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## **IMPLEMENTATION OF THE SAVING MATRIX METHOD TO DETERMINE VEHICLE ROUTES**

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**Abstract** *The availability of the number of vehicles in Karawang Regency is not matched by the availability of fuel at gas stations. Due to the very high demand for fuel, the Cikampek BBM Terminal has several problems, including the absence of a standard distribution route in distributing its products to gas stations so that it takes a long time and the high amount of transportation costs that must be borne by the company. In this study, the route and distribution schedule will be determined as well as determining the capacity and number of tanker trucks that are able to minimize mileage, travel time and transportation costs. Based on calculations using the Saving Matrix method, it produces efficiency in the number of vehicles needed from 7 trucks to 4 tanker trucks, vehicle usage from 9 times to 6 times, distance traveled from 63 KM to 53 KM and the difference in transportation costs per day is Rp. 1,312,633.*

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## **Introduction**

Distribution management is one of the factors that must be considered by companies for product distribution to consumers (Suryanto & SE, 2016). So it plays an important role in the company. Because in meeting customer demand, it is not enough to just fulfill the total demand, but also service problems, the timeliness of product delivery is the main concern of consumers (Adriantantri, Irawan, & Indriani, 2015). Distribution costs can be reduced by calculating all factors correctly so that time, distance and energy are used efficiently and effectively.

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Adequate transportation is closely related to distribution (Salsabila, 2021). For this reason, it is necessary to clearly know the distribution channel, total customer demand and the capacity of the transportation means used, so that distribution can be carried out efficiently and effectively (Momon & Ardiatma, 2018).

PT PERTAMINA (Persero) Cikampek BBM Terminal in distributing its products to gas stations in Cikampek has several problems, one of which is the high total transportation costs that must be borne by the company. Coupled with the absence of a clear standard distribution route so that gas stations have to wait for a long supply of fuel from tanker trucks that are distributing to other gas stations because the truck must first return to the depot for refilling and the distribution schedule is inconsistent every day (Supardi & Sianturi, 2020).

To anticipate this problem, a method is needed that can provide minimal product distribution costs (MOCHAMAD ARIF WIBOWO, 2019). The Saving Matrix method is a method used to determine product distribution routes to marketing areas by determining the distribution routes that must be passed and total vehicles based on vehicle capacity in order to obtain the shortest route and minimal transportation costs (Tyas, Dzulqarnain, & Aini, 2020).

Distribution Management is a matter that covers all aspects of the process of delivering products to consumers, because this activity is very important in the marketing system, effective and efficient distribution can accelerate goods to be marketed (Suryanto & SE, 2016). According to Suhardi Sigit, the distribution channel is a path traversed by the flow of goods from producers to intermediaries to consumers (Laksono, 2017). Manufacturers must consider various factors that are very influential in the selection of distribution channels. The selection of an effective distribution channel will be able to encourage the expected increase in sales, so that the survival of the company can be guaranteed (Mardhiyah & Safrin, 2020).

Transportation is defined as the business and activity of transporting or carrying goods and or passengers from one place to another (Yasmin & Wirawan, 2018). In addition, the carriage or transfer of passengers or goods by transportation is to reach the destination and increase the utility or usability of the goods being transported. Each form of transportation has four main elements of transportation, namely roads, vehicles and means of transportation, propulsion, and terminals (Munawar, n.d.). In the modern transportation system, transportation is an integral part of the functions and activities of society. There is a very close relationship with lifestyle, range, location of production activities, fulfillment of goods, and services available for consumption (Suparjo, 2017).

This research at PT Pertamina Terminal BBM Cikampek will arrange distribution routes and schedules and determine the capacity and total tank truck vehicles that are able to minimize mileage, travel time, and transportation costs. Some of the benefits from the results of this study are expected to provide useful input and information for the company, including knowing an effective and efficient premium distribution schedule so that it can speed up delivery, minimize transportation costs, and increase company profits, then be able to determine the capacity and total truck vehicles. the right tank according to the total demand for premium so that the problem of high demand can be resolved, and can find out the distribution route that can be a distribution standard for every day so that it can facilitate the delivery of fuel to gas stations.

### **Research Method**

The Savings Matrix method is also one of the techniques used to schedule a limited total of vehicles from facilities that have a maximum capacity (Erlina, 2009). The Saving Matrix method consists of several steps. According to (Istantiningrum, 2010) the steps in the saving matrix method are as follows:

1. Determining the Distance Matrix  
In determining the distance matrix, data on the distance between the company and the location of the destination is very necessary. After knowing the coordinates of each location.
2. Determine the Saving Matrix  
After knowing the overall distance, namely the distance between the company and other destination locations, that in this step it is assumed that each location will be passed by one truck specifically.
3. Allocation of Vehicles and Routes by Location  
After the results of the saving matrix are known, the next step is the allocation between locations to routes or vehicles.

The research was conducted by PT. Pertamina Cikampek BBM Terminal which carries out the distribution of BBM (Fuel Oil). The data collection method used is Interview, then conduct a review or direct observation to the field by taking data on the related company. Total delivery data, total vehicles and total customers are taken from the data for the last 3 months. Conducting interviews with related parties to find out the existing problems in order to map the system as a whole in the distribution process with actual time and data. And the final stage is the conclusion of the overall research that has been done and suggestions for the development of research in the future.

### **Result and Discussion**

PT. PERTAMINA (Persero) Cikampek BBM Terminal has a distribution area in Kab. Karawang. Peralite is a product that is needed in the community, so the demand

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for pertalite is high. The average daily demand for pertalite and a list of gas stations in the Kab. Karawang and the distance data from the depot to each gas station taken from google maps can be seen in Table 1. Distribution of fuel to gas stations PT. Pertamina Cikampek BBM Terminal uses tanker trucks. Tank trucks available at the company are trucks with a capacity of 3 units of 16 kiloliters and 4 units of 24 kiloliters. A truck with a capacity of 24 kiloliters has a higher fuel cost than a truck with a capacity of 16 kiloliters.

One tanker truck requires 1 driver and 1 assistant. In this study, transportation costs consist of variable costs and fixed costs, salaries for drivers and assistants, including fixed costs. Fixed costs will decrease if the number of drivers and assistants is reduced by reducing the number of tanker trucks. Salaries of drivers and assistants within 25 days are presented in table 1.

Table 1. Number of requests and distance from TBBM to gas stations

SPBU Code	Request (Kiloliter)	Distance from TBBM to SPBU (KM)
34.41305	20	1.7
34.41304	29	7.3
34.41307	31	1.3
34.41332	30	3
34.41315	32	3.2
Total	142	

Table 2. Truck Cost Data per Kilometer

No	Truck Capacity	Usage	BBM Price	Distance	Cost per KM
1	16	1	9,500	3	3,166.667
2	24	1	9,500	2	4,750

Table 3. Driver and Kernet Salary Data

No	Position	Salary	Number of Days	Salary per day
1	Supir	4,200,000	25	168,000
2	Kernet	4,000,000	25	160,000

Table 4. Data for the Distribution of Delivery Stages

SPBU Code	Request (Kiloliter)	Phase 1	Phase 2
34.41305	20	20	0
34.41304	29	24	5
34.41307	31	24	7
34.41332	30	24	6
34.41315	32	24	8

The system used in the distribution is direct shipment, for round trips, the distance from the depot to the gas station is multiplied by 2.

Table 5. Transportation Costs Phase 1

Route	Phase 1 (Kiloliter)	Cap. Tank Truck (Kilometer)	Cost/KM (Rp)	Distance From Depot (KM)	Variable Cost
0-1-0	20	24	4,750	3.4	16,150
0-2-0	24	24	4,750	14.6	69,350
0-3-0	24	24	4,750	2.6	12,350
0-4-0	24	24	4,750	6.0	28,500
0-5-0	24	24	4,750	6.4	30,400
Total	116			33	156,750

Table 6. Transportation Costs Phase 2

Code	Phase 2 (Kiloliter)	Cap. Tank Truck (Kilometer)	Cost/KM (Rp)	Distance From Depot (KM)	Variable Cost
0-2-0	5	16	3,166.7	14.6	46,233
0-3-0	7	16	3,166.7	2.6	8,233
0-4-0	6	16	3,166.7	6	19,000
0-5-0	8	16	3,166.7	6.4	20,267
Total	26			29.6	93,733

Table 7. Number of trucks used

Vehicle	Total Initial	Usage	Number of Queue
Premium 16 KL	3	4	1
Premium 24 KL	4	5	1

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Total	7	9	3
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From the calculation results, the total variable costs are obtained, namely the first stage transportation costs plus the second stage transportation costs. Total fixed costs are obtained from the total number of vehicles used.

$$\begin{aligned} \text{Total Variable Cost} &= \text{Rp. } 250,483 \\ \text{Total Fixed Cost} &= ((7 \text{ sopir} \times 168.000) + (7 \text{ kernet} \times 160.000)) \\ &= \text{Rp. } 2,296,000 \\ \text{Total Transportation} &= \text{Total Variable Cost} + \text{Total Fixed Cost} \\ &= \text{Rp. } 250,483 + \text{Rp. } 2,296,000 \\ &= \text{Rp. } 2,546,483,- \end{aligned}$$

**Table 8. Distribution of Delivery Matrix Saving Method**

SPBU Code	Phase 1	Phase 2
34.41305	8	12
34.41304	24	5
34.41307	24	7
34.41332	8	22
34.41315	8	24
Total	72	70

**Table 1. Distance SPBU Data**

Depot	0	1	2	3	4	5
0	-	1.7	7.3	1.3	3	3.2
34.41305	1	-	6.9	1.5	0.5	1.9
34.41304	2	2	-	5.7	7.5	7.6
34.41307	3	3	3	-	3.1	3.2
34.41332	4	4	4	4	-	0.8
34.41315	5	5	5	5	5	-

**Table 2. Savings Matrix**

	0	1	2	3	4	5
0	-					
1	1	-	2.1	1.5	4.2	3
2	2	2	-	2.9	2.8	2.9
3	3	3	3	-	1.2	1.3
4	4	4	4	4	-	5.4
5	5	5	5	5	5	-

Table 3. Distance Saving Route

Route	Distance
4,5	5.4
1,4	4.2
1,5	3
2,3	2.9
2,5	2.9
2,4	2.8
1,2	2.1
1,3	1.5

Table 12. Transportation Costs Phase 1 Saving Matrix Method

Route	Phase 1 (Kiloliter)	Cap. Tank Truck (Kilometer)	Cost/KM (Rp)	Distance From Depot (KM)	Variable Cost
0-4-5-1-0	24	24	4,750	7.40	35,150
0-2-0	24	24	4,750	14.60	69,350
0-3-0	24	24	4,750	2.60	12,350
Total	72			24.60	116,850

Table 13. Transportation Costs Phase 2 Saving Matrix Method

Route	Phase 2 (Kiloliter)	Cap. Tank Truck (Kilometer)	Cost/KM (Rp)	Distance From Depot (KM)	Variable Cost
0-4-0	22	24	4,750	6	28,500
0-5-0	24	24	4,750	6.4	30,400
0-1-2-3-0	24	24	4,750	15.6	74,100
Total	70			28	133,000

Table 14. Number of Trucks used by the Saving Matrix Method

Vehicle	Number of Initial	Usage	Phase 1	Phase 2
Premium	24 KL	3	3	3
Total		3	3	3

Total Variable Cost = Rp. 249,850

Total Fixed Cost = ((3 sopir x 168.000) + (3 kernet x 160.000))  
= Rp. 984,000

Total Transportation = Total Variable Cost + Total Fixed Cost  
= Rp. 250,483 + Rp. 984,000

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= Rp. 1,233,850

From the calculations that have been carried out, the following results are obtained:

Table 4. Comparison of Calculation Results

No	Comparison Factor	Initial Value	Saving Matriks Method
1	Mileage	63	53
2	Number of Vehicles	7	3
3	Vehicle Usage	9	6
4	Transportation Fee	2,546,483	1,233,850

### Conclusion

Based on result and discussion can be concluded that the saving matrix method produces efficiency in total vehicle needs from 7 trucks to 4 tanker trucks, vehicle usage from 9 times to 6 times, distance traveled from 63 KM to 53 KM and the difference in transportation costs per day is Rp. 1,312,633.

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