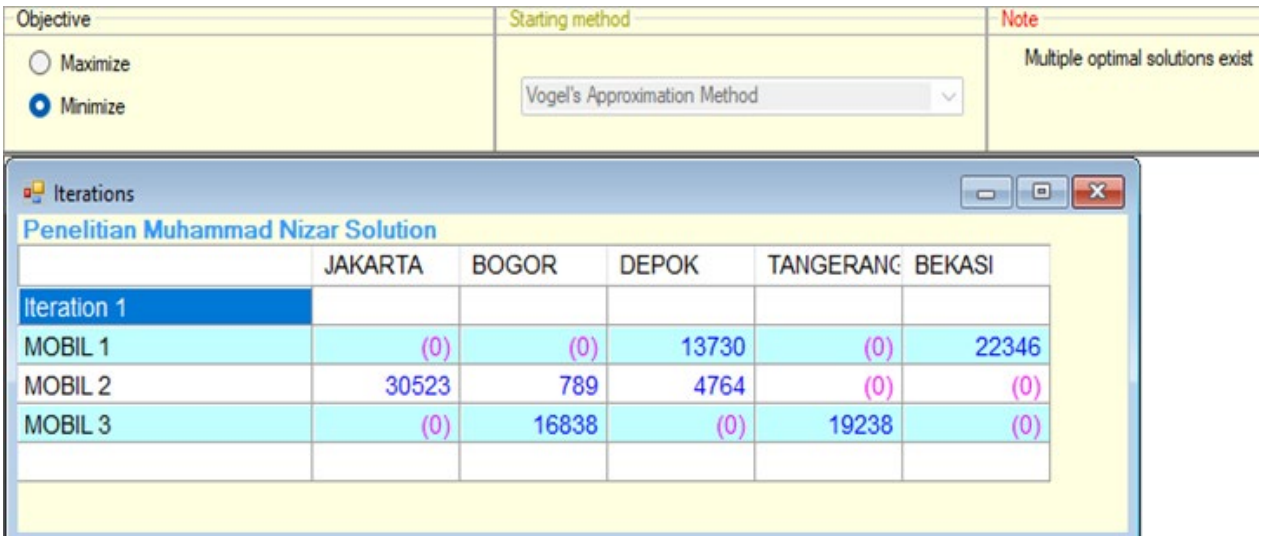
	JAKARTA	BOGOR	DEPOK	TANGERANG	BEKASI
Iteration 1					
MOBIL 1	30523	5553	(0)	(0)	(0)
MOBIL 2	(0)	12074	18494	5508	(0)
MOBIL 3	(0)	(0)	(0)	13730	22346

Figure 3. Iteration Using the North West Corner (NWC) Method



solution value = $197120600	JAKARTA	BOGOR	DEPOK	TANGERANG	BEKASI
MOBIL 1			13730		22346
MOBIL 2	30523	789	4764		
MOBIL 3		16838		19238	

Figure 4 Optimal Results Using Vogel's Approximation Method (VAM)



	JAKARTA	BOGOR	DEPOK	TANGERANG	BEKASI
Iteration 1					
MOBIL 1	(0)	(0)	13730	(0)	22346
MOBIL 2	30523	789	4764	(0)	(0)
MOBIL 3	(0)	16838	(0)	19238	(0)

Figure 5. Iteration Using Vogel's Approximation Method (VAM)

The Tangerang region uses one vehicle, namely car 3, to deliver 19,238 units at a cost of IDR1,950/unit. Thus, the total shipping cost for the Tangerang area was IDR 37,514,100. This cost is calculated by multiplying the number of goods to be shipped by the cost of shipping goods per unit, namely, 19,238 × IDR1,950 = IDR37,514,100.

The Bekasi area uses one vehicle, namely, car 1, to deliver 22,346 units at a cost of IDR1,720/unit. Thus, the total shipping cost for the Bekasi area was IDR 38,435,120. This cost is calculated by multiplying the number of items to be shipped by the cost of shipping goods per unit, namely, 22,346 × IDR1,720 = IDR38,435,120.

After the author analyzed the transportation method, namely the North West Corner method and the Vogel's Approximation method using QM for windows V5 software, the results were obtained with a shipping cost of IDR197,120,600, with calculations that have been optimized using the MODI method. Meanwhile, the calculation of shipping costs that have been running in the company is IDR 307,016,000, which means that the shipping costs incurred by the company are not optimal.

Implication Manajerial

This study's findings have several important managerial implications. First, the CV Mitra Visi Persada should standardize the use of quantitative methods such as NWC and VAM in the logistics decision-making process to ensure cost-effectiveness and operational efficiency. Implementing these methods can provide a systematic and data-driven approach to shipping allocations, thereby reducing subjective or experience-based decisions that may not be optimal.

Second, the company must invest in logistics and operations management training for staff to enhance their understanding and application of optimization tools. Proficiency in software such as QM for Windows V5 can improve the accuracy and speed of decision making.

Third, management should establish a periodic evaluation framework in which the actual distribution costs are compared with optimized models. Regular monitoring ensures that deviations are quickly identified and corrected.

Finally, the cost savings achieved should be strategically reinvested in expanding operational capacity, improving customer service, or adopting more advanced logistics technologies, thereby strengthening the company's competitive advantage.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The optimal cost of shipping goods in the company using the North West Corner method and the Vogel's Approximation method is IDR 197,120,600. The cost

of running for 2023 is IDR 307,016,000. Based on the calculations and analysis obtained, the method that has been running for 2023 is not optimal and efficient, so the company can use one of the transportation methods between the North West Corner method and the Vogel's Approximation method. By using one of the transportation methods, the company will reduce costs by IDR109,895,400.

The solution that the company should choose is to ship goods using either the North West Corner method or the Vogel's Approximation method, because the company will get the optimal cost compared to the current method.

Recommendations

Implementation of Transportation Methods: The company should adopt the Northwest Corner or Vogel's Approximation Method for daily distribution planning to optimize shipping costs.

1. Integration of Digital Tools: It recommended to utilize logistics management software such as QM for Windows or more advanced ERP systems to effectively automate and monitor the distribution process.
2. Training and Development: Regular training programs should be provided for logistics and operations teams to enhance their skills in cost optimization and software usage.
3. Periodic Evaluation: Management should conduct quarterly evaluations comparing actual distribution costs with optimized models to ensure continuous improvement.
4. Strategic Reinvestment: The savings achieved through optimization should be reinvested in expanding the company's service coverage, upgrading distribution facilities, and enhancing customer satisfaction initiatives.

By implementing these recommendations, the CV Mitra Visi Persada can significantly enhance its operational efficiency, reduce unnecessary expenses, and maintain a competitive edge in the logistics and service distribution industry.

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