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Transportation Model to Optimize Shipping Costs at PT Tiki Jalur Nugraha Ekakurir (JNE) Medan

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Abstract. This study aims to develop and analyze a transportation model to optimize the cost of shipping goods at PT Tiki Jalur Nugraha Ekakurir (JNE) Medan Branch Office which is driven by the challenges of cost management amidst the rapid growth of the logistics sector. The method used is a transportation model, specifically the initial solution approach North West Corner (NWC) and Vogel's Approximation Method (VAM), with the help of the POM QM application for Windows. The data processed includes the capacity of three large warehouses (gateways), namely Aceh, Kisaran, Pekanbaru and three small warehouses (dropcenters), namely Amplas, Gatot Subroto, Marelan, as well as the cost of shipping goods. The results of the initial allocation comparison show that both the NWC and VAM methods produce the same total transportation cost, namely Rp 5,477,900. However, this cost is not optimal. Furthermore, the calculation of the separate minimum driver wage using the Assignment Method resulted in a cost of Rp 578,000,- which is much lower than the total wage based on the NWC/VAM allocation of Rp 967,000,-. In conclusion, to achieve optimal operational cost efficiency, it is recommended that the allocation of goods distribution be integrated with the results of driver wage cost optimization.

Keywords: Transportation Model, Shipping Cost Optimization, North West Corner (NWC), VAM

1. INTRODUCTION

The logistics and freight forwarding sector at the national level The national economy is experiencing rapid growth driven by increased commercial digital activity. such as e-commerce and dynamics community preferences in activity consumption , especially in big cities like Medan [1] . This is proven by the surge in demand for package delivery services. [2] . In a company, logistics management has a vital role in optimizing the distribution of goods, namely ensuring process efficiency and ensuring the fulfillment of customer requests. To simplify the implementation of distribution tasks, most companies choose to use logistics support services due to the many requirements related to the demands of business organizations [3] . One of them company expedition the biggest namely PT Tiki Jalur Nugraha Ekakurir (JNE) Established on November 26, 1990, the company plays a crucial role in the national supply chain. However, the simultaneous increase in shipping *volume* also presents significant challenges, particularly in managing transportation costs. Shipping operational costs, including fuel, fleet maintenance, and labor wages, are often the largest cost component that can impact a company's profitability. Therefore, optimizing routes and transportation models is an absolute must to maintain competitiveness and operational efficiency.

The JNE Branch Office in Medan operates in a unique and challenging context, making the need for an adaptive and optimal transportation model and goods distribution system crucial. Achieving efficiency in the distribution of goods from warehouse facilities to the hands of end consumers is key to maintaining profitability and meeting customer expectations in this region. Reducing costs associated with shipping goods will certainly lead to increased profits for a business, and vice versa [4] . The core of operational efficiency lies in the selection of optimal routes. Optimal routes are the driving force for an effective distribution system, ensuring that each delivery vehicle can minimize the distance traveled.

When distance is successfully minimized, the chain effect is very significant, directly affecting various cost elements. Based on research [5] , reducing travel distance automatically reduces transportation costs, especially fuel consumption, speeds up delivery service travel times, reduces pollution levels, and minimizes the amount of energy expended for the entire process. Through strategic route planning and distribution of goods, companies can achieve substantial optimization of shipping costs. This cost optimization extends beyond the route on the road, to the use of internal resources. With good planning, JNE can optimize the use of resources such as more efficient workforce assignments and warehouse facility arrangements that facilitate the *loading process* , so that the entire distribution process becomes smoother and more cost-effective [6] . Conversely, without proper optimization in route determination and fleet management, JNE is at high risk of experiencing losses. The potential

for wasted costs due to inefficient routes, high increases in fleet idle time due to being stuck in traffic or unproductive waiting time, or the use of fleets that are not in accordance with capacity (for example, sending small packages with large trucks) will drastically increase the cost per unit of goods. Therefore, for JNE, implementing a route and distribution optimization model is not just an operational improvement, but a strategic necessity to ensure business continuity and competitiveness through significant reductions in shipping costs.

The complexity of freight networks involving multiple *nodes* , varying fleet capacities, and delivery time constraints makes this problem ideal for solving using Operations Research approaches [7] . Linear programming is a very successful strategy for addressing various optimization challenges, especially in efficient transportation route management [8] . Transportation models serve as instruments for determining the appropriate distribution of shipments with the aim of achieving the most profitable transportation costs. Methods used in transportation engineering to achieve the lowest possible transportation costs include: 1) *North West Corner (NWC)* ; 2) *Least Cost* ; and 3) *Vogel Approximation Method (VAM).* [9] . The next stage after these three approaches involves the use of the *Stepping Stone method* [10] . Several previous studies have shown the successful implementation of this model in various logistics contexts [11] ; [12] .

This research focuses on implementing the most optimal transportation model for the allocation of goods delivery from large warehouses *(Gateway)* to several JNE *drop centers* in Medan City so as to achieve minimum shipping costs. The implementation of this research is to analyze and manage a transportation model that is able to optimize the allocation of goods delivery routes at JNE and ultimately, determine the minimum total shipping costs that can be achieved. In supporting internal logistics operations from *the gateway* to *the drop center* , JNE operates an independent fleet of route vehicles. land namely *Grand Max* . Optimization of shipping costs in this process is attempted through a transportation modeling approach. This study applies the *North West Corner (NWC)* and *Vogel's Approximation Method (VAM) methods* to find more efficient distribution solutions [13] . In line with the findings in studies [14] and [15] , the use of *VAM has been proven to accelerate and simplify resource allocation to various destinations. With the help of POM* software *QM for Windows* [16] ; [17] , this research is expected to produce strategic recommendations for increasing operational efficiency at JNE.

2. RESEARCH METHOD

This research relies on direct observation of the company and uses interviews to collect information (primary data). This involves requesting data from employees or company managers. JNE's business operations, such as routes and package delivery costs, form the basis for the research questions. The company manages three main storage warehouses *(gateways)* located in Aceh, Kisaran, and Pekanbaru, as well as three smaller storage warehouses *(drop centers)* located in Marelan , Amplas , and Gatot Subroto . The information collected indicates that goods are transported daily, with drivers earning between Rp100,000 and Rp250,000.

The data for this study was compiled from summary reports from the main warehouse (gateway) and its distribution warehouses *(drop centers) . This information provides details regarding* inventory availability at *the gateway* and *the volume* of demand at each branch *(drop center),* as follows:

Table 1. Large Warehouse Storage *(Gateaway)*

Gateway	**Storage *Gateway* (Kg/Day)**
Aceh	5800
New Week	7400
Range	3100
TOTAL	**16300**

Source: Storage Data JNE *Gateway* 2025

Table 2. Small Warehouse Storage *(Dropcenter)*

Transit Warehouse	**Request *Drop Center* (Kg/Day)**
Sandpaper	4750
Gatot Subroto	3400
Marelan	7100
TOTAL	**15250**

Source: JNE 2025 Demand Data

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Car fleet *Grand Max pick-up* operated For distribute goods and package from the gateway to the JNE drop center in the Medan area . details cost transportation can seen in the table below This :

Table 3. Shipping Costs for Goods from Warehouse to Destination

No.	Track Expedition	Cost Delivery / Kg	Cost Delivery Packages From *Gateway* to *Drop Center*
		Cost /Kg	Cost / Ton
1.	Aceh→ Sandpaper	355	355000
2.	Aceh→ Gatot Subroto	357	357000
3.	Aceh→ Marelan	400	400000
4.	Week New → Sandpaper	402	402000
5.	Week New → Gatot Subroto	405	405000
6.	Pekanbaru → Marelan	409	409000
7.	Range → Sandpaper	252	252000
8.	Range → Gatot Subroto	255	255000
9.	Range → Marelan	300	300000

Source: Land Management Data Details JNE Expedition Costs (Driver Fee + Fuel) in 2025

3. RESULTS AND DISCUSSION

The research scheme in the transportation model is taken based on data that has been obtained by considering the capacity of large warehouses *(Gateaway)* and small warehouse capacity *(dropcenter)* as well as the cost per kilogram for each distribution. Packages from the three *gateways* are sent to each JNE *drop center* in Medan. The following is a schematic of the allocation table used to optimize JNE shipping costs :

Table 4. JNE Goods Delivery Allocation Table

To / From	Destination Warehouse *(Drop Center)*						Capacity *Gateway*
	Sandpaper		Gatot Subroto		Marelan		
Gateway Aceh		355		357		400	5,800
Gateway Week New		402		405		409	7,400
Gateway Range		252		255		300	3,100
Capacity *Drop Center*	4,750		3,400		7,100		

Source: JNE Data Processing Capacity, Demand, and Shipping Costs for 2025

The data obtained above was then processed using *the North West Corner (NWC) method* , namely as follows:

Table 5. Results of *the NWC Method*

To / From	Destination Warehouse *(Drop Center)*						*Dummy*
	Sandpaper		Gatot Subroto		Marelan		
Gateway Aceh	1650	355	3400	357	750	400	
Gateway Week New		402		405	6350	409	1050
Gateway Range	3100	252		255		300	

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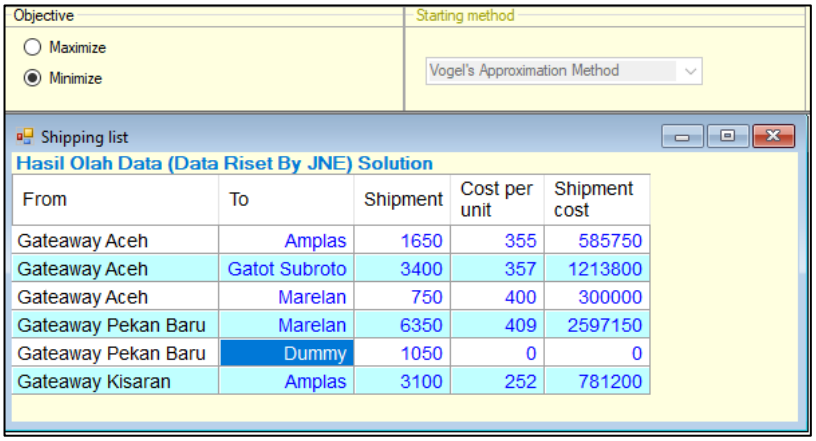
Capacity *Drop Center*	4,750	3,400	7,100	

Source: Data Processing on Capacity Allocation, Demand, JNE Expedition Costs

Based on the application of the NWC method, the accumulated package distribution costs from *the gateway* to *the dropcenter* produce a value of Z = (1650 x 355) + (3400 x 357) + (750 x 400) + (6350 x 409) + (3100 x 252) = Rp. 5,477,900,- with an additional dummy: 1,050 Kg.

A comparative analysis was conducted by applying the *VAM method* to find the optimal distribution cost solution in addition to the *NWC method* . The results of the cost calculations using the *POM application QM for Windows* with the *VAM approach* is described as follows:



From	To	Shipment	Cost per unit	Shipment cost
Gateaway Aceh	Amplas	1650	355	585750
Gateaway Aceh	Gatot Subroto	3400	357	1213800
Gateaway Aceh	Marelan	750	400	300000
Gateaway Pekan Baru	Marelan	6350	409	2597150
Gateaway Pekan Baru	Dummy	1050	0	0
Gateaway Kisaran	Amplas	3100	252	781200

Figure 1. Total Cost of *VAM Method POM QM software for Windows*
Source: Data Processing Using *POM QM for Windows*

Although *the VAM* and *NWC methods* produce the same total transportation cost, namely Rp 5,477,900, this cost is not yet the minimum (optimal) cost. Therefore, the initial allocation results from one of the methods (for example, *NWC*) will then be tested and refined to achieve the minimum distribution cost using the *Stepping Stone (SS) method.*

The distribution process from *the gateway* to *the dropcenter* uses the *NWC method* , which is then tested for efficiency using the *SS method* , resulting in the following transportation cost details:

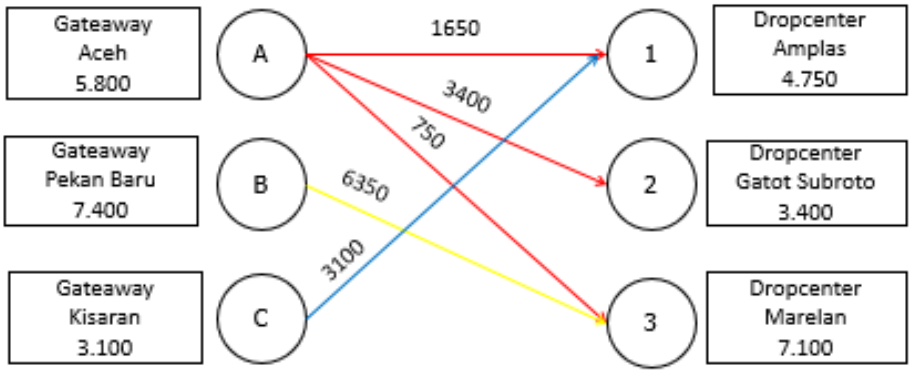


Figure 2. Shipping Cost Path
Source: JNE Goods Delivery Route Data Processing in 2025

The next step involves calculating driver compensation. The data, sourced internally by the company, is presented in detail in the following table:

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Table 6. Driver Compensation

Gateway	*Drop Center*		
	Sandpaper	**Gatot Subroto**	**Marelan**
Aceh	Rp . 189,000	Rp . 195,000	Rp . 185,000
Week New	Rp . 212,000	Rp . 220,000	Rp . 225,000
Range	Rp . 173,000	Rp . 192,000	Rp . 179,000

Source: JNE Driver Compensation in 2025

After obtaining the driver cost data, the total driver wages are calculated based on the delivery allocations generated by the *NWC* and *VAM methods* . The calculation details are as follows:

Table 7. Driver Compensation Allocation Based on Delivery Route

No.	***Gateway***	***Drop Center***	**Cost Driver**
1.	Aceh	Sandpaper	Rp . 189,000
2.	Aceh	Gatot Subroto	Rp . 195,000
3.	Aceh	Marelan	Rp . 185,000
4.	Week New	Marelan	Rp . 225,000
5.	Range	Sandpaper	Rp . 173,000
	TOTAL		**Rp.967,000**

Source: Compensation Allocation Data for 2025

POM QM for Windows software . The optimal assignment results are presented in the following table:

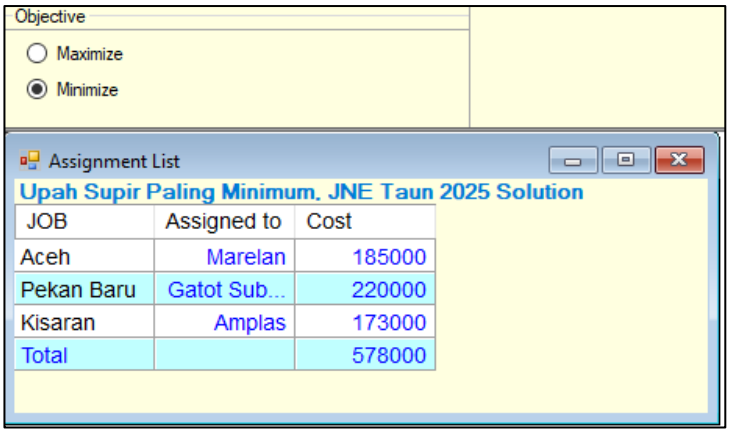

Figure 3. Cheapest Driver Cost Allocation
Source: POM QM Data Processing *for Windows*

4. CONCLUSION

Based on the analysis of transportation problems in the delivery of goods/packages at the JNE company, two main findings were obtained. First, the comparison of the initial allocation using the *North West Corner Method (NWC)* and *the Vogel's Approximation Method (VAM)* resulted in identical total transportation costs, namely Rp. 5,477,900 ,-. Second, there is a significant difference in the calculation of driver wages. The minimum driver wage cost calculated separately using the Assignment Method is Rp. 578,000,-. However, when the driver cost is calculated based on the delivery allocation generated by the *NWC/VAM Method,* the total cost that must be incurred jumps to Rp. 967,000,-. This difference indicates that the *feasible distribution allocation (NWC/VAM)* has not been integrated with labor cost optimization (Assignment Method). Therefore, to achieve the company's main goal of obtaining maximum profit with minimal expenditure, it is recommended that the distribution allocation of goods be adjusted and integrated with the results of driver wage cost optimization, so that a more efficient and optimal total distribution operational cost is obtained.

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