Optimizing Fuel Tank Truck Distribution to The Gas Station at Fuel Terminal

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ABSTRACT

PT Pertamina Patra Niaga Sorong Fuel Terminal is a company engaged in receiving, stockpiling, and distributing. Fuel stockpiled in the tank will be distributed through a tank truck with a capacity of 5,000 liters. The limited capacity of the tank truck makes the distribution less than optimal. The limited tank truck capacity triggers problems in the distribution system, especially considering that the life of 3 of the 6 existing tank trucks will expire in 2024. By considering the remaining time, the company needs to evaluate the distribution facilities that will be used and one of the solutions is to vary the capacity of the tank trucks. This problem can be solved through several considerations such as the urgency of tank truck needs, the amount of fuel needed, the infrastructure of the Sorong region, and some data that will be processed using Anylogistix. The results show that with the new tank truck capacity variations, namely 28,000 liter and 15,000 liter, in the selected periods it is more efficient by 24.58%, 3.44%, 31.6%, 26.37%, 30.67%, and 23.65% in terms of time compared to without variation. In addition, 445.6 liters of fuel can be saved in a month. All demands can be met from the minimization results so that this solution can optimize the distribution carried out and have a positive impact on the company.

1. INTRODUCTION

Distribution is one of the main functions of Fuel Terminal Sorong. It is carried out to meet the needs of fuel of the community and ensure better operational activities in Sorong. Various products such as Pertalite, Pertamax, BiosolarB35, Pertamina Dex, and Dexlite are distributed to regular gas stations. Nowadays people generally have motorbikes or cars as a mode of daily transportation. Recorded in 2021 through the central statistics agency (BPS) for vehicles in West Papua Province when it was not yet divided into Papua Barat Daya consisted of 36,863 units of cars and 308,791 units of motorbikes [1]. Apart from that, people who make a living by being involved in projects, expeditions, or passenger delivery services drive trucks or large vehicles such as buses in their work so that there are 352 units of buses and 17,789 units of trucks [1]. All the modes of transportation mentioned above use those fuels. The various types and amounts of community need for each day give an important role for distribution in the operational sustainability.

Fuel Terminal or also known as Sorong Fuel Oil Terminal has 3 main functions. The first function is receiving. The fuel received generally comes from Wayame Integrated Terminal, Refinery Unit (RU) V Balikpapan, and Refinery Unit (RU) VII Kasim. Fuel that has been received will be stored in 13 tanks whose owned by FT Sorong before being distributed. The distribution process is carried out from the tank to the filling shed using a pipe and then being distributed to the gas stations by tank trucks. There are 2 types of tank truck capacities that take part in the distribution scheme, tank trucks with a capacity of 5,000 liters and 8,000 liters. The maximum long life for tank trucks is 10 years. In 2024, there are 3 tank trucks that will be decommissioned and the rest of them will follow in the following year. This is not a good thing, especially for the distribution function because it will cause major obstacles in the

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distribution process. Preparation of new tank truck requests to Pertamina Logistics is mandatory, especially considerations related to the type of capacity that they want to have. The comparison from ritage planning which made from July to September, there's in 1 day at least 1 tank truck will load about 25,000 to 45,000 liters. This indicates that the demand of a gas station for 1 type of product is generally more than 5,000 liters. Therefore, the high amount of consumer demand has an impact on the high mobility of tank trucks whose run into a single trip scheme. Single trip can be defined as the condition of a vehicle that moves from the origin to the destination and then returns to its origin [3]. Distribution will start from 07:30 - 12:00 WIT and will be continued from 13:00 – 16:00 WIT. In actuality, the distribution often ends between 16:30 and 17:30 due to the delayed operational time. It proves the inability of tank trucks with those capacities to handle delivery, which is going to increase based on demand. If tank truck drivers (AMT) work in exceed time, it is counted as overtime and receives overtime pay. Besides that, the greater the number of planned ritage, the greater the likelihood of tank trucks requesting the fuel costs. In the next 1 year, Fuel Terminal Sorong will also experience a change of tank trucks due to the expiration of the long life of 3 tank trucks. Based on these various problems, research will be conducted to analyze the efficiency obtained when fuel products delivered to regular gas stations are transported by tank trucks through scenario planning with capacity variations by Anylogistix in a normal week and the effects to the optimation. Within this timeframe, scenario comparisons can be considered to determine the variation in tank truck capacity that will be used in 1 year.

This research was carried out with some previous research as references in solving it. The research by Xiaoyan Li has almost similar problems in delivery product [3]. Besides that, research by Gribkovskaia gives solution with Tabu search and result with less expense by Rahmah [4] [5]. With adding other references give propose for this research to solve the problems by giving comparison of tank truck combination in expense, route scheduling for time and distance information, and order fulfilling.

The data processing tool used is flexible and able to assist companies in comparing the efficiency of existing scenarios. The Transportation Network Optimization (TO) function in Anylogistix produces a fuel distribution route scenario. The scenarios created will be developed by considering several things ranging from company demand, regional infrastructure, and gas station conditions. With the simulation based on the resulting scenario, it is hoped that it can be taken into consideration in submitting a request for variations in tank truck capacity for the Sorong Fuel Terminal in 2024.

2. THE PROPOSED METHOD

3.2. Systematic Research

This research uses a quantitative type of research method with the object of research is PT Pertamina Patra Niaga Fuel Terminal Sorong. Data are going to be processed by Anylogistix in Transport Network Optimization function. This research is divided into several stages, such as problem identification, research objectives, literature and field studies, data collection, data processing, analysis of results and conclusions and suggestions as in Fig.1.

3.3. Research Steps

The stages of research will be defined below:

1. Problem identification & goal of research

   Observations were made directly at FT Sorong and focused on the optimization of fuel distribution every day which became the basis of data to be analyzed after trials were made related to the application of capacity variations. Through identifying the problem, it is expected to be in line and in accordance with the research objectives.

2. Literature review

   The literature study of this research is about 4 main topics with entitled logistics, Pertamina distribution policy, Single Trip Capacitated Vehicle Routing Problem with Time Windows (STCVRPTW), and Anylogistix. The literature on these 4 topics is useful to provide insight in the results of data processing as well as to strengthen the analysis of the research. For field studies, data

is needed related to fuel distribution activities to regular gas stations for 3 months which are then selected as distribution sample, the 1 week constant distributions graph for each product. From the results of these observations, a comparison scenario of tank truck capacity variations was made.

3. Data collecting

The data are collected in 2 ways, observation and interviews. From these two data collection methods, data in the form of fuel type, regular gas station demand, FT Sorong distribution policy, and coordinates were obtained. The 4 data are the data needed to assist in the completion of this research. Fuel type, regular gas station demand, FT Sorong distribution policy, and coordinates will affect the optimation level of distribution to regular gas station.

4. Data processing

Anylogistix is a software which helps the research in part of data processing. There are 4 main stages in data processing on Anylogistix. Due to the problems experienced in this research related to the optimization of distribution vehicles, 'Transport Network Optimization' is the right choice for processing data. TO can produce output in the form of scheduling route scenarios with clear visualization. scenarios along with the time clearly with attractive visualizations.

a. Supporting Theory

There are some following sources of literature that are related to this research and helping to analyze the result.

1. Logistics

Logistics is the process of flowing goods from upstream to downstream by human resources using transportation modes, facilities, and other equipment. Logistics is the link between the production process to consumption [4]. Logistics has evolved. The beginning of logistics was known starting in the 1960s, which was still divided into several activities. These activities became known as logistics in the 1990s. By the time goes by logistics evolved to become part of supply chain management. Since 2010 until now, the development of supply chain management adapts to the digitalization system that continues to grow globally and becomes a component in the operation of an industry [5]. At the very first time, logistics was known on the battlefield through its activities that delivered the needs of soldiers at the right time and right place. The lack of digitalization in that era showed that logistics only played a role in delivery activities. This evolved in the following years as the terms inbound and outbound began to be recognized. Logistics was studied by experts resulting in many thoughts related to logistics and regulations in distribution and then penetrated the world of business. The focus of cost-sharing by companies was based on negotiations with carriers. By the 1990s, various electronic goods began to take part in the ongoing logistics business system. Digitalization offered better supply chain management starting from the management of information data [6].

Digitalized logistics increases the value of efficiency in working in the industrial field. Good connectivity and transparency can make forecasting and management more precise. All logistics activities ranging from planning, estimating, procurement, storage, packaging, and delivery can be done more optimally. Accuracy in terms of product type, quantity, condition, location, time, destination, and price are right on target. Therefore, the use of digitalization in supply chain logistics requires good coordination for each activity to reduce the operational costs by 20% [7]. Sustainable and mutually supportive logistics create a positively growing industrial sector.

2. Pertamina Distribution Policy

Pertamina's fuel distribution can be done using 2 modes of transportation, tank trucks and tankers. The production refinery will send the products requested by the fuel terminal and stockpile it before distributed it to various gas stations. Monitoring of fuel distribution data to the community is carried out by PIEDCC (Pertamina Integrated Enterprise Data and Command Center) [8]. By using tankers to distribute the fuel, a high probability of evaporation will be the risk. The transport loss tolerance for tankers is 0.02%. This policy is different in tank trucks because the delivery is carried

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out within a few minutes from the distribution location. The distribution process runs according to the quota policy per region which is set down by BPH Migas and the allocation for each gas station is detailed by Retail. Distribution is carried out for 6 working days, Monday to Saturday. The number of distributions made on Saturdays is 2 times more because the quota which sent on Saturdays is the quota for 2 days, Saturday and Sunday. BiosolarB35 and Pertalite are the products delivered with the highest quota with a range of 15,000 liters per day for each gas station while other products range from 5,000 liters. In addition, Retail also provides a policy by observing the comparison of the needs of each gas station. Each gas station in Sorong City and Sorong Regency will be given a quota of fuel according to history based on the determination made by Retail. Distribution can be done if the Sales Order (SO) has been converted into a Loading Order (LO). The data contained in the LO becomes the reference for printing the road letter. This road letter contains signatures, one of which is the signature of the fuel receiving gas station. Based on company policy, each tank truck has a delivery limit in a day, which is a minimum of 5 times and a maximum of 9 times. The number of tank truck trips to the gas station is usually referred to as a ritage plan or trip planning. Fuel from tank trucks can be filled based on the policy of the Distribution function which determines that the truck can fill its own fuel, which is called own use, about 5-6 times in a month.

3. Single Trip Capacitated Vehicle Routing Problem with Time Windows (STCVRPTW)

STCVRPTW can be interpreted as a route determination problem for vehicles that have limited capacity and operating time with trips that are only intended to 1 destination and then return to the place of origin. Problems related to distribution routes are solved generally to produce minimization of distance and costs incurred during the operational period. The optimal results obtained help companies increase the competitive value of the company [9]. This problem can be modeled with the equation below [10]:

Parameters

NN Number of donation nodes

NV Number of vehicles

C Capacity of vehicles

Q Demand at node j for 1 product

s_i Loading and unloading time at node

t_{ij} Travel time from node i to i

D_{kj} Departure time of truck k at node i

E_i Earliest time available at node i

L_i Latest time available at node i

M, B Big constant number

Node settings

N(k) Set of nodes visited by truck k

Variable

$$l_{ijk} = \begin{cases} 1 & arc\ i,j\ is\ traversed\ by\ vehicle\ k \\ 0 & otherwise \end{cases}$$

$$V_k = \begin{cases} 1 & arc\ i,j\ is\ if\ vehicle\ k\ used \\ 0 & otherwise \end{cases}$$

Objective function

$$Min\ Z = B \times \Sigma_1^{NV} V_k + \Sigma_{i=0}^{NN} \Sigma_{j=0}^{NN} \Sigma_{k=1}^{NV} l_{ijk} \times t_{ij} \quad (1)$$

Mathematical model

Number of tank trucks which get in and out to the gas station are same

$$\Sigma_{i=0}^{NN}\Sigma_{k=1}^{NV} l_{ijk} = \Sigma_{i=0}^{NN}\Sigma_{k=1}^{NV} l_{jik} \qquad for\ all\ j \tag{2}$$

Demand for single trip is delivered by 1 tank truck

$$\Sigma_{i=0}^{NN}\Sigma_{k=1}^{NV} l_{ijk} = 1 \qquad for\ all\ j \tag{3}$$

Tank trucks cannot have multiple trips because of the limited capacity

$$C - \Sigma_{j=1}^{NN}\{Q_j \Sigma_{i=0}^{NN} l_{ijk}\} \geq 0 \qquad for\ all\ k \tag{4}$$

Ritage limit for 1 tank truck in a day is 5 to 9 times

$$5 \leq \Sigma_{j=0}^{NN} l_{0jk} \leq 9 \qquad for\ all\ k \tag{5}$$

$$5 \leq \Sigma_{i=0}^{NN} l_{i0k} \leq 9 \qquad for\ all\ k \tag{6}$$

If the tank truck is being used, the value is 1 and otherwise

$$\Sigma_{i=0}^{NN}\Sigma_{j=0}^{NN} l_{ijk} \leq M \times V_k \qquad for\ all\ k \tag{7}$$

The trip is always from fuel terminal to 1 gas station and getting back to fuel terminal

$$\Sigma_{j=1}^{NN} l_{0jk} - V_k = 0 \qquad for\ all\ k \tag{8}$$

$$\Sigma_{i=1}^{NN} l_{i0k} - V_k = 0 \qquad for\ all\ k \tag{9}$$

Ensure there are no additional routes and capacities in the trip

$$u_{ik} - u_{jk} + C \times l_{ijk} \leq C - Q_j \quad for\ all\ i,j,k \tag{10}$$

Ensure the product is fully transferred to the destination

$$Q_i \times u_{ik} = 0 \tag{11}$$

Driver working time isn't more than 7 hours

$$\Sigma_{i=0}^{NN}\Sigma_{j=0}^{NN} l_{ijk} \times t_{ij} \leq 7h \qquad for\ all\ k \tag{12}$$

4. Anylogistix

There is an application that plays a major role in the distribution system. This app is known as Anylogistix. Anylogistix focuses on the supply chain flow. There are 4 main functions in Anylogistix, GFA, NO, SIM, and TO and these are the description [12]:

a. Green Field Analysis (GFA)

GFA plays a role in determining the optimal point of the Distribution Center (DC) or Factory that can reach all customers. The data required is in the form of customer locations, product lists, aggregated demand for each customer and product, and the distance between the customer and the DC/warehouse or the number of facilities to be found. GFA generates data related to the direction of product flow, the location of new facilities, detailed statistics on the distance traveled to fulfill a certain percentage of demand, and detailed statistics on demand that can be fulfilled within a certain distance.

b. Network Optimization (NO)

NO conducts experiment to be able to provide the most optimal location of distribution or production facilities as well as the product flow and resource origin options. The selection of the optimal solution for the best flow and facility arrangement considers the objectives of maximizing profits and adhering to all predefined constraints. Experiments made in NO should include data related to demand specifications, location and type of vehicle travel, storage and product flow, cost, and time. The experimental results of the NO are in the form of a presentation of cost flows, a description of demand fulfillment, the types of vehicles used in the supply chain, and so on.

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c. Simulation (SIM)

The data used for SIM is the same data used for GFA and NO data processing but in addition there are 4 other data. These data are supplier, storage policy, dispensing, and product source. What will result from the experiments conducted in the SIM section are expenses, revenues, inventory dynamics, service levels, incoming/outgoing orders, and others.

d. Transport Network Optimization (TO)

TO focuses on the optimization of the transportation used. There are several constraints such as the capacity of the transport vehicle, the type of vehicle, the speed at which it is traveling, and the operating time. Experiments from TO produce travel routes and traveling hours of the vehicle. TO determines the travel route with various constraints that are made so that the transportation optimization model matches the actual conditions without considering several things such as road construction and the condition of the destination building.

3. METHOD

Transport Network Optimization is the chosen method to resolve the vehicle routing problem with Anylogistix as the tool. It processes the collected data and serves the result which is in line with the goal of research.

3.4. Collected data

This research consists of various kinds of data as follows.

1. Fuel Terminal Sorong and gas station location

The location of the fuel terminal is the one with a red point and the blue points are the gas stations. There are 5 gas stations in Sorong city and 2 gas stations are in Sorong district.

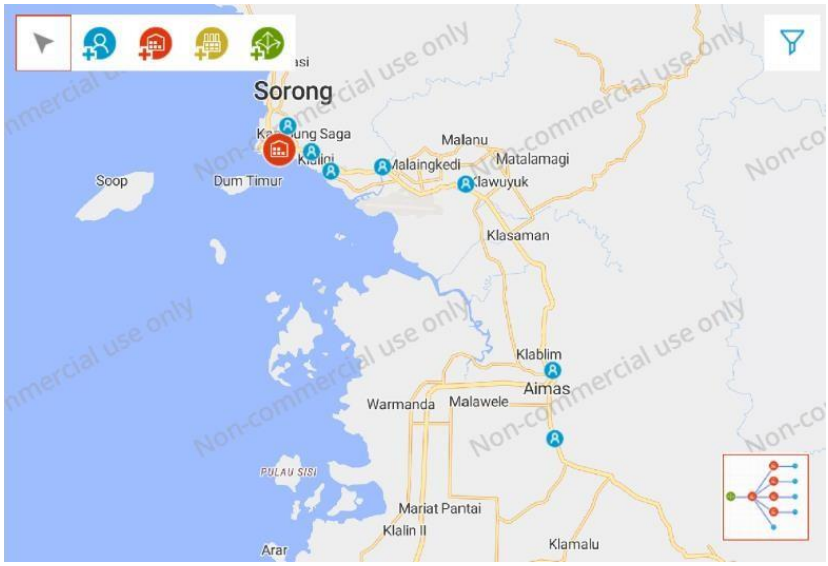

Fig. 1. Location of fuel terminal and gas station

2. The chosen constant demand week sample

The observation occurred in June until August (Fig.2). Fuel demand of each day was calculated and the result is presented on the Fig.3. Demand in July is not always the highest nor the lowest and can be considered as the chosen month.

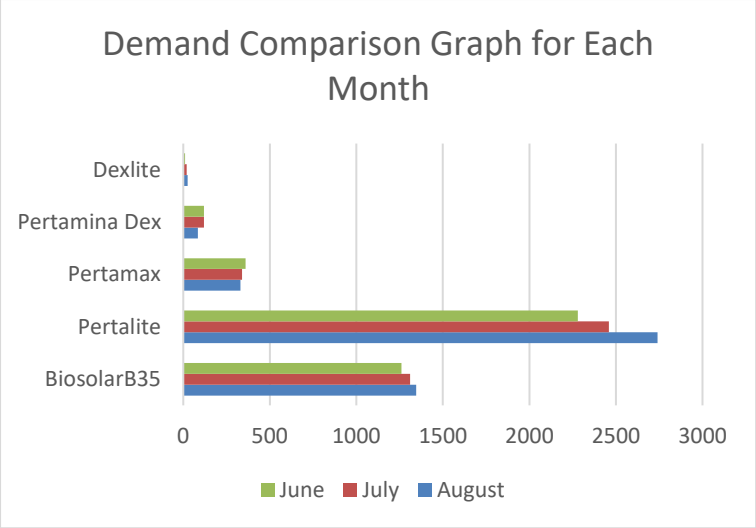

Fig. 2. Demand comparison for each month

In July, the most constant graph of demand is in 10th to 15th. From Monday to Saturday, the demand data for that week will be the main data to be processed.

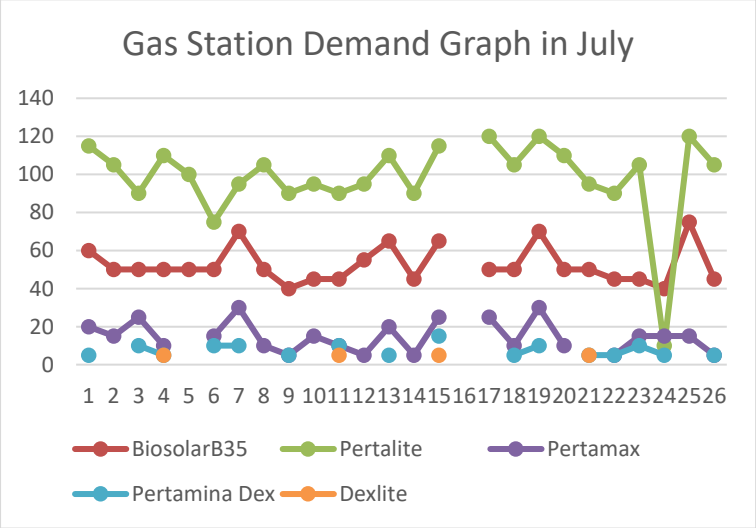

Fig. 3. Demand of gas station in July

3. Total fuel demand of each gas station

It shows the total demand of the week for each product in Sorong that will be distributed to the gas stations.

Table 1. Total of Fuel Demand in The Chosen Week

Date	Fuel				
	Biosolar B35 (KL)	***Pertalite (KL)***	***Pertamax (KL)***	***Pertamina Dex (KL)***	***Dexlite (KL)***
July 10th 2023	50	105	10		
July 11st 2023	40	90	5	5	
July 12nd 2023	45	95	15		
July 13rd 2023	45	90	10	10	5
July 14th 2023	55	95	5		
July 15th 2023	65	110	20	5	

4. Detail fuel demand of each gas station

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It shows the detailed demand of the day for each product in Sorong that will be distributed to the gas stations.

Table 2. Total Demand of Each Products from July 10th-15th 2023

July 10th	**Gas Station**						
	8198401	***8498401***	***8498402***	***8498403***	***8498404***	***8498405***	***8498406***
B35 (KL)	15		20			15	
PTL (KL)	20	10	15	15	20	15	10
PTX (KL)	5				5		
P.Dex (KL)							
Dexlite (KL)							
July 11th	**Gas Station**						
	8198401	***8498401***	***8498402***	***8498403***	***8498404***	***8498405***	***8498406***
B35 (KL)	15		20			5	
PTL (KL)	15	5	10	15	15	20	
PTX (KL)				5			
P.Dex (KL)					5		
Dexlite (KL)							
July 12th	**Gas Station**						
	8198401	***8498401***	***8498402***	***8498403***	***8498404***	***8498405***	***8498406***
B35 (KL)	15		15			15	
PTL (KL)	15	10	10	15	20	15	10
PTX (KL)		5	5		5		
P.Dex (KL)							
Dexlite (KL)							
July 13th	**Gas Station**						
	8198401	***8498401***	***8498402***	***8498403***	***8498404***	***8498405***	***8498406***
B35 (KL)	15		15			15	
PTL (KL)	10	10	15	10	20	15	10
PTX (KL)						5	
P.Dex (KL)				5		5	
Dexlite (KL)							5
July 14th	**Gas Station**						
	8198401	***8498401***	***8498402***	***8498403***	***8498404***	***8498405***	***8498406***
B35 (KL)	20		20			15	
PTL (KL)	5	10	15	10	20	15	10
PTX (KL)					5		
P.Dex (KL)							
Dexlite (KL)							
July 15th	**Gas Station**						
	8198401	***8498401***	***8498402***	***8498403***	***8498404***	***8498405***	***8498406***
B35 (KL)	25		20			20	
PTL (KL)	10	5	15	15	30	20	15
PTX (KL)				5	5	5	
P.Dex (KL)					5		
Dexlite (KL)							

3.5. Steps to process in Anylogistix

The following are the steps that can be taken to process the input data that is available into a scenario:

1. Determine the location point in Locations section
2. Write down the list of gas stations that will receive fuel and Fuel Terminal Sorong as the distribution center in Customers and DCs & Factories section
3. Determine the fuel distribution period based on the selected date range in Period section
4. Determine the start and end time of distribution function operations in Time Windows section
5. Determine the speed of the 2 types of vehicles that have been determined based on the interview results in Vehicle Types section
6. Write down the demand in Demand section based on the data and according to the real conditions
7. Create the first scenario with only 1 type of tank truck capacity according to the Fleet section
8. Determine the flow of distribution will be carried for each period in Path section
9. Write down the source of fuel in Sourcing section
10. Choose capacitated TO experiment according to the type of problem
11. Determine the start and end periods of the scenario as well as tank truck capacity variations used based on the period data input entered in the Path section and then run the data
12. The first scenario can be seen through Generated Path Segments
13. To proceed to scenario 2 for the same period, the changes are in steps 8 through 11 and 13
14. The results of the data processing are then adjusted to the waiting time when filling the tank loading at FT Sorong and unloading at fuel terminal.

4. RESULTS AND DISCUSSION

Distribution is done by tank trucks with a single trip distribution type. The reason for choosing this type of distribution is the number of compartments in the tank truck which is only 1 so that it can only carry 1 type of product. Distribution by FT Sorong is carried out by tank trucks that can load other types of products without having to clean the tank truck first. This can affect the quality of the product even though it is in a small percentage, but it is a tolerance considering the limited tank trucks used for distribution to regular gas stations. Data was processed for 2 different scenarios on each working day within 1 week, which were selected through consideration of graphs that matched the average distribution quota of each product for each gas station.

4.1. Processing Data I

1st scenario

Based on the scheduling that has been made for the period July 10th, 2023, without capacity variation, the distribution time ends at 15:28. This time is still within the specified time range.

Table 3. Schedule of Tank Truck A on July 10th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***A5***	***A6***
07:30	07:37	07:44	07:51	07:58	08:05
08:07	08:09	08:30	08:23	08:44	08:42
09:44	09:36	09:57	10:00	09:30	09:24
10:16	10:32	10:34	10:56	10:07	09:56
11:12	11:14	11:20	11:33	11:03	11:33
14:00	14:00	14:00	14:00	14:07	14:07

Tank Trucks					
A1	***A2***	***A3***	***A4***	***A5***	***A6***
14:32	14:32	14:32	14:46	14:49	14:53
15:28					

2nd scenario

Based on the scheduling that has been made for the period July 10th, 2023, with capacity variations, the distribution time ends at 12:02. This time is still within a reasonable range.

Table 4. Schedule of Tank Truck A & B on July 10th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***B5***	***B6***
07:30	07:37	07:44	07:51	07:30	07:37
08:07	08:14	08:26	08:28	08:16	08:09
09:44	09:41	10:03	09:24	08:48	08:55
10:18	10:23	11:30	11:01	09:44	09:27
11:09	11:40	12:02	11:38	10:30	10:23
11:46			12:15	11:02	11:09

Route details:

A1	FT – 8498402 – FT – 8498401 – FT – 8198401 – FT – 8498404 – FT – 8498402 – FT
A2	FT – 8498402 – FT – 8498406 – FT – 8498402 – FT – 8498403 – FT
A3	FT – 8498401 – FT – 8498403 – FT – 8498406 – FT – 8198401 – FT
A4	FT – 8498402 – FT – 8498404 – FT – 8498403 – FT – 8498402 – FT – 8498402 – FT
B5	FT – 8498405 – FT – 8198401 – FT – 8498404 – FT – 8498405 – FT – 8198401 – FT
B6	FT – 8198401 – FT – 8498405 – FT – 8198401 – FT – 8498404 – FT – 8498405 – FT

Based on the comparison of the schedule table between scenarios 1 and 2, the working hours are reduced by 88 minutes or equivalent to 1 hour 28 minutes. The time efficiency achieved through the tank truck capacity variation scenario is 24.58%.

4.2. Processing Data II

1st scenario

Based on the scheduling that has been made for the period July 11th, 2023, without capacity variation, the distribution time ends at 11:54. This time is still within the specified time range.

Table 5. Schedule of Tank Truck A on July 11th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***A5***	***A6***
07:30	07:37	07:44	07:51	07:58	08:05
08:07	08:09	08:30	08:23	08:44	08:42
09:03	09:05	09:12	10:10	09:16	09:24
10:40	10:42	10:05	10:42	10:53	10:20
11:17	11:19	10:51	11:24	11:25	10:57
11:54	11:51	11:37			11:43

2nd scenario

Based on the scheduling that has been made for the period July 11th, 2023, with capacity variations, the distribution time ends at 11:45. This time is still within the predetermined time range.

Table 6. Schedule of Tank Truck A & B on July 11th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***B5***	***B6***
07:30	07:58	07:44	08:05	07:37	07:51
08:07	08:35	08:30	08:47	08:09	08:23
09:44	09:31	10:07	09:24	09:05	09:09
10:40	11:08	10:53	11:01	09:51	09:41
11:23	11:45	11:30	11:43		10:13

Route details:

A1	FT – 8498402 – FT – 8498403 – FT – 8498404 – FT – 8498401 – FT
A2	FT – 8498402 – FT – 8498404 – FT – 8498403 – FT – 8498402 – FT
A3	FT – 8498405 – FT – 8498403 – FT – 8498405 – FT – 8498402 – FT
A4	FT – 8498401 – FT – 8498402 – FT – 8498403 – FT – 8498401 – FT
B5	FT – 8198401 – FT – 8198404 – FT – 8498405 – FT
B6	FT – 8198401 – FT – 8498405 – FT – 8198401 – FT – 8198401 – FT

Based on the comparison of the schedule table between scenarios 1 and 2, the working hours are reduced by 9 minutes. The time efficiency achieved through the tank truck capacity variation scenario is 3.44%.

4.3. Processing Data III

1st scenario

Based on the scheduling that has been made for the period July 12th, 2023, without capacity variation, the distribution time ends at 15:07. This time is still within the specified time range.

Table 7. Schedule of Tank Truck A on July 12th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***A5***	***A6***
07:30	07:37	07:44	07:51	07:58	08:05
08:07	08:09	08:30	08:23	08:44	08:42
09:03	09:05	09:12	09:09	09:21	09:24
10:40	10:01	10:39	10:05	09:53	09:56
11:17	10:47	11:16	10:37	11:30	11:23
11:49	11:29	11:53	11:23	14:16	15:07

2nd scenario

Based on the scheduling that has been made for the period July 12th, 2023, with capacity variations, the distribution time ends at 11:41. This time is still within the predetermined time range.

Table 8. Schedule of Tank Truck A & B on July 12th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***B5***	***B6***
07:30	07:58	07:30	07:51	07:37	07:44
08:07	08:40	08:12	08:28	08:23	08:16
09:44	10:07	09:41	10:05	08:55	09:12
10:28	10:44	11:18	10:42	09:51	09:58
11:24	11:41		11:19	10:23	10:44
				11:09	11:16

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Route details:

A1	FT – 8498402 – FT – 8498403 – FT – 8498401 – FT – 8498404 – FT
A2	FT – 8498401 – FT – 8498406 – FT – 8498402 – FT – 8498402 – FT
A3	FT – 8498401 – FT – 8498406 – FT – 8498403 – FT
A4	FT – 8498402 – FT – 8498401 – FT – 8498402 – FT – 8498402 – FT
B5	FT – 8498405 – FT – 8198401 – FT – 8498404 – FT – 8198401 – FT – 8498405 – FT
B6	FT – 8198401 – FT – 8498404 – FT – 8498405 – FT – 8498405 – FT – 8198401 – FT

Based on the comparison of the schedule table between scenarios 1 and 2, the working hours are reduced by 116 minutes or equivalent to 1 hour 46 minutes. The time efficiency achieved through the tank truck capacity variation scenario is 31.6%.

a. Processing Data IV

1st scenario

Based on the scheduling that has been made for the period July 13th, 2023, without capacity variation, the distribution time ends at 14:45. This time is still within the specified time range.

Table 9. Schedule of Tank Truck A on July 13th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***A5***	***A6***
07:30	07:37	07:44	07:51	07:58	08:05
08:07	08:09	08:30	08:23	08:44	08:42
09:44	09:36	09:16	09:26	09:21	09:24
10:40	11:03	09:53	10:03	10:58	11:01
11:26	11:45	11:39	10:49	11:35	11:47
11:58	14:17	14:26	11:45	14:16	14:19

2nd scenario

Based on the scheduling that has been made for the period July 13th, 2023, with capacity variations, the distribution time ends at 11:44. This time is still within the predetermined time range.

Table 10. Schedule of Tank Truck A & B on July 13th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***B5***	***B6***
07:30	07:30	07:30	07:51	07:37	07:44
08:07	08:12	08:57	08:28	08:23	08:16
09:44	10:49	09:34	09:35	08:55	09:02
11:21	11:21	10:30	10:21	09:51	09:48
11:58	11:58	11:12	11:07	10:37	10:44
		11:44	11:44		

Route details:

A1	FT – 8498402 – FT – 8498403 – FT – 8498403 – FT – 8498402 – FT
A2	FT – 8498401 – FT – 8498403 – FT – 8198401 – FT – 8498402 – FT
A3	FT – 8498406 – FT – 8498402 – FT – 8498404 – FT – 8498401 – FT – 8498402 – FT
A4	FT – 8498402 – FT – 8498406 – FT – 8498405 – FT – 8498405 – FT – 8198401 – FT
B5	FT – 8498405 – FT – 8198401 – FT – 8498404 – FT – 8498405 – FT

B6	FT – 8198401 – FT – 8498405 – FT – 8498405 – FT – 8498404 – FT

Based on the comparison of the schedule table between scenarios 1 and 2, the working hours are reduced by 91 minutes or equivalent to 1 hour 31 minutes. The time efficiency achieved through the tank truck capacity variation scenario is 26.37%.

b. Processing Data V

1st scenario

Based on the scheduling that has been made for the period July 14th, 2023, without capacity variation, the distribution time ends at 14:26. This time is still within the specified time range.

Table 11. Schedule of Tank Truck A on July 14th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***A5***	***A6***
07:30	07:37	07:44	07:51	07:58	08:05
08:07	08:23	08:16	08:28	08:44	08:30
09:03	09:19	09:53	09:10	09:21	09:02
10:40	10:01	10:25	10:06	10:07	10:29
11:12	11:28	11:11	10:43	10:53	11:25
11:42	14:16	11:43	11:20	11:40	14:07
			14:26		

2nd scenario

Based on the scheduling that has been made for the period July 14th, 2023, with capacity variations, the distribution time ends at 11:16. This time is still within the predetermined time range.

Table 12. Schedule of Tank Truck A & B on July 14th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***B5***	***B6***
07:30	07:30	07:30	07:51	07:37	07:44
08:08	08:12	08:07	08:28	08:23	08:16
09:35	08:49	09:44	09:10	08:55	09:02
10:12	10:26	10:16	10:37	09:51	09:34
11:08	11:03	10:40	11:14	10:37	10:30
				11:09	11:16

Route details:

A1	FT – 8498402 – FT – 8498406 – FT – 8498402 – FT – 8498404 – FT
A2	FT – 8498401 – FT – 8498402 – FT – 8498403 – FT – 8498402 – FT
A3	FT – 8498402 – FT – 8498403 – FT – 8498401 – FT – 8498404 – FT
A4	FT – 8498402 – FT – 8498401 – FT – 8498406 – FT – 8498402 – FT
B5	FT – 8498405 – FT – 8198401 – FT – 8498404 – FT – 8498405 – FT – 8198401 – FT
B6	FT – 8198401 – FT – 8498405 – FT – 8198401 – FT – 8498404 – FT – 8498405 – FT

Based on the comparison of the schedule table between scenarios 1 and 2, the working hours are reduced by 100 minutes or equivalent to 1 hour 40 minutes. The time efficiency achieved through the tank truck capacity variation scenario is 30.67%.

c. Processing Data VI

1st scenario

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Based on the scheduling that has been made for the period July 15th, 2023, without capacity variation, the distribution time ends at 16:07. This time is still within a reasonable range.

Table 13. Schedule of Tank Truck A on July 15th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***A5***	***A6***
07:30	07:37	07:44	07:51	07:58	08:05
08:07	08:23	08:16	08:23	08:44	08:42
09:03	09:05	09:12	09:00	09:16	09:14
10:40	10:01	10:39	10:37	09:53	10:10
11:12	11:28	11:25	11:23	11:30	10:47
11:58	12:00	14:57	12:00	14:46	11:43
14:23	15:19	15:29	15:21	15:23	14:29
15:19	16:05		16:07		15:25

2nd scenario

Based on the scheduling that has been made for the period July 15th, 2023, with capacity variations, the distribution time ends at 14:53. This time is still within the predetermined time range.

Table 14. Schedule of Tank Truck A & B on July 15th

Tank Trucks					
A1	***A2***	***A3***	***A4***	***B5***	***B6***
07:30	07:30	07:30	07:51	07:37	07:44
08:07	08:12	08:16	09:28	08:23	08:16
09:44	09:39	09:53	10:00	08:55	09:02
10:21	10:16	11:20	10:32	09:51	09:59
11:58	11:53	11:57	11:59	10:37	10:55
14:26	14:26	14:16	14:16	11:32	11:27
		14:53	14:53		14:26

Route details:

A1	FT – 8498402 – FT – 8498403 – FT – 8498402 – FT – 8498403 – FT – 8498404 – FT
A2	FT – 8498401 – FT – 8498406 – FT – 8498402 – FT – 8498403 – FT – 8498404 – FT
A3	FT – 8498405 – FT – 8498403 – FT – 8498406 – FT – 8498402 – FT – 8498405 – FT – 8498402 – FT
A4	FT – 8498402 – FT – 8198401 – FT – 8198401 – FT – 8498406 – FT – 8498405 – FT – 8498402 – FT
B5	FT – 8498405 – FT – 8198401 – FT – 8498404 – FT – 8498405 – FT – 8498404 – FT
B6	FT – 8198401 – FT – 8498405 – FT – 8498405 – FT – 8498404 – FT – 8198401 – FT – 8498404 – FT

Based on the comparison of the schedule table between scenarios 1 and 2, the working hours are reduced by 101 minutes or equivalent to 1 hour 41 minutes. The time efficiency achieved through the tank truck capacity variation scenario is 23.65%.

d. The Use of Fuel for Tank Truck Operation

It is known that a tank truck with a capacity of 8,000 liters has an engine power of 2,800 cc. This vehicle consumes 1 liter after traveling 11.7 km [12]. For a day, this 8,000-liter vehicle travels about 63

km according to the scenario. The vehicle has a fuel tank that holds 200 liters so in a month it is estimated that only 127.2 liters are used for 1 tanker truck. When compared to the 5,000-liter tank truck which is an asset and uses 350 liters in a month with an engine power of 1300 cc, the use of variations in the capacity of the distribution mode can be considered because it can reduce the amount of usage from 2,450 liters per month for 7 tank trucks with a capacity of 5,000 liters to 2,004.4 liters for 5 tank trucks with a capacity of 5,000 liters and 2 tank trucks with a capacity of 8,000 liters. The decrease in the amount of own use usage is 445.6 liters. Given the increasing price of Pertamina dex, saving the amount of fuel used can help the company to manage its revenue better. The low fuel usage by the 8 KL tank truck is because the distance traveled is smaller than the 5 KL tank truck so that it can consume less fuel but be able to work more effectively.

e. Discussion

Based on the results of data processing, efficiency occurs when tank truck variations are applied. Variations are made with only 2 types of capacity out of a total of 3 replaced vehicles. The tank truck that is no longer in operation will be replaced with 1 tank truck with a capacity of 5,000 liters, 2 others with a capacity of 8,000 liters and all of them only have 1 compartment. This decision was made by considering that the infrastructure of the area is still possible for tank trucks to pass through. This variation in capacity helps distribution run more efficiently. Deliveries can be made in less time but all delivery requests for the day are fulfilled. The number of ritages can be reduced through this application. Generally, the ritage that has been given a variation will be reduced by 1 line in the data processing. This indicates the fewer number of trips from the tank truck evenly. In addition, the costs incurred are also less. According to research, vehicles with large engine cc are more wasteful in fuel usage, but if examined, the expenditure for the existing tank truck is greater because of the longer distance that must be traveled due to the limited number of compartments and the small amount of cargo transported for a one-way tank truck. Tank trucks with a capacity of 8,000 liters are only able to distribute to 3 gas stations due to the physical inadequacy of the gas stations for tank trucks with larger capacities to maneuver. Although only able to distribute to a few gas stations, this is enough to optimize the distribution. It is likely that the distribution will be carried out in accordance with the predetermined time if supported by operational timeliness. Out of the 6 periods of the route scenario, the distribution carried out through a combination of tanker trucks with different capacities outperformed in all selected periods. Punctuality helps prevent the company from incurring extra costs such as overtime wages for tank car crews. Through the selected weekly sample, options regarding capacity variation can be considered as a proposed request for the type of tank truck capacity variation to be replaced.

This research helps to provide the comparison of tank truck combination for the company. It can easily decide the best combination which gives the less expense, time, and distance with fulfilling the demand order. By doing research, it can show to the company that delay time on finishing the distribution is be caused by the inability of tank truck with a capacity of 5,000 liters. It also compares the different capacities for tank truck combination. By considering the result, Pertamina retail, part of Pertamina which has responsible for all product sales distributed by FT Sorong, can give determination of the distribution policy for each gas station to be designed according to the variation capacities that it has.

5. Conclusion

Tank truck capacity variations are considered based on the urgency of the company, the amount of fuel required, and the actual condition of the Sorong region's infrastructure. The large number of trips that must be made makes distribution operations less effective and one way to optimize it is to provide capacity variations by considering the region's infrastructure as a limitation. In addition, the amount of demand also affects the distribution time. The limited capacity and number of tank trucks make the time used during the distribution process longer. Since the distribution process can take longer than operational hours, solutions such as applying capacity variations can be considered when the company wants to apply for a tank truck replacement.

Based on the samples for distribution activities carried out in the selected periods, it is found that the scenarios with better capacity variations are 24.58% for the first period, 3.44% for the second period, 31.6% for the third period, 26.37% for the fourth period, 30.67% for the fifth period, and 23.65% for the sixth period, respectively. Savings can also be seen from the amount of fuel consumption for both types

of vehicles. The use of capacity variation can make the company save the purchase cost of 445.6 liters in a span of 1 month. In addition, capacity variation also minimizes excessive operational time so as to reduce expenses such as overtime wages. From all the results of data processing, it can be concluded that optimization can be achieved through the application of capacity variation and can be taken into consideration for the distribution process in the future.

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