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Optimization of PT. Ciomas Adisatwa Distribution Routes to Minimize The Distribution Cost

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***Abstract*—Optimal distribution means that the process of sending goods from the company to agents has a basis for scheduling and determining routes appropriately, and products received by consumers are in a good and fresh condition by the specified time with low operating costs. PT CiomasAdisatwa is one of the Japfa group companies that produce processed chicken products that are fresh, hygienic, and of good quality but have a problem with the route that is passed in the distribution process. Based on the knowledge of the driver and assistant the distance traveled is uncertain which results in a longer delivery time. The distribution costs become expensive and erratic. The purpose of this study is to determine the optimal distance from each branch outlet and provide suggestions for route improvements to get a lower cost using the dynamic programming method. The Dynamic Program method provides distance savings of 1.0261 Km and costs savings of Rp. 1,426,433, with a percentage of cost savings of 4.7%, so that the Dynamic Program can be used for company distribution.**

Keywords*: *Dynamic Programming, Distribution, Short delivery time, Cost Minimization

I. INTRODUCTION

According to Yapanto and Musa (2018), distribution is a process of delivering goods or services from producers to consumers and users, whenever and wherever the goods or services are needed. While The distribution channel is an intermediary party between producers and consumers (Rao et al., 2021).Every big company usually has its distribution center (DC).

Distribution and transportation management generally perform some basic functions, namely segmenting and determining service level targets, determining the mode of transportation to be used, consolidating information and delivery, scheduling and determining delivery routes (Tsang et al., 2018), providing value-added services, store inventory, and handle returns (Grabińska et al., 2019). Some problems that occur due to inappropriate scheduling and route determination, namely delay (Cao et. Al., 2020) and waiting times (Smith et al., 2019) usually appear because of the estimated service time from the vehicle departing until the unloading of cargo at the consumer is not appropriate. Delays in the consumer will affect the service time to the next consumer if there is more than one consumer in a shipping route that is passed by a carrier vehicle.

Based on Dua et al. (2019), transportation is defined as the transfer of goods and resources from the place of origin to the destination. In the physical distribution process, a transportation process is needed to move one commodity from one place to another in a supply chain. Two parties involved in the transportation process in the supply chain are the shipper and the carrier. Routing and scheduling in distribution are seen as relatively complicated problems. This is due to many constraining factors that can arise and must be considered so that it causes different types of problems for each case. These types of problems can be categorized into 4 things, namely: (1) Strategy problems Refer to the long-term aspects of routing and scheduling, such as whether or not it is necessary to send a product in a fixed quantity regularly to some customers. This applies to the examples of the distribution of bread and grocery stores. Its main characteristic is that there is a fixed number of regular requests sent to the same location. So, vehicle scheduling can be done on a historical basis. (2) Operational problems This problem concerns the routes that must be arranged every day or every week. Generally, this problem occurs in the gift delivery company. An important factor to consider is the unpredictable number of requests and location changes. (3) Interactive Delivery

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operations are currently being planned on an interactive basis to allow a dispatcher to use a computer or digital device to determine the most effective route. In this interactive basis, actual demand data is used more than historical demand data, or it can be said as real-time data. This data becomes a reference for determining the route, and one of the advantages of this method is that the route can be changed as soon as possible if needed. The disadvantage of this method is the high cost of providing this kind of technology. (4) Planning To determine the route and delivery scheduling, route and schedule planning is carried out which is then simulated with a computer, then analyzed as a result of changes in demand or the addition of vehicles, the addition of vehicles with a larger capacity, or the possibility of policy changes.

PT CiomasAdisatwa, which is located at Jalan Tarik Km 2, is one of the Japfa group companies that produce fresh, hygienic, and quality processed chicken products to provide solutions to the needs of entrepreneurs, modern food providers, and household needs in East Java. To serve all consumers to remain loyal during intense trade competition, it is necessary to schedule and determine the right route so that the products received by consumers are in good condition and of good quality, and on time with low operating costs. The problem with this company is that the path taken in the distribution process is based on the knowledge of the driver and assistant so that the distance traveled is uncertain which results in long delivery times and results in the use of fuel that exceeds what it should be so that the costs incurred by the company increase and distribution costs become expensive and erratic

Dynamic Programming is a technique of solving a problem by decomposing or decomposing the solution into a set of stages so that the solution obtained is a series of interrelated decisions in which the decision-making determination maximizes its entire effectiveness (Liu et al., 2020). This method has been widely used in previous research on the same problem, such as Fachini et al. (2020), Lera-Romero et al. (2020), Şenaras et al. (2021), and Şahin et al. (2021) that use dynamic programming to solve the transportation problem. From those researches, the transportation problem at PT.CiomasAdisatwawould be solved using a dynamic program along with WinQsb software.

II. RESEARCH METHODOLOGY

A. Data Collection

Data collection is an activity carried out in research to collect information. This data will be input at the data processing stage. The data collection method used is secondary data using data that has been obtained from existing sources. The software used in this data processing is WinQsb software.

The data needed in this study are as follows:

1. Transportation cost data from the origin node to destination node
2. Maximum capacity data of conveyance
3. Distribution route data of PT. CiomasAdisatwa

B. Data Processing

The method used in this study is the Stagecoach Problem, which is a method to obtain optimal results from a mathematical model that compiles transportation costs. The data that has been collected will then be processed to determine the minimum transportation costs for instant noodle products that the company must spend to meet demand. Figure 1 below is a flowchart in this study.

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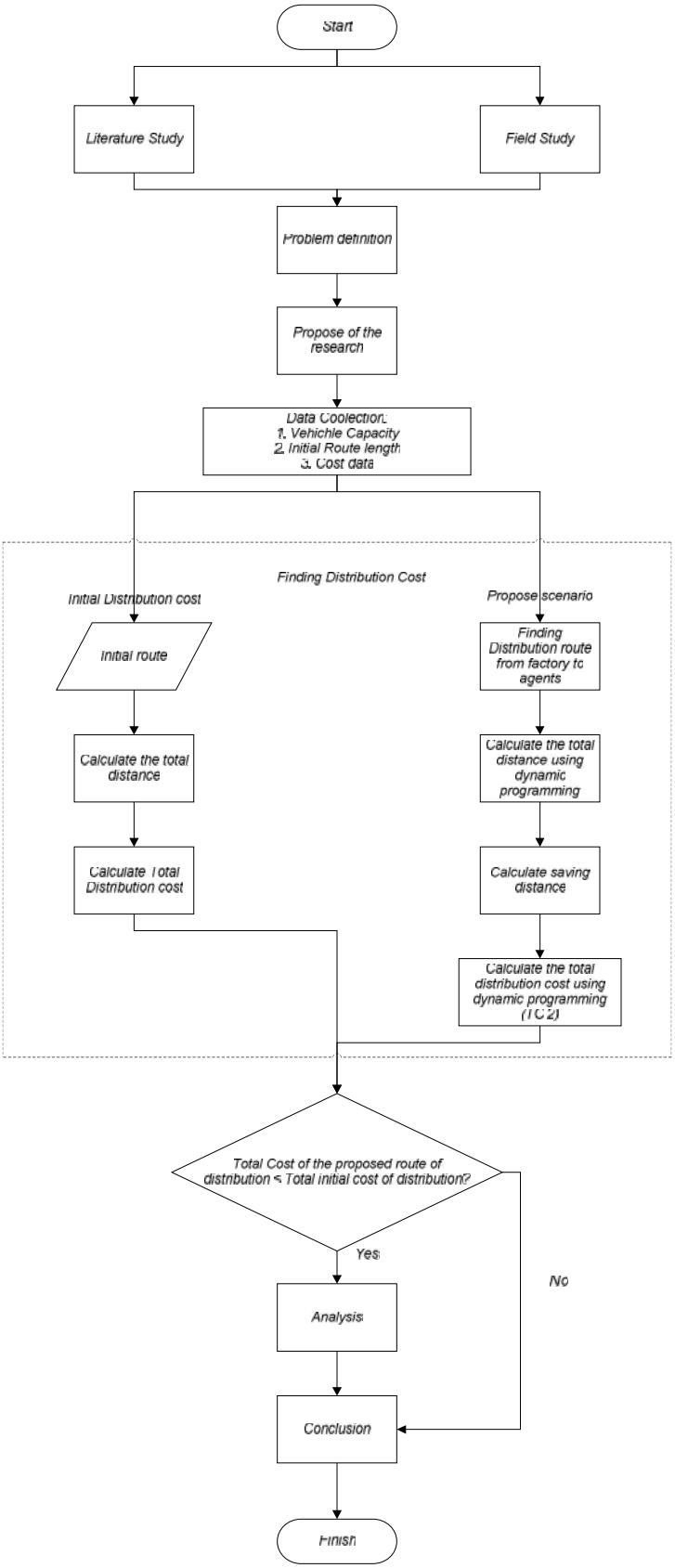

Figure 1. Research Methodology

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III. RESULT AND DISCUSSION

The type ofvehicle used todistribute the Chicken is a cooler box car with a capacity of 2000 kg with a fleet of 23 self-owned trucks.

A. Initial Scenario

The following Table 1 is the costs and routes that have been issued for the distribution of chicken pieces and Table 2 is initial route data from historical data.

Table 1. Distribution Cost from Company to Agents

Month	Agents	Distribution cost (Rp)
Agustus 2020	Mojopahit	2.726.731
	Kludan	2.707.704
	Majapahit	2.707.704
	Let. Suprapto	2.838.300
	Pasuruan	3.118.600
	Manukan	2.852.850
	Mulyosari	3.012.490
	Gresik	2.900.800
	Jombang	3.317.277
	Nganjuk	3.321.787
	Kediri	3.771.713
	Malang	3.786.227
Total		38.062.183

Table 2. Initial Route

Sub Route	Destination	Route	Distance (Km)
I	Sidoarjo, Jl. Raya Kludan No.12	Balongbendo – Tol manyar – Tol Sidoarjo – Pahlawan – Majapahit – Kludan	15 Km
II	Sidoarjo, Jl. Raya Majapahit No.89	Balongbendo – Tol manyar – Tol Sidoarjo - Pahlawan – Majapahit	15 Km
III	Mojokerto, Jl. Mojopahit No.36	Balongbendo – Tol Surabaya Porong – Tol Sumo – Raya Canggu – Raya Mlirip – Gajah Mada – Bhayangkara – Majapahit	17 Km
IV	Sidoarjo, Jl. Letjen Suprapto No. 27 c	Balongbendo – Tol manyar – Tol Juanda – Tol Berbek - Berbek Industri – Raya Berbek – Let.Suprapto	24 Km
V	Surabaya. Jl. Manukan Tama No. A3-26	Balongbendo – Tol manyar – Tol Margomulyo – Kyai Amir – Manukan Tama	25 Km
VI	Gresik, Jl. Kartini No.7	Balongbendo – Tol manyar – Tol Romokalisari – Veteran – Kartini	29 Km
VII	Surabaya. JL. Mulyosari No.69D	Balongbendo Joyoboyo Basuki Rahmat Gub.Suryo Prof Dr Moestopo – Mulyosari	36 Km
VIII	Pasuruan. Jl. Raya Bangil No. 10	Balongbendo – Jl. Raya Tarik – Jl Bulang- Tol Porong- Jl Beji- Sidowayah	44 Km
IX	Jombang, Jl. Brigjen Kretarto	Balongbendo – Tol Jombang – Jl pesantren – Jl. Jogoroto – Jl makam - Jl. Brigjen Kretarto	57 Km
X	Nganjuk, Jl. Bengawan Solo	Balongbendo – Tol Mojokerto – Jl. Bengawan solo – Jl. Ploso - Jl Barito	82 Km
XI	Kediri, Jl. Makmur selatan no. 14	Balongbendo – Tol Mojokerto – Jl Pahlawan – Jl. Kayen – Jl. Mojokarep – Jl. Cisadane – Jl. Makmur	89 Km
XII	Malang, Jl. Veteran No. 2	Balongbendo – Jl. Raya Prambon- Jl Bulang- Tol Pandaan- Jl. A. yani – jl. Soekarno Hatta- Jalan Besar Ijen- Jl. Veteran No. 2	90 Km

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B. Proposed Scenario

Figure 2 below is the proposed scenario obtained by using dynamic programming.

Kludan: Stagecoach-Shortest Route Problem

05-15-2022 17:55:49	Stage	From Input State	To Output State	Distance	Distance to Node10	Status
1	1	Node1	Node2	3	14	Optimal
2	2	Node2	Node4	5	11	Optimal
3	2	Node3	Node6	7	10	
4	3	Node4	Node7	5	6	Optimal
5	3	Node5	Node8	3,10	14,10	
6	3	Node6	Node9	2	3	
7	4	Node7	Node10	1	1	Optimal
8	4	Node8	Node10	11	11	
9	4	Node9	Node10	1	1	
	From Node1	To Node10	Minimum	Distance =	14	CPU = 0

Figure 2. Dynamic program output with WinQsb output Kludan

C. Cost Comparison

Table 3 below is a cost comparison based on those two scenarios.

Table 3
Comparison of the two scenarios

Scenario	Total Distance (Km)	Total Cost (Rp)
Initial	16.213 Km	38.062.183
Proposed	15.600 Km	36.635.750
Gap	592,1 Km	1.426.433

The initial distribution cost of the Mojopahit Outlet company is Rp. 2,726,731 for the cost of the Dynamic Program method of Rp. 2,712,200. The initial distribution cost of the Kludan Outlet company is Rp. 2,707,704 for the cost of the Dynamic Program method of Rp. 2,683,100. The initial distribution cost of the Majapahit Outlet company is Rp. 2,707,704 for the cost of the Dynamic Program method of Rp. 2.650.200. The initial distribution cost of the Pasuruan Outlet company is Rp. 3,118,600 for the Dynamic Program method of Rp. 3.118.600. The initial distribution cost of the Manukan Outlet company is Rp. 2.852.850for the cost of the Dynamic Program method of Rp. 2.819.800. The initial distribution cost of the Mulyosari Outlet company is Rp. 3,012.490for the cost of the Dynamic Program method of Rp. 2.141367. The initial distribution cost of the Kediri company is Rp. 3,771,713, the initial distribution cost of the Gresik Outlet company is Rp. 2.900,800 for the Dynamic Program method fee of Rp. 2,835,800. The initial distribution cost of the Jombang Outlet company is Rp. 3,317,277for the cost of the Dynamic Program method of Rp. 3,263,700. The initial distribution cost of the Nganjuk Outlet company is Rp. 3,321,787. The initial distribution cost of the Malang Outlet company is Rp.3.786.227 for the cost of the Dynamic Program method of Rp.3744.100.

IV. CONCLUSION

Based on the research, it can be concluded that the use of WinQSB optimization program, and can be used properly to overcome the problem of determining operational costs that can be used by companies to determine the distribution route with the lowest cost. Of the 12 distribution routes taken with a total distance of 15,600 Km, resulting in a total distribution cost of Rp. 36,635,750 while the results of the observation that the distribution route taken by the company's method now reaches 16,213 Km and requires a total distribution cost of Rp. 38,062.183. Thus, the Dynamic Program method provides a transportation distance savings of 592.1 Km and a cost savings of Rp. 1,426,433, with a cost-saving percentage of 4.7%, so that dynamic programs can be used for company distribution.

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