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Article

Analysis of Fuel Distribution at Pertashop at PT XYZ

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ABSTRACT

PT. XYZ is a company involved in various activities related to fuel oil (BBM), such as receiving, storing, and distributing it to gas stations or Pertashop. The process of sending fuel from PT. XYZ to Pertashop is carried out using tanker trucks. One of the problems faced is the limited number of tanker trucks, which can cause delays in fuel delivery, so that the distribution schedule cannot be met properly. In addition, this also reduces the time available for vehicle maintenance and increases the risk of fatigue for tanker truck drivers, which can lead to work accidents. This study aims to find an effective fuel delivery route so that travel time is shorter, so that fuel delivery to various locations can run well and on time. Using the Nearest Neighbor Method, this study can produce a more efficient solution in terms of saving distance when compared to the route currently used by the company. The proposed route with the Nearest Neighbor method has a total distance of 5268.3 km, which is a decrease of 14.49% from the current total distance. The Nearest Neighbor method can also result in savings in the number of tanker trucks, which initially used 119 trucks for 14 days, consisting of 88 tanker trucks with a capacity of 8,000 L and 31 tanker trucks with a capacity of 16,000 L. 41 tanker trucks with a capacity of 16,000 L, which has a savings in the number of tankers of 13.44%

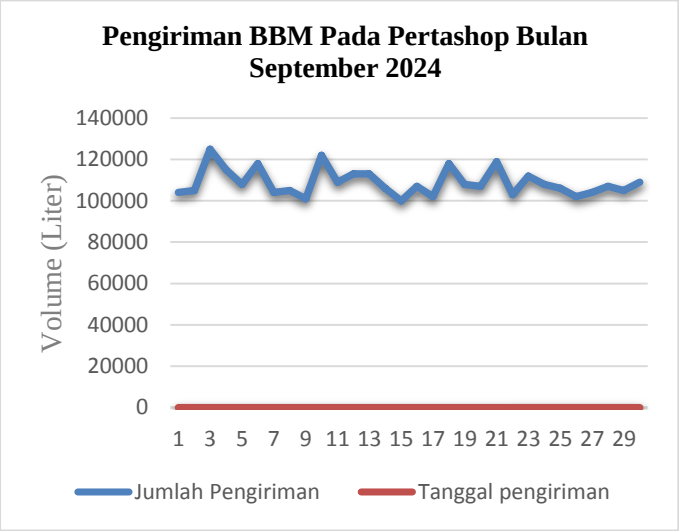
1. BACKGROUND

1.1 Introduction

Fuel Oil (BBM) is an energy derived from fossils that is very much needed in everyday life. Along with the increasing human population and the growing industry in Indonesia, so that the distribution process has increased, making distribution activities at the BBM Terminal increase, indicating the need for larger tanker cars to meet the needs of Fuel Oil (BBM).

Terminal BBM XX is a terminal that has various activities related to BBM such as receiving, storing and distributing BBM to gas stations or Pertashop. Pertashop is a small-scale Pertamina distribution institution that serves consumers with non-subsidized BBM, non-subsidized LPG, lubricants, and other retail Pertamina products.not yet served by other Pertamina distribution agencies. Pertashop outlets offer an easier way for people to meet their vehicle fuel needs without having to go far to regular gas stations. Pertashop outlets offer environmentally friendly fuel products such as the Pertamax Series at the same price as regular gas stations. With many pertashops spread across various locations, this can create challenges in carrying out efficient distribution, especially when there are different geographical constraints, regulations, and road conditions in each region. (Pokhrel 2024)

Distribution is one of the main functions in the logistics system, which involves the flow of products from manufacturers or distribution centers to customers through a transportation network and is a very expensive function. (Kasih and Maulidina 2023). The supply and distribution department regulates the transportation flow and also the operating system of the tanker car which is the basis of the distribution process. The process of distributing fuel from PT.XYZ to pertashop uses tanker cars. Distribution activities with tanker cars aim to meet the needs of consumers and the community with a total of 12 working areas with 300 pertashop points. PT. XYZ uses tanker cars with a capacity of 5 KL and 16 KL to distribute to pertashop while for gas stations it uses tanker cars with a capacity of 24 KL and 32 KL. Currently, PT.XYZ has 8 tanker cars with a capacity of 5 KL and 3 tanker cars with a capacity of 16 KL that distribute pertamax to pertashop. However, with the increase in the establishment of pertashop which has an impact on the high number of daily requests which causes the number of tanker cars to be insufficient for fuel distribution.



Picture1. Pertashop Shipping Data

Based on figure 1.fuel delivery data to Pertashop, PT. XYZ carries out the distribution process every day with an average delivery of 108,833 liters for 12 regions. The fuel distribution fleet consists of 8 tankers with a capacity of 5 KL with a total transport capacity of 40,000 liters of fuel, and 3 tankers with a capacity of 16 KL which can load up to 48,000 liters of fuel. Thus, the total daily transport capacity of the fleet reaches 88,000 liters, but the capacity is still below the average daily requirement of 108,833 liters, which indicates a difference in shipping needs that need to be met to ensure smooth fuel distribution throughout the region.

The shortage of tankers can cause delays in fuel deliveries,so that the distribution schedule cannot be met properly. This also reduces the allocation of car maintenance time and increases the risk of fatigue in tanker crews which can result in work accidents. Therefore, PT.XYZ requires further analysis in determining the optimal number of tanker cars and developing a more efficient distribution system. In addition, PT. XYZ needs to determine the right fuel distribution route so that travel time is shorter, so that fuel delivery to various regions can run smoothly and on time.

The high demand for fuel makes ordering and delivery to Pertashop almost every day. To meet these needs, PT XYZ as the manager of the tanker truck is responsible for arranging the delivery and assignment of tanker trucks to each Pertashop, supported by a well-integrated operational system. However, until now, the determination of the distribution route is stilldone manually, with the delivery destination determined based on the subjectivity of the related parties. Observations show that there are Pertashops served by two tanker trucks with different routes, although they can actually be optimized using one tanker truck according to demand capacity. In addition, there are no clear instructions for the Tanker Truck Crew (AMT) regarding the order of delivery or the distribution route that must be taken, so that the distance traveled becomes longer and transportation costs increase.

The tanker trucks used in distribution have a certain capacity that must be optimized to support

efficiency.Therefore, it is necessary to design a distribution route that can utilize the maximum capacity of the tanker truck. Determining the distribution route aims to minimize the total distance traveled so that distribution costs can be significantly reduced. By ensuring the distance between Pertashops on one route is minimal, the distance traveled by the tanker truck can be minimized, which ultimately contributes to savings in operational costs.

Based on this problem, it can be concluded that PT. XYZ has problems in determining the need for tankers for fuel distribution to Pertashop and determining the most optimal distribution route because there is no direction in the fuel distribution process to Pertashop. Therefore, the company needs to make an effort to overcome these problems by determining the number of tankers based on the area to be distributed, determining the number of tankers based on the tanker's transport capacity and determining the fuel distribution route to Pertashop using distance savings and route grouping based on the closest distance so that the optimal number of tankers and efficient travel distance will be obtained.

1.2 Research Purposes

This research aims todevelop a more efficient distribution system, increase operational effectiveness, and ensure a smooth supply of fuel for the community in the future.

2. LITERATURE REVIEW

This literature review contains a review of research from previous researchers. There are several studies that are related to the research to be conducted, as follows.

Research conducted by Yudha Satria Prawira and Kushariyadi entitled "Analysis of Tanker Truck Needs in the Distribution Process at PT. XYZ Integrated Terimial Gas Station". The study revealed that the demand for tanker trucks continues to increase due to increasing daily demand, so an analysis is needed to determine the optimal number of tanker trucks.(Satria Prawira 2023)

Furthermore, research conducted by Erwin Indra Prasetyo and Indrianawati Usman entitled "Increasing the Number and Placement of Subsidized Fertilizer Distribution Warehouses in East Java as an Impact of Changes in Government Policy". This research revealed that there were around 33 buffer warehouses in the studied area, of which 25 were selected and 8 other warehouses were not used.(Erwin Indra Prasetyo and Usman 2023)

Next, research by Anhesa Nialanov Putri entitled "Optimization of the Number of Tank Cars in Fuel Distribution Using Cluster and Proportional Methods at PT Pertamina Integrated Terminal". Explains that the use of tank cars in the distribution process is considered not optimal due to the lack of tank cars, damaged tank cars and so on. Determination of the number of tank cars is carried out using the proportional method so that it produces 113 tank cars needed.(Princess 2022)

Furthermore, research by Yunaik, Muhammad Siddiq Abdillah entitled "Determination of Tanker Truck Needs in the Fuel Distribution Process to Pertashop at PT.XYZ. Explains that the distribution of fuel to Pertashop is delayed due to the inadequate number of cars, resulting in less than satisfactory service in fuel delivery times, so calculations are needed to calculate the number of tanker trucks using the cluster and proportional methods based on capacity.(Yuna and Abdillah 2023)

Furthermore, research conducted by Sonna Kristina and Wasingten entitled "Application of Classification Methods on Algorithms to Determine Modes and Routes to Reduce Transportation Costs". This study shows that the classification method has a positive impact on the selection of mode routes, the number of vehicles can be reduced when compared to the rayon system. The total transportation cost at PT XYZ in January 2017 using the rayon system was Rp661,227. By applying the nearest neighbor clustering method, the total transportation cost became Rp594,635, which means there is a reduction in total transportation costs of Rp66,529 or 10.07%. While with the nearest neighbor clustering method, the total transportation cost became Rp571,722, recording a decrease in total transportation costs of Rp89,505 or 13.54%.%.(Kristina and Wasingten 2019)

3. METHODOLOGY

This study uses a descriptive quantitative approach that begins with data collection through direct observation in the field, interviews with related parties at PT. XYZ, and internal company documentation, which is then supplemented with literature studies as secondary data. The data obtained is analyzed using the clustering method to group distribution areas based on geographical distance, and the proportional method to determine the allocation of the number of tankers based on the available transport capacity. Furthermore, distribution route planning is carried out using the Vehicle Routing Problem (VRP) approach, especially by applying the Saving Matrix method and the Nearest Neighbor algorithm, in order to compile the most efficient distribution route by considering the shortest distance, time savings, and optimization of the fuel distribution fleet to each Pertashop

4. Results and Discussion

Data collection

The research conducted at PT.XYZ aims to determine the minimum tanker truck requirements and determine the optimal route in distributing fuel from TBBM to Pertashop by conducting an analysis using the VRP (vehicle routing problem) method.

Distribution to Pertashop

PT. XYZ is one of Pertamina's companies as a distribution center (DC) for fuel oil products. PT.XYZ is a fuel depot for consumers in some areas of northern Central Java. The consumers of this depot are gas stations. The product delivery system is based on consumer orders.men on one day before delivery. The list of orders will be

collected by the Sales Service division in the form of loading orders, and then forwarded to the distribution division to create a distribution plan.

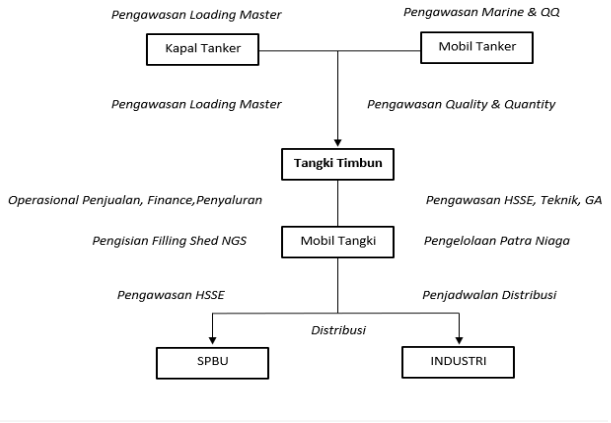


Figure 2. Operational Process Data

The fuel distribution process in Figure 4.1 shows that the fuel distribution process goes through several stages, namely from the tanker filling the fuel tank to the storage tank which is supervised by the loading master and quality quantity, then from the storage tank it will be distributed to the tanker car to be sent to each pertashop and gas station. The fuel distribution process to pertashop is carried out when pertashop orders and pays for fuel, then the request will enter the Company's system and the fuel will be sent so that the delivery process can be carried out if there is a request from pertashop. In sending fuel to pertashop using a tanker car with a capacity of 8 Kiloliters and 16 Kiloliters which can send fuel to several pertashop locations.

Vehicle Data

There are 3 types of vehicles used by PT.XYZ in distributing its products. The types of vehicles used are tanker trucks that are red and blue. The red tanker truck is used for gas stations and pertashops located at the delivery point from TBBM, while the blue tanker truck is used to serve industrial companies, such as PT KAI, PT PLN, TNI and POLRI. On tanker trucks for industry, a basket is added to the top of the tank according to the company's request.

Figure 3. 8 kl capacity tanker

Figure 4. 16 kl capacity tanker

Data processing

In this data processing, the calculation and determination of the current route and the processing of proposed data based on the distance matrix will be carried out. The distribution will be calculated using the nearest neighbor method according to the company's conditions with calculations that have been carried out comparing the calculations with the nearest neighbor with the current company's conditions.

Clustering

In the application of clustering, the centroid value is generated from the data obtained with the condition that the grouping to be determined is 2. The determination of the cluster is divided into two parts, namely the long-distance level cluster (C1) and the closest distance level cluster (C2), so there are 2 centroid points, namely:

Table 1. Centroid Point

Attribute	Value(Km)
The Farthest Distance	204
Closest Distance	12

By using the centroid, the data that has been obtained can be clustered into several clusters. The grouping process by determining the closest distance from each processed data.

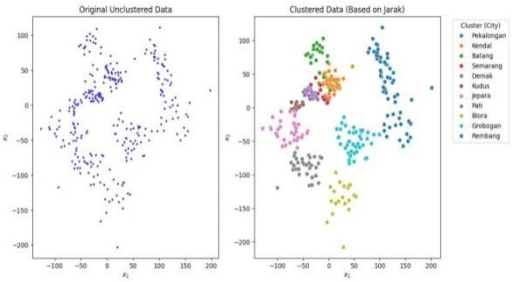


Figure 5. Regional clustering

Fromclustering above, it can be obtained the division of clusters into 4 based on the existing distance interval, namely Cluster 1 (Batang, Kendal, Semarang), Cluster 2 (Pekalongan), Cluster 3 (Demak, Kudus, Jepara, Pati) and Cluster 4 (Grobogan, Rembang, Blora).

Table 2.Cluster

No	Pertashop Code	Distance (P)	Objective Delivery	No	Pertashop Code	Distance (PP)	Shipping Destination	No	Pertashop Code	Distance (P)	Shipping Destination
1	4P50201	41	Semarang	28.	4P51313	35.8	Kendal	55.	4P51338	42	Kendal
2	4P50601	55	Semarang	29.	4P51310	48	Kendal	56.	4P51339	40	Kendal
3	4P50102	13.2	Semarang	30.	4P51316	40.2	Kendal	57.	4P51335	57	Stem
4	4P50203	20	Semarang	31.	4P51314	51	Kendal	58.	4P51201	84	Stem
5	4P50204	23	Semarang	32.	4P51315	22	Kendal	59.	4P51202	75	Stem
6	4P50205	35	Semarang	33.	4P51317	38.5	Kendal	60.	4P51203	111	Stem
7	4P50206	12	Semarang	34.	4P51318	40	Kendal	61.	4P51303	33	Stem
8	4P50207	15	Semarang	35.	4P51319	49	Kendal	62.	4P51204	98	Stem
9	4P50103	23	Semarang	36.	4P51320	63.5	Kendal	63.	4P51205	91	Stem
10	4P50208	21	Semarang City	37.	4P51321	38.5	Kendal	64.	4P51206	102	Stem
11	4P50210	18	Semarang City	38.	4P51322	27	Kendal	65.	4P51207	93	Stem
12	4P50211	24	Semarang	39.	4P51323	40	Kendal	66.	4P51208	1	Stem
13	4P50104	24	Semarang City	40.	4P51324	53	Kendal	67.	4P51201	84	Stem
14	4P50710	54	Semarang Regency	41.	4P51325	46	Kendal	68.	4P51209	55	Stem
15	4P50214	20	Semarang City	42.	4P51326	48	Kendal	69.	4P51211	106	Stem
16	4P50215	35	Semarang City	43.	4P51328	37	Kendal	70.	4P51212	101	Stem
17	4P50206	12	Semarang	44.	4P51329	40	Kendal	71.	4P51213	84	Stem
18.	4P51301	44	Kendal	45.	4P51327	60	Kendal	72.	4P51214	64	Stem
19.	4P51302	85	Kendal	46.	4P51330	71	Kendal	73.	4P51215	94	Stem
20.	4P51304	45	Kendal	47.	4P51333	40	Kendal	74.	4P51217	93	Stem
21.	4P51305	60	Kendal	48.	4P51334	46	Kendal	75.	4P51216	93	Stem
22.	4P51306	30	Kendal	49.	4P51332	49	Kendal	76.	4P51218	100	Stem
23.	4P51307	47	Kendal	50.	4P51331	51	Kendal	77.	4P51219	85	Stem
24.	4P51308	40	Kendal	51.	4P51335	57	Kendal	78.	4P51220	100	Stem
25.	4P51309	43	Kendal	52.	4P51336	53	Kendal	79.	4P51221	51	Stem
26.	4P51312	35.3	Kendal	53.	4P51337	55	Kendal	80.	4P51210	98.2	Stem
27.	4P51311	53	Kendal	54.	4P51339	40	Kendal				

Table 3.Cluster 2

No	Pertashop Code	Distance (P)	Shipping Destination	No	Pertashop Code	Distance(P)	Shipping Destination
1	4P.51101	126	Pekalongan	22.	4P51114	108	Pekalongan
2	4P51102	158	Pekalongan	23.	4P51123	123	Pekalongan
3	4P51103	112	Pekalongan	24.	4P51124	121	Pekalongan
4	4P51104	125	Pekalongan	25.	4P51128	121	Pekalongan
5	4P51105	131	Pekalongan	26.	4P51130	129	Pekalongan
6	4P51106	198.8	Pekalongan	27.	4P51126	114	Pekalongan
7	4P51108	109	Pekalongan	28.	4P51129	132	Pekalongan
8	4P51107	104	Pekalongan	29.	4P51127	118	Pekalongan
9	4P51110	108	Pekalongan	30.	4P51125	111	Pekalongan
10	4P51109	107	Pekalongan	31.	4P51132	115	Pekalongan
11	4P51115	105	Pekalongan	32.	4P51131	113	Pekalongan
12	4P51113	124	Pekalongan	33.	4P51133	117	Pekalongan
13	4P51112	126.9	Pekalongan	34.	4P51135	121	Pekalongan
14	4P51111	110	Pekalongan	35.	4P51136	113	Pekalongan
15	4P51116	121	Pekalongan	36.	4P51137	125	Pekalongan
16	4P51118	117	Pekalongan	37.	4P51134	124	Pekalongan
17	4P51117	130	Pekalongan	38.	4P51139	104	Pekalongan
18.	4P51120	106	Pekalongan	39.	4P51138	110	Pekalongan
19.	4P51121	105	Pekalongan	40.	4P51141	150	Pekalongan
20.	4P51119	126	Pekalongan	41.	4P51140	125	Pekalongan
21.	4P51122	108	Pekalongan				

Table 4.Cluster 3

No	Pertashop Code	Distance (P)	Shipping Destination	No	Pertashop Code	Distance (PP)	Shipping Destination	No	Pertashop Code	Distance (P)	Shipping Destination
1	4P59501	36.5	Demak	28.	4P59301	50.5	Holy	56.	4P51339	40	Jepara
2	4P59502	26	Demak	29.	4P59307	60	Holy	57.	4P59421	80	Jepara
3	4P59503	41	Demak	30.	4P59308	57	Holy	58.	4P59422	98	Jepara
4	4P59504	37	Demak	31.	4P59309	66	Holy	59.	4P59423	72	Jepara
5	4P59505	32	Demak	32.	4P59310	72	Holy	60.	4P59424	77	Jepara
6	4P59506	38	Demak	33.	4P59311	63	Holy	61.	4P59427	106	Jepara
7	4P59507	40	Demak	34.	4P59401	90.5	Jepara	62.	4P59428	100	Jepara
8	4P59508	25	Demak	35.	4P59402	73	Jepara	63.	4P59429	91	Jepara
9	4P59509	45	Demak	36.	4P59403	64	Jepara	64.	4P59425	82	Jepara
10	4P59510	24	Demak	37.	4P59404	108	Jepara	65.	4P58101	74	Jepara
11	4P59511	20	Demak	38.	4P59405	64	Jepara	66.	4P59426	78	Jepara
12	4P59512	30	Demak	39.	4P59406	65	Jepara	67.	4P59430	65	Jepara
13	4P59513	47	Demak	40.	4P59407	65	Jepara	68.	4P59431	68	Jepara
14	4P59514	41	Demak	41.	4P59408	94.1	Jepara	69.	4P59432	53	Jepara
15	4P59515	35	Demak	42.	4P59409	130.5	Jepara	70.	4P59433	56	Jepara
16	4P59517	17	Demak	43.	4P59410	115	Jepara	71.	4P59434	85	Jepara
17	4P59518	43	Demak	44.	4P59411	115	Jepara	72.	4P59101	88	Starch
18.	4P59519	26	Demak	45.	4P59412	96.8	Jepara	73.	4P59102	92.5	Starch
19.	4P59516	30	Demak	46.	4P59416	102	Jepara	74.	4P59103	104	Starch
20.	4P59520	28	Demak	47.	4P59414	70	Jepara	75.	4P59105	150	Starch
21.	4P59521	32	Demak	49.	4P59415	108	Jepara	76.	4P59104	93	Starch
22.	4P59301	50.5	Holy	50.	4P59413	69	Jepara	77.	4P59107	104	Starch
23.	4P59302	62	Holy	51.	4P59417	107	Jepara	78.	4P59106	110	Starch
24.	4P59304	72	Holy	52.	4P59418	62	Jepara	79.	4P59108	96	Starch
25.	4P59305	49	Holy	53.	4P59419	70	Jepara	80.	4P59109	106	Starch
26.	4P59303	63.2	Holy	54.	4P59420	69	Jepara	81.	4P59110	87	Starch
27.	4P59306	55	Holy	55.	4P59401	90.5	Jepara	82.	4P59111	103.3	Starch
83.	4P59112	91	Starch	90.	4P59118	86	Starch	97.	4P59124	89	Starch
84.	4P59113	110	Starch	91.	4P59120	103	Starch	98.	4P59125	101	Starch
85.	4P59101	88	Starch	92.	4P59121	88	Starch	99.	4P59128	82	Starch
86.	4P59114	92	Starch	93.	4P59123	74	Starch	100.	4P59129	72	Starch
87.	4P59117	76	Starch	94.	4P59122	118	Starch	101.	4P59130	111	Starch
88.	4P59115	91	Starch	95.	4P59127	105	Starch	102.	4P59131	73	Starch
89.	4P59116	78	Starch	96.	4P59126	116	Starch				

Table 5.Cluster 4

No	Pertashop Code	Distance (P)	Objective Delivery	No	Pertashop Code	Distance (P)	Shipping Destination	No	Pertashop Code	Distance (P)	Shipping Destination
1.	4P58304	166	Blora	28.	4P58107	73	Kendal	55.	4P58136	69	Grobogan
2.	4P58205	113	Blora	29.	4P58109	79	Grobogan	56.	4P58137	67	Grobogan
3.	4P58207	134	Blora	30.	4P58110	90	Grobogan	57.	4P58138	70	Grobogan
4.	4P58206	153	Blora	31.	4P58112	62	Grobogan	58.	4P58134	81	Grobogan
5.	4P58309	120	Blora	32.	4P58113	74	Grobogan	59.	4P58139	93	Grobogan
6.	4P58208	138	Blora	33.	4P58111	35	Grobogan	60.	4P58140	29	Grobogan
7.	4P58310	92	Blora	34.	4P58114	80	Grobogan	61.	4P58141	103	Grobogan
8.	4P58211	135	Blora	35.	4P58115	59	Grobogan	62.	4P59201	149	Rembang
9.	4P58312	204	Blora	36.	4P58116	60	Grobogan	63.	4P59202	114	Rembang
10.	4P58214	107	Blora	37.	4P58117	81	Grobogan	64.	4P59203	140	Rembang
11.	4P58315	130	Blora	38.	4P58121	68	Grobogan	65.	4P59205	156	Rembang
12.	4P58213	140	Blora	39.	4P58120	74	Grobogan	66.	4P59204	107	Rembang
13.	4P58216	114	Blora	40.	4P58119	100	Grobogan	67.	4P59206	159	Rembang
14.	4P58215	150	Blora	41.	4P58118	101	Grobogan	68.	4P59207	151	Rembang
15.	4P58217	137	Blora	42.	4P58123	80	Grobogan	69.	4P59210	116	Rembang
16.	4P58218	118	Blora	43.	4P58122	74	Grobogan	70.	4P59211	105	Rembang
17.	4P58219	115	Blora	44.	4P58126	50	Grobogan	71.	4P59208	127	Rembang
18.	4P58220	115	Blora	45.	4P58125	30	Grobogan	72.	4P59209	137	Rembang
19.	4P58221	132	Blora	46.	4P58127	83	Grobogan	73.	4P59212	156	Rembang
20.	4P58313	135	Blora	47.	4P58124	38	Grobogan	74.	4P59213	152	Rembang
21.	4P58101	44	Grobogan	48.	4P58128	57	Grobogan	75.	4P59214	133	Rembang
22.	4P58102	54.6	Grobogan	49.	4P58130	74	Grobogan	76.	4P59215	110	Rembang
23.	4P58103	43.9	Grobogan	50.	4P58129	70	Grobogan	77.	4P59216	121	Rembang
24.	4P58104	31	Grobogan	51.	4P58131	60	Grobogan	78.	4P59217	135	Rembang
25.	4P58105	87	Grobogan	52.	4P58132	95	Grobogan				
26.	4P58106	83	Grobogan	53.	4P58133	84	Grobogan				
27.	4P58108	64	Grobogan	54.	4P58135	53	Grobogan				

Vehicle Routing Problem (VRP) Solution

The following is a solution using the VRP (Vehicle Routing Problem) method betweenother :

Determining the distance matrix

Distance matrix data is taken from the distance traveled in kilometers (km) from PT. XYZ to Pertashop, and the distance between customers obtained using the Google Maps application which is input during working hours to show actual distance data. In the Google Maps application there are two descriptions which shows the distance and travel time, for the distance it is input into the distance matrix.

The first stage is the distance between the depot and the pertashop location and the distance between one pertashop and another. To find the distance needed between pertashops.Then the results of the distance determination are used to determine the savings matrix for the next step.

	TBBM	50102	50210	59101	59103	59108	59120	59130	59308	59309	59310	59516	59126	59106	59114	59115	59118	59122	59124
	0	13	18	88	104	96	103	111	57	66	72	30	116	110	92	91	86	118	89
50102	13	0																	
50210	18	18	0																
59101	88	53.7	49	0															
59103	104	89.2	96.2	22.8	0														
59108	96	103	109	24.7	16.9	0													
59120	103	112	118	11.9	32.3	33.3	0												
59130	111	100	128	37.9	34.9	17.9	41.8	0											
59308	57	62.5	72.7	35.7	23.4	36.8	45.1	55.6	0										
59309	66	75.5	81.9	33.8	14	30.9	43.2	50	9	0									
59310	72	83.8	90.1	29	6.1	23	38.4	37.2	17.2	7.9	0								
59516	30	33.6	40.2	73.3	61.2	74.7	83	89.9	38.4	47	55.1	0							
59126	116	120	130	39.5	38.3	19.6	40.6	5.5	57.1	55.1	47.6	93.2	0						
59106	110	117	124	33.4	32.1	17.5	35.5	6.3	50.9	49	38.2	88.9	20.2	0					
59114	92	99	112	8.8	26.1	17.6	15.4	28.7	39	37.1	32.1	77	32.9	27.8	0				
59115	91	98.4	90	15.8	20.7	15.8	15.3	26.5	36.3	34.3	34.4	74.3	25.3	20.2	7.6	0			
59118	86	87	106	6	17	23.3	15.4	28.2	33.3	28.2	23.1	71.2	33.5	27.3	9.4	12.7	0		
59122	118	121	131	20.2	42.9	21.2	42.1	7	58.5	56.6	49	96.5	3.4	8.9	34.3	26.8	34.9	0	
59124	89	98.3	105	20.3	9.5	9.7	29.7	23.8	28.9	19.5	11.6	69.8	29.3	32.8	23.6	18.2	14.2	40	0

Figure 7. Pertashop Distance Matrix

Determining the Delivery Order

Table 6.sorting of distance saving values

No	I,J	Saving(Km)	Total Load (L)	Tanker Route
1	59122, 59130	222	2000 + 2000 = 4000	1
2	59126.5 59106	205.8	2000 + 2000 = 4000	1
3	59103, 59124	183.5	2000 + 2000 = 4000	1
4	59103, 59108	183.1	3000	1
5	59115, 59126	181.7	3000 + 2000 = 5000	2
6	59101, 59120	179.1	2000 + 2000 = 4000	2
7	59309, 59310	169.9	2000 + 2000 = 4000	2
8	59114, 59118	168.4	3000 + 2000 = 5000	3
9	59516, 50102	9.4	2000 + 2000 = 4000	3
10	50102, 50210	1.2	2000 + 2000 = 4000	3

Route Grouping

Route Grouping by considering the capacity of the tanker car and the demand from each Pertashop. Based on the previous steps, the order of visits can be determined to form 4 routes and the company has 11 tanker cars consisting of 3 tankers with a capacity of 16 Kl and 8 tankers with a capacity of 8 Kl which will be used as a reference in compiling the route. The following table shows the total distance and number of tankers used from the results of compiling the route .

Table 7.tanker capacity requirements

No	Route	Needs (L)	Tanker Car Capacity (L)
1.	TBBM 59126 – 59106 – 59122 – 59130 – 59108 – 59103 - 59124 TBBM	2000 + 2000 + 2000 + 2000 + 2000 + 2000 + 3000 = 15,000 L	16,000
2.	TBBM – 59101- 59120 – 59114 – 59118 – 59115– 59126 – TBBM	3000 + 2000 +2000 + 2000 + 2000 + 2000 + 2000 = 15,000 L	8,000
3.	TBBM -59309 – 59310 – 59516 – 50102 – 50210 TBBM	3000 + 2000+ 2000 + 2000 + 2000 = 11,000 L	8,000

The following is a grouping of routes using the Nearest Neighbor method obtained from the largest Saving Matrix value.

a. 16,000 L Tanker Car

The travel route consists of TBBM 59126 – 59106 – 59122 – 59130 – 59108 – 59103 - 59124 - TBBM. The travel route formed using the Nearest Neighbor method is:

1) The route starts from TBBM. The nearest Pertashop from the warehouse is customer 59126, the route that is temporarily formed is TBBM -59126.
2) The closest route from customer 59126 is customer 59106, so the route that is temporarily formed is TBBM -59126 – 59106.
3) The closest route from customer 59106 is customer 59122, so the route that is temporarily formed is TBBM-59126 – 59106 – 59122.
4) The closest route from customer 59122 is customer 59130, so the route that is temporarily formed is TBBM -59126 – 59106 – 59122 - 59130
5) The closest route from customer 59130 is customer 59108, so the route that is temporarily formed is TBBM -59126 – 59106 – 59122 – 59130 - 59108
6) The closest route from customer 59108 is customer 59103 so the route that is temporarily formed is TBBM -59126 – 59106 – 59122 – 59130 – 59108 - 59103
7) The closest route from customer 59103 is customer 59124, so the route that is temporarily formed is TBBM -59126 – 59106 – 59122 – 59130 – 59108 – 59103 - 59124
8) Each route starts and ends at TBBM, so the order of the travel route is TBBM -59126 – 59106 – 59122 – 59130 – 59108 – 59103 – 59124 TBBM with a distance of 1231 kilometers.

b. 16,000 L Tanker Car

The travel route consists of TBBM - 59101- 59120 – 59114 – 59118 – 59115 – 59126 - TBBM. The travel route is formed using the methodNearest Neighbor is:

1) The route starts from TBBM. The nearest Pertashop from the warehouse is customer 59101, the route that is temporarily formed is TBBM -59101.
2) The closest route from customer 59101 is customer 59120, so the route that is temporarily formed is TBBM -59101 – 59120.
3) The closest route from customer 59124 is customer 59114, so the route that is temporarily formed is TBBM-59101 – 59120 – 59114
4) The closest route from customer 59114 is customer 59118, so the route formed temporarily is TBBM - 59101 – 59120 – 59114 - 59118.
5) The closest route from customer 59118 is customer 59115, so the route that is temporarily formed is TBBM- 59101 – 59120 – 59114 – 59118 – 59115 - TBBM

Tanker Route September 1, 2024

The following is a grouping of routes on September 1, 2024 as follows:

6) The closest route from customer 59115 is customer 59126, so the route that is temporarily formed is TBBM- 59101 – 59120 – 59114 – 59118 – 59115 – 59126 - TBBM
7) Each route starts and ends at TBBM, so the order of the travel route is TBBM- 59101 – 59120 – 59114 – 59118 – 59115 – 59126 – TBBM with a distance of 987 kilometers.

c. 8,000 L Tanker Car

The travel route consists of TBBM - 59309 – 59310 – 59516 – 50102 – 50210 – TBBM. The travel route formed using the Nearest Neighbor method is:

1) The route starts from TBBM. The nearest Pertashop from the warehouse is customer 59309, the route that is temporarily formed is TBBM -59309 - TBBM
2) The closest route from customer 59309 is customer 59310, so the route that is temporarily formed is TBBM -59309 – 59310 - TBBM
3) The closest route from customer 59310 is customer 59516 so the route that is temporarily formed is TBBM – 59310 – 59309 – 59516- TBBM
4) The closest route from customer 59516 is customer 59102 so the route that is temporarily formed is TBBM – 59310 – 59309 – 59516 – 59102 - TBBM
5) The closest route from customer 59102 is customer 59210 so the route that is temporarily formed is TBBM – 59310 – 59309 – 59516 – 59102 – 50210 - TBBM
6) Each route starts and ends at TBBM, so the order of the travel route is TBBM TBBM – 59310 – 59309 – 59516 – 59102 – 50210 - TBBM with a distance of 283 kilometers.

In the process of writing the calculation is done once, because the scheme of how to determine the route is fixed and does not change. Thus, the writing remains consistent so that it is enough to be written once as a reference for the route of another day.

Distance Analysis

From the results of data processing calculations using the Nearest Neighbor method. Then a comparison can be made between the results of the initial conditions. (existing) with the final condition. The factors compared include the distance traveled and the number of tanker trucks. Analysis of data processing is used to determine the final result of the comparison between the determination of the company's current route and the determination of the proposed route using the Nearest Neighbor solution method based on distance

Current Total Distance Calculation

Table 8.Current Total Distance Calculation

Date	Number of Tank Cars		Total Demand (L)	Total Distance(Km)
	8000 L	16,000 L		
1	3	1	41,000	2590
2	5	2	72,000	3570
3	4	2	70,000	3360
4	5	3	88,000	4000
5	5	2	71,000	3690
6	6	3	99,000	4400
7	5	2	59,000	2900
8	6	2	72,000	3500
9	6	2	74,000	4200
10	6	3	88,000	4100
11	6	2	73,000	3500
12	5	3	72,000	3267
13	5	3	88,000	4100
14	6	3	91,000	4235
Total	75	33	1058000	51412

Total Distance Calculation with VRP

Table 9.Current Total Distance Calculation

Date	Number of Tank Cars		Total Demand (L)	Total Distance(Km)
	8000 L	16,000 L		
1	1	2	41,000	2501
2	3	3	72,000	3540
3	3	3	70,000	3346
4	5	3	88,000	3998
5	3	3	71,000	3345
6	6	3	99,000	4238
7	3	3	59,000	2769
8	3	3	72,000	3330
9	4	3	74,000	4020
10	6	3	88,000	3970
11	4	3	73,000	3420
12	3	3	72,000	3200
13	5	3	88,000	3989

14	6	3	91,000	4190
Total	55	41	1058000	49856

Comparative Analysis

Based on tables 4.10 and 4.11, the percentage of savings in company routes and the number of tankers can be obtained using the nearest neighbor method. The following is the difference between route savings and tankers

a. Total Distance Savings

$$= \frac{total\ jarak\ rute\ perusahaan - total\ jarak\ nearest\ neighbor}{total\ jarak\ perusahaan}\ x\ 100\ \%$$

$$= \frac{51412 - 49856}{51412}\ x\ 100\ \%$$

$$= \frac{1556}{51412}\ x\ 100\%$$

$$= 3.3\%$$

Table 10.Comparison Results Table

	Capacity	Number of Tank Cars		Total Distance
		8000 L	16,000 L	
Company	1058000	75	33	51412
Saving Distance	1058000	55	41	49856

Hypothesis

In this study there are two results, namely route consideration based on distance saving and route determination based on time saving with route sequencing using the Nearest Neighbor method which considers the proximity of the distance. The following are the results of the comparison based on route determination based on distance saving and route determination based on total distance time saving, the initial condition of the company with the Nearest Neighbor method:

1. Based on Distance Saving Matrix

The following is a hypothesis based on the comparison between the total distance, determined based on distance savings.

a. Total Distance Savings

The total initial distance of distribution at this time with 14 working days covers a distance of 51412 km, while the determination of the route using the Nearest Neighbor method based on saving distance covers a distance of 49856 km with a saving of 1556 km or a percentage of 3.3%. This shows that the proposed route using the Nearest Neighbor method based on saving distance is the optimal route because the proposed route has a shorter distance compared to the company's current distance.

5. CONCLUSION

Based on the description and discussion above, this research can be concluded:

a. Optimal Route

Vehicle routes on September 1, 2024 include:

1) 16,000 L tanker: TBBM -59126 – 59106 – 59122 – 59130 – 59108 – 59103 – 59124 TBBM with a distance of 1231 kilometers.
2) 16,000 L tanker: TBBM- 59101 – 59120 – 59114 – 59118 – 59115 – 59126 – TBBM with a range of 987 kilometers.
3) 8,000 L tanker: TBBM – 59310 – 59309 – 59516 – 59102 – 50210 - TBBM with a distance of 283 kilometers.

b. Based on the research above, it was found that the grouping of routes based on saving distance has... savings of 1556 km or a percentage of 3.3%.

c. Comparison of the company's initial policy with the Proposal based on distance saving:

1) Mileage Savings:

The Nearest Neighbor method can produce a more optimal mileage saving solution than the company's current route. The proposed route with the Nearest Neighbor method has a total distance of 49856 km, a decrease of 3.3% from the current total distance.

2) Saving the Number of Tank Cars

The Nearest Neighbor method can produce a solution to save the number of tank cars, which initially for 14 days used 108 tank cars consisting of 75 tank cars with a capacity of 8000 L and 33 tank cars with a capacity of 16,000 L, while using the nearest neighbor method for 14 days used 91 tank cars consisting of 55 tank cars with a capacity of 8000 L and 41 tank cars with a capacity of 16,000.

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