Application of Fuel Oil Distribution Route Using Ford Algorithm

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Abstract. The company which is engaged in Fuel Oil distribution is located in Riau City. Distribution in the company is to distribute Fuel Oil to each distribution center (SPBU) which is the scope of the company with the amount set by the distribution center. Distribution often experiences delays because there is no distribution route. This causes the company's losses in the form of increasing working hours (overtime and adding of transportation vehicles. Determination of distribution routes to the company is a key to success in handling the problem of distributing Fuel Oil to each distribution center. This method provides alternatives for the company about the shortest distance traveled for the Fuel Oil distribution and delay can be minimized. The final result in this study is the company find out the loading time of the vehicle in the form of distance traveled by vehicle, distance time and cost distribution and the company can find out how long the distribution time needed to each distribution center, the shortest path problem method with the Ford algorithm can minimize the distance as much as 13 distribution center and minimize the average savings of distance for 56 km / hour.

1. Introduction

The rapid development of oil distributor companies in Indonesia is increasingly making competition conditions in the market share increasingly of high competition. This condition because of the oil distributor company as a company engaged in services and current needs has not been replaced and always meet the needs and desires of the community. An oil distributor company is a company engaged in distributing oil to each distribution center with the amount set by the gas station. Therefore, the company must ensure that oil distribution arrives at the distribution center on time [1, 2].

Oil distributor companies are the main needs of society by presenting efficient and quality services. Distribution refers to the relationship between the production point and the last customer at the right time, the right quality specifications and cheap costs. The goal is to achieve the level of consumer needed based on cost level. This satisfaction can be a benchmark for the quality of the company and as an evaluation material. This causes companies required to provide on time services in accordance with established standards and reach all distribution centers. The business scope consists of the energy business in the upstream sector and the downstream sector. Timeliness in delivery is at the main core of good production system. In addition, the company also ensure the quality of oil arriving at the distribution center [3].

Oil distributor companies have many distribution centers are served by depots. The company distributes Fuel Oil every day according to working hours and demands from the distribution center. All of vehicle delivers FUEL OIL has a different route of delivery destination. The number of vehicles that
deliver Fuel Oil with different destination routes, the company expects Fuel Oil delivery arrives at the right time and the company reach all demands from the distribution center without increase the hours of overtime work. From the distribution center also expects the delivery of Fuel Oil to be on time, if there is a delay in effect on the image of the distribution center and potentially lose customers and the distribution center suffers from financial and customer confidence. This is the main projection of the company. Based on the real condition in one period (one year) there are many delays in the distribution of Fuel Oil from Central Supply Facilities to the Distribution Center. This is caused by various factors such as the absence of a delivery schedule, the absence of route determination, processing time, and limited transportation. The delay in distributing fuel cause several losses including increasing overtime hours, transportation rent (tank cars), and losing customer trust. Avoiding and minimizing company losses, then one way can be taken is to determine the distribution route. The distribution routes currently used are still random, where the company does not know which routes are passed by transporters. The lack of clarity in choosing a route lead to inappropriate distribution. This is what the company is facing.

One method that can be used to analyze the distribution problem is using Ford algorithm. Ford algorithm is a method used in distance-vector routing protocols to saving network resource, routing information protocol and based on two metric routing problem [4]. Ford Algorithm can be used to reduce the network system for distribution problem [5]. Ford algorithm is defined by Abishek and Kalpana as shortest path from one node to another node in applied on negative weight [6]. Bellman ford algorithm can be used to solve the single source shortest path problem in which edges of a given diagraph can have negative weight as long as the graph contains no negative cycle. The computational time of his algorithm increases exponentially with the increase in the number of nodes. This algorithm returns a Boolean value TRUE if the given diagraph contains no negative cycles that are reachable from source vertex otherwise it returns Boolean value FALSE [7].

Many previous studies have been done in handling of distribution problem using Ford algorithm. Uzar & Catay (2012) do research applied ford algorithm on distribution planning problem of bulk lubrication at BP Turkey. Their objective is to minimize total transportation related cost. They model the problem with the first approach being a linear programming-based ford algorithm. Using a real-data of BP Lubes Logistics, they found that both variant of the rolling horizon threshold heuristic are able to provide good result very vast [8]. Other studies have been done by Onut (2013) applied ford algorithm on distribution problem in Turkey. This study works on heterogeneous fleet vehicle routing model for solving liquefied petroleum gas. Using real world data obtained from LPG Operating Company, their optimal solution aided in scheduling and assigning vehicle route daily. Zhan end Noon (1998), has conducted a research on the related matter regarding the most suitable shortest path network method with the road structure in the United State of America. They found that the ford algorithm is the most suitable method with this network. This exploratory research has been conducted in order to calculate the shortest path running time utilizing real road data of the State of Johor and Malacca. There are a few considerate matters in this research as assumption which is the tested data did not take into account the negative path in the network structure. Other than that, the network has a directed path from a node to all nodes in the network range. Thus, the network has two ways directed path. Lastly, obstructions in the network such as traffic light, traffic jam and damaged road factor has not been considered. [9, 10]. The application of Ford algorithm to improve distribution problems is still rarely applied to oil distributor companies.

2. Methodology
The research was conducted at an oil distributor in the Riau city where the object under study was a distribution system influenced and supported distribution route planning. The research begins with conducting direct observation in the company from the central supply facilities and distribution center. Activities carried out at this stage are measuring distance time from the central supply facilities to each distribution center and between distribution centers. After observation, the topic and purpose of the study are determined according to the conditions in the company. After that, data collection is needed to improve distribution service quality, namely distance. After the data has been collected, the analysis
is then carried out using the Ford algorithm. This algorithm has advantages such as cost minimization, maximizes the performance and allows splitting traffic [11]. Ford algorithm is formed by measuring distance. The stages in using the ford algorithm method are by distance time measurements. After measurements are carried out, the theoretical time of oil fuel loading is calculated by calculating cycle time, normal time and standard time. The route for distribution determination is done by ford algorithm to obtain the minimum distribution center distance. Finally, calculating the distance time of the shortest route, then the theoretical time needed to calculate the unexpected time.

3. Result and Discussion

3.1. Calculation of Theoretical in Oil Fuel Loading Time
This stage is to calculate the theoretical time when loading is done by looking for cycle time, normal time and standard time. Calculation of cycle times by paying attention to how long the worker completes their work from the beginning of the process to the final process. The normal time for each product with each conveyance capacity per product uses an adjustment factor according to Westinghouse. Standard time is done using the allowance table. Recapitulation of cycle time, normal time and standard time can be seen in table 1.

| Premium | 16 KL | 18 KL | 21 KL | 24 KL |
|---------|-------|-------|-------|-------|
| WS      | 1:04:38 | 1:11:05 | 1:14:34 | 1:15:55 |
| Wn      | 1:19:29 | 1:27:26 | 1:31:43 | 1:33:23 |
| Wb      | 1:06:40 | 1:13:20 | 1:16:55 | 1:18:19 |
| Biosolar | 16 KL | 18 KL | 21 KL | 24 KL |
| Ws      | 0:56:20 | 1:03:31 | 1:08:23 | 1:16:13 |
| Wn      | 1:09:17 | 1:18:08 | 1:24:07 | 1:35:45 |
| Wb      | 0:58:06 | 1:05:32 | 1:10:33 | 1:18:37 |

3.2. Determination of Distribution Route
Based on the result of the distribution route determination using Ford algorithm there are several distances that can be minimized. The results of the determination of distance minimization can be seen in table 2.

| No | Distribution Center Code | Distance Before Route Determination (km) | Distance After Route Determination (km) | Difference |
|----|--------------------------|----------------------------------------|----------------------------------------|------------|
| 1  | 14.214226                | 208                                    | 120                                    | 88         |
| 2  | 14.214281                | 234                                    | 225                                    | 9          |
| 3  | 14.214284                | 217                                    | 129                                    | 88         |
| 4  | 14.214255                | 254                                    | 91                                     | 163        |
| 5  | 14.214225                | 253                                    | 165                                    | 88         |
| 6  | 14.227350                | 272                                    | 263                                    | 9          |
| 7  | 14.214230                | 312                                    | 303                                    | 9          |
| 8  | 14.214223                | 315                                    | 227                                    | 88         |
| 9  | 14.214219                | 300                                    | 291                                    | 9          |
| 10 | 14.214299                | 307                                    | 298                                    | 9          |
| 11 | 14.212278                | 362                                    | 353                                    | 9          |
| 12 | 14.285673                | 370                                    | 248                                    | 122        |
| 13 | 14.284617                | 189                                    | 157                                    | 32         |
From table 2 it can be seen that there are 13 minimized distribution distances from a total of 70 distribution distances.

3.3. Determination of Total Time
Travel time is obtained from the results of interviews with the relevant agencies. The agencies interviewed were drivers, employees, workers and depot heads. The results of the interview were the speed of driving a vehicle of 40 km/hour and unexpected estimation things on the trip given the 30-minute allowance. Total time can be seen in table 3.

Table 3. Total Time of Distribution Center

| No | SPBU Code | Distance (km) | Total Time       |
|----|-----------|---------------|------------------|
| 1  | 14.2886101| 43            | 1:04:30 1:34:30  |
| 2  | 14.284602 | 47            | 1:10:30 1:40:30  |
| 3  | 14.288614 | 4             | 0:06:00 0:36:00  |
| 4  | 14.288652 | 13            | 0:19:30 0:49:30  |
| 5  | 14.2896120| 90            | 2:15:00 2:45:00  |
| 6  | 14.287695 | 35            | 0:52:30 1:22:30  |
| 7  | 14.288659 | 9             | 0:13:30 0:43:30  |
| 8  | 14.288619 | 67            | 1:40:30 2:10:30  |
| 9  | 14.288626 | 60            | 1:30:00 2:00:00  |
| 10 | 14.287634 | 62            | 1:33:00 2:03:00  |
| 11 | 19.708.288| 13            | 0:19:30 0:49:30  |
| 12 | 14.288619 | 21            | 0:31:30 1:01:30  |
| 13 | 14.287632 | 64            | 1:36:00 2:06:00  |

3.4. Determination of Distribution Cost
The distribution cost is Rp. 650,-/KM/KL. Distribution costs include maintenance costs and depreciation costs. Maintenance costs and depreciation costs should be recalculated and distribution costs are more representative for company expenses. This is a usual problem because the distribution costs determined by the government. The distribution costs are set by the government usually happens and affected to disadvantage of company and losses due to the distance total time too far, to reduce losses the company create a distribution route with the shortest distance and the distribution costs can be minimized.

4. Conclusion
Oil distributor company have 70 distribution centers at first. The distance between central supply facilities to distribution center and between distribution center to distribution center does not have a clear distribution route. The distribution route based on random. The distribution route is more organized and not random and the distance total time by the transport vehicle is shorter or not too far away. The average of total time can be minimized is 56 km. The minimum distribution distance is 13 gas stations. The total time becomes shorter than before can make the distribution not take a long time and can save 1 hour of travel time so that the distribution costs can decrease.

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